Department of Primary Industries

Shark Meshing (Bather Protection) Program 2011-12 Annual Performance Report

Prepared in accordance with the requirements of the Joint Management Agreements and associated Management Plan

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Executive summary

Since the 2009-10 meshing season, the Shark Meshing (Bather Protection) Program (SMP) has operated in accordance with Joint Management Agreements (JMAs) and an associated Management Plan authorised under the *Fisheries Management Act 1994* and the *Threatened Species Conservation Act 1995*.

The JMAs and the management plan require an annual performance report to be prepared and submitted to the parties to the JMAs and relevant scientific committees convened under the State's threatened species legislation by 31 July each year. In general terms, the report is to:

- Document progress towards implementing the Management Plan, and
- Assess the performance of the Management Plan and the JMAs in mitigating impacts on threatened species, populations and ecological communities.

More specifically, the report is to:

- Document progress in achieving the management objectives,
- Report on progress in implementing the measures in the plan,
- Assess and report on each performance indicator,
- Identify any trigger points that have been tripped,
- Identify any overdue actions,
- Document compliance, research and monitoring outcomes, and
- Recommend any amendments required to the management plan.

Implementation of the measures in the Management Plan is progressing on time or ahead of schedule. Contracts were revised prior to the 2010-11 meshing season to ensure all meshing operations would be conducted in accordance with the provisions of the Management Plan from that time on.

On average, observers were present during 22% of all net checks (hauls) undertaken by contractors. During 2011-12 funding from the SMP budget was allocated to a comparative trial of aerial surveillance techniques; and to fund a beach observation tower program. Allocations from the SMP budget to meet these commitments resulted in a reduction in total available funding for observer coverage in the 2011-12 season.

The compliance plan was implemented and no compliance issues were identified during the 2011-12 meshing period.

Implementation of the Strategic Research and Monitoring Program continued. Samples were collected as required to aid in scientific research and monitoring programs.

In 2011-12, the 'human risk from shark attack' trigger point was tripped for the first time. Two shark bites occurred at meshed beaches during the 2011-12 season; a relatively minor bite injury at North Avoca Beach, and a serious injury at Redhead Beach. The latter serious injury resulted in the trigger point being tripped. Consequently a review report will be prepared to investigate and identify the cause of the interaction and identify what, if any, remedial action is required to return the performance indicator to an acceptable range.

A range of other complementary programs were also delivered during the reporting period and are detailed in this report. These include ongoing work on the ‘SharkSmart’ awareness and public education program; and a comparative trial of fixed and rotary winged aircraft in aerial surveillance to assess whether there is a role for aerial surveillance as an adjunct to the SMP.

The annual performance report has recommended several changes to the management plan including:

- Updating agency names to reflect changes following the 2011 election,
- Renaming the Newcastle administrative region the Hunter region,
- Recognising the creation of the Sydney Central region,

The proposed amendments will be referred to the Scientific Committee and Fisheries Scientific Committee for comment and advice prior to seeking the concurrence of all parties to the JMAs to give effect to the amendments. Further amendments to the Management Plan may also be made subject to the recommendations of the review report arising from the Redhead Beach attack.

In 2011-12 the program met the requirements of the JMAs and associated Management Plan.

Introduction

The Shark Meshing (Bather Protection) Program (SMP) is a public safety measure introduced in 1937 to reduce the risk of shark attack at the State's most popular public bathing beaches. Around 2 million people swim at NSW most popular beaches each year. Under the program, 51 beaches are netted by contractors using specially designed meshing nets to reduce the chances of shark encounters. The SMP has been effective in helping to provide a safer environment for swimmers, with no fatalities on a meshed beach in over 50 years, and only one fatality on a meshed beach since the program commenced.

Since the 2009-10 meshing season, the SMP has operated in accordance with Joint Management Agreements (JMAs) and an associated Management Plan authorised under the *Fisheries Management Act 1994* and the *Threatened Species Conservation Act 1995*. In 2010-11, consistent with the recommendations of the 2009 review into the operation of the SMP, the beach meshing contracts were revised so that the program could operate fully in accordance with JMAs and an associated Management Plan.

The SMP is listed as a key threatening process by the Fisheries Scientific Committee (convened under the *Fisheries Management Act 1994*) and the Scientific Committee (convened under the *Threatened Species Conservation Act 1995*) as it adversely affects two or more threatened species, populations or ecological communities and could cause species, populations or ecological communities that are not threatened to become threatened.

The Director-General of the Department of Premier and Cabinet (DPC) (formerly Department of Environment Climate Change and Water) may enter into a JMA under s.121 of the *Threatened Species Conservation Act 1995* with another public authority. 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.

For the SMP there are two JMAs. One is between the Minister for Primary Industries and the Director-General of the Department of Primary Industries (DPI). The second JMA is between the Director-General of DPI and the Director-General of DPC. The JMAs and associated Management Plan are publicly available from the department's website: www.dpi.nsw.gov.au

The JMAs and associated Management Plan were developed after broad consultation with stakeholder groups and the wider community during March to May 2009. The consultation document *'Report into the NSW Shark Meshing (Bather Protection) Program - 2009'* (the SMP Review) provided an environmental assessment of the impacts of the SMP and made key recommendations about ways to achieve the objectives of the program while reducing the potential impact on threatened and other non-target species - and to maximise the potential scientific benefits of the SMP.

The objectives of both JMAs are to:

1. Minimise the impact of shark meshing on fish and marine vegetation which are 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 JMAs:

1. DPI will only carry out shark meshing in accordance with the JMAs and the associated Management Plan.
2. DPI will only carry out shark meshing during the meshing season.
3. DPI will ensure that nets are fitted with acoustic warning devices for cetaceans.

4. DPI will require that contractors comply with by-catch reduction protocols and release protocols contained in the Management Plan and any release plans.
5. DPI will 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.
6. The parties to the JMAs will ensure that comprehensive release plans are in place.

The objectives of the Management Plan are to:

a. Reduce the risk to humans from shark attack at beaches subject to the SMP, and, consistent with that objective:
b. 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.
c. Minimise occupational health and safety risks to contractors and agency personnel associated with implementing the SMP.
d. Ensure that monitoring and reporting on the SMP is undertaken in a transparent manner.

In accordance with the Management Plan, the activity of shark meshing is defined as:

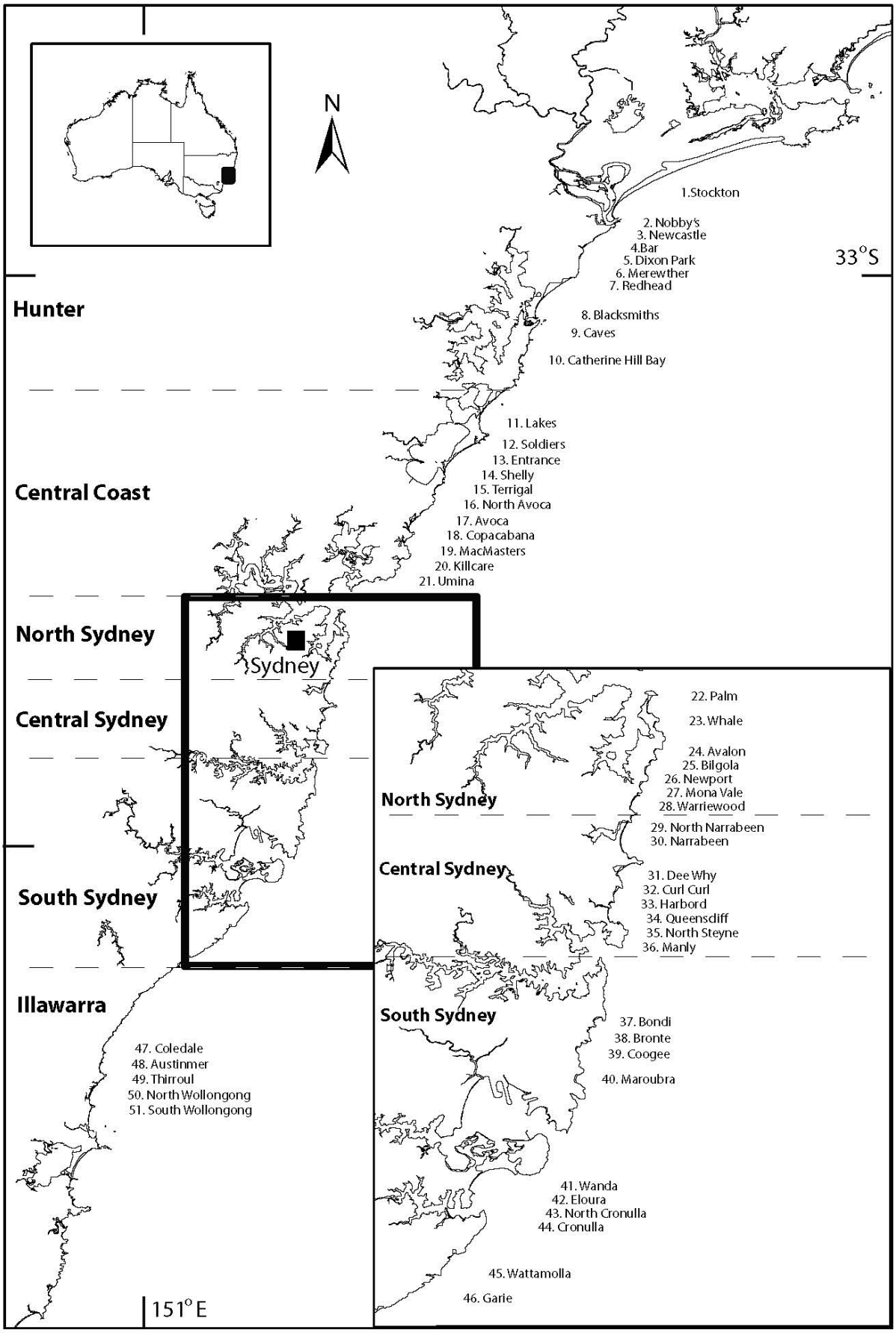
1. The placing of nets around beaches or other waters at the 51 beaches listed in Table 1 of the Management Plan to protect the public from sharks.
2. The activity is formally undertaken in NSW through the SMP.
3. The SMP uses bottom-set synthetic filament mesh nets 150 m in length and 6m in depth of 60 cm mesh size that are set in a generally parallel direction off the beach, anchored in approximately 10-12 m depth of water. The nets have a weighted bottom line (leadline) and a floated top line (floatline) and are identified by surface floats.
4. The SMP includes all activities by contractors who set, haul, run, and clear the nets in accordance with requirements established by contract.
5. The SMP also includes all activities by DPI associated with contract administration, compliance, supervision, observer programs, research programs, monitoring, and reporting.

Table 1 shows the 6 administrative regions and 51 beaches meshed during the 2011-12 meshing season (1 September 2011 to 30 May 2012).

Table 1 The 6 regions and the 51 beaches of the SMP meshed during the 2011-12 meshing period.

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

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



1 Reporting on achieving the management objectives

In accordance with the legislative requirements relating to the JMAs, an annual review of the performance of the parties to the agreements is to be conducted by the Fisheries Scientific Committee (Appendix 1) convened under the *Fisheries Management Act 1994* and the Scientific Committee convened under the *Threatened Species Conservation Act 1995*. The Annual Performance Report (this report) is to be prepared by DPI on the operation of the program, and will be made available publicly.

The Annual Performance Report is required to:

a) Document progress in achieving management objectives by:
   i) Reporting on progress in implementing the Management Plan,
   ii) Assessing and reporting on each performance indicator,
   iii) Identifying any trigger points that have been tripped, and
   iv) Identifying any overdue actions.

b) Document outcomes of:
   i) The Compliance Plan,
   ii) The Strategic Research and Monitoring Program, and
   iii) The Observer Program.

c) Recommend any amendments to the Management Plan that may be required as a result of the performance of the SMP for the meshing year including:
   i) The nature of the proposed change,
   ii) The reason why the proposed change is required, and
   iii) The effect of making the proposed change.

1.1 Progress in implementing measures contained in the Management Plan

1.1.1 Controls on the activity (Part 3 of the Management Plan)

The Management Plan (cl. 14 - 31) 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.

The Tender Specifications are consistent with the requirements detailed in the JMAs and Management Plan and underpin the requirements of the Compliance Plan. Any variation from the specific contract requirements are noted in this report (refer to section 1.1.3 Compliance Plan).

1.1.2 Observer Program (Part 4 of the Management Plan)

Establishment of the Observer Program

The Management Plan (cl. 32 - 36) requires an Observer Program to operate as part of the SMP, the purpose of which is to help qualify the delivery of the services provided under contract and quantify certain aspects of the activity including:

1. Contractor compliance with contract conditions.
2. Certifying that the observed meshings meet contract requirements.
3. Data and sample collection.
4. Detailing catch of target and non-target species.

Temporary employment

To satisfy the Observer Program requirements, two people were engaged in August 2011 by way of temporary employment for the eight months of the SMP (2011-12). One of the positions was a casual position for the 8 months of the 2011-12 meshing season and worked on the two northern-most contractor boats (Hunter Region and Central Coast). The second position was retained as a temporary full-time position for 12 months. This observer covered all three Sydney basin contractors (Sydney North, Sydney Central and Sydney South), plus the Illawarra region. The latter position also assists the Shark Scientist with collation of data, dissections and cataloguing samples, purchasing and maintaining acoustic alarms and other duties associated with the SMP.

Duties of the observers

The duties of the observers are:

1. Observing the work involved in the setting, hauling or running of nets to ensure it is undertaken in accordance with all terms and conditions of the contract and the Management Plan.
2. Coordinating and performing the physical collection of biological samples for DNA analysis (or other projects).
3. Identifying shark species taken in net catches (cross-referencing with the provided identification manual).
4. Maintaining a written logbook and photographic image record of all animals that are caught in the nets while observers are present.
5. Collection and recording of biological samples from animals, as requested and including, but not limited to, genetic, teeth, vertebrae, reproductive and stomach content samples of sharks.
6. Liaising with the DPI Shark Scientist regarding collection of research samples.
7. Organising for the collection of sampled material for delivery to relevant end-point.
8. Observing and verifying (by initialing the contractor's log book) the meshings observed each day against those recorded by the contractor.
9. Signing the monthly logbook to certify accuracy of the observed meshings.
10. Keeping a record of acoustic warning devices (dolphin pingers and whale alarms) – noting if devices are functioning when catches are reported, identifying and replacing ones that are not-operational, and date of battery replacement (including battery type), and providing that advice to the Shark Scientist.

Training of the 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 regard to seagoing skills, assisting in the release of entangled animals and performing animal dissections and tissue sampling.

To ensure the observers were competent and resourced to safely undertake the duties prescribed in the Observer Program for the 2011-12 meshing period, the department conducted a Training Day on 25 August 2011 at the Cronulla Fisheries Research Centre.

Contractors also attended the training day and were instructed in tagging procedures. A representative from the NSW Office of Environment and Heritage (OEH) provided training to improve identification and management of captured marine mammals, birds and reptiles.

In 2012-13 contractors and observers will be advised to pay particular attention to any Hammerhead Sharks caught in the nets in an attempt to ensure correct identification following

the listing of the Great Hammerhead as a Vulnerable species and the Scalloped Hammerhead as an Endangered species in NSW. Historically, hammerheads were only identified to genus level, particularly prior to improvements in species identification introduced in 1998 (Reid *et al.* 2011). Since this time however, records indicate that very few of either species have been captured in the SMP, and that Smooth Hammerhead sharks constitute most of the catch. This is not unexpected given that the area of operation of the SMP is at the edge of the range of both listed species.

Observers will continue to focus on ensuring collection of all threatened and protected species captured, plus Bull Sharks, Blacktip Sharks, Angel Sharks and now hammerhead sharks.

Provision of equipment

Prior to the commencement of the meshing period each observer was provided equipment and resources specific to the role including:

- Personal Protective Equipment such as:
  - Ultraviolet (sun) protection (e.g. sunscreen, sunglasses and broad-brimmed hat).
  - Wet weather gear - protective clothing for boat work.
  - Type-1 PFD life jacket (yoke style - inflatable).
  - High visibility work vest (Hi-vis vest).
- Safe Work Method Statements (read, understood and signed by each Observer).
- Kits for specimen dissection and sampling.
- Shark identification books.
- Marine mammal and sea bird identification information resources.
- Mobile phone (for reporting captures / arranging trip dates/times).
- Digital camera for photographing specimens taken in nets.
- Hand-held GPS devices for logging net locations.
- Sundry items for administration and paperwork.

Allocated hours for observers

For the 2011-12 meshing season, each observer was allocated designated observer hours per meshing region as set out in clause 34(2) of the Management Plan. The number of ‘allocated’ hours and the ‘actual’ hours worked during the reportable period, as certified by observers on monthly timesheets for the 2011-12 meshing season, are set out in Table 2.

Observers are mainly used on hauling days to observe what is being caught and to assist contractors with obtaining samples for scientific research.

Contractors must set the nets before the net can be hauled. During the hauling process the contractors check the net for any catch, clean the net and check for any damage. After the net is hauled it may be reset.

On average observers were present on over 22% of hauling days. Details of observer coverage for each region are provided in Table 2.

Table 2 Observers hours and hauling days present for 2011-12.

Meshing Region	Total No. of days setting and hauling	Total No. of hauling days	No. of hauling days observed	% of hauling days observed	Allocated Hours	Actual Hours
Hunter	117	106	45	42%	490	312
Central Coast	117	108	49	45%	630	340
Sydney North*	115	108	14	13%		98
Sydney Central*	135	133	18	14%		126
Sydney South*	167	160	11	7%		77
Illawarra*	124	104	20	19%		140
Total	775	719	156	22%		1093

*Denotes the 4 Meshing Regions overseen by the only full-time observer position in the SMP- time is allocated for this position up to 35hrs per week for the entire meshing period and includes work on other SMP-related duties. Accordingly, no specific hours were allocated for the Sydney North, Central and South and Illawarra Regions – the full time observer was required to appropriately and equitably dispense his duties throughout those regions in consultation with the Supervisor.

Variations to allocated hours

Downward and upward variations to the allocated hours can be expected due to inclement / unfavourable weather and unforeseen events. For example, the funding available for the Observer Program in the 2011-12 meshing season was reduced as a result of commitments to fund aerial surveillance trials and to establish a beach observation tower program. The program allocated $30,000 which was shared between Lakes, Soldiers, Birubi and Tea Gardens/Hawkes Nest beaches.

One full-time observer was used to oversee the Sydney North, Sydney Central, Sydney South and Illawarra regions and a second casual observer was used to oversee the Central Coast and Hunter regions. As a result of the reduced funding availability for the observer program, the overall percentage of haul days observed in the 2011-12 meshing season was 22%; down from 46% in the 2010-11 meshing season.

Outcomes of Observer Program

Outcomes of the Observer Program in achieving progress toward the measures specified in the Management Plan for the 2011-12 meshing season include:

1. All catches of target and non-target species taken in nets were certified by the observer and included in monthly catch data sheets (records held by Fisheries Compliance Unit, Ourimbah).
2. Using hand-held global position units (GPS) the observers provided accurate setting locations of all nets within the area of operation.
3. Details relayed to DPI and OEH for all marine mammals and reptiles captured in nets.
4. Samples of all animals as required and assistance in the delivery of whole animals.

1.1.3 Compliance Plan (Part 5 of the Management Plan)

A Compliance Plan is required to ensure that the optimal level of compliance with the controls on the activity is achieved as set out in Part 5 (cl. 37) of the Management Plan.

Audit and compliance checks in 2011-12

Compliance inspections were undertaken prior to and during the 2011-12 meshing season. For example:

- Nets and equipment were inspected prior to the commencement of the season to ensure all contractors were complying with current contract conditions.

- Covert operations were coordinated by the Shark Meshing Supervisor as opportunities arose to do so in a cost efficient manner.
- Observers were requested to report on any animals entangled in the nets and note any issues or concerns during the helicopter and fixed wing aerial surveillance trials conducted in 2011-12.

Following a number of covert compliance surveillance operations meetings were held with contractors and observers when required to discuss some possible reporting inconsistencies. All matters of concern were resolved at the meetings with no further follow up required.

The auditing and compliance checks undertaken during 2011-12 did not reveal any non-compliance with the current provisions of the SMP. Details of the compliance measures undertaken in the 2011-12 meshing period are set out in Table 3.

Table 3 Details of compliance measures undertaken during 2011-12.

Region	Inspection Type	Date
Hunter	14 nets inspected*	28/08/2011
Central Coast	13 nets inspected*	28/08/2011
Sydney North	21 nets inspected*	18/08/2011
Sydney Central	9 nets inspected*	26/08/2011
Sydney South	13 nets inspected*	26/08/2011
Illawarra	12 nets inspected*	18/08/2011
Sydney South	6 nets observed# (Bondi to Maroubra, Elouera & Cronulla)	11/11/2011
Central Coast	5 nets observed # (Terrigal, Nth Avoca, Copacabana, MacMasters & Killcare)	30/03/2012
Sydney North	All nets observed # (Palm Beach to Warriewood)	17/02/2012
Sydney Central	4 nets observed# (Harbord to Manly)	10/02/2012
Newcastle	All nets observed # (Stockton to Catherine Hill Bay)	29/03/2012
Illawarra	5 nets observed# (South Wollongong to Coledale)	09/12/2011
Fisheries Patrol Vessel (Sydney Swan) Illawarra	2 nets sighted (Coledale & Austinmer)	03/04/2012
Sydney South	6 nets sighted (Bondi, Bronte, Coogee, Maroubra, Wanda, Elouera & Nth Cronulla)	02/04/2012
Sydney Central	All nets sighted (Nth Narrabeen to Manly)	02/04/2012
Sydney North	All nets sighted (Palm Beach to Warriewood)	02/04/2012
Aerial surveillance All regions	Fixed wing and helicopter aerial surveillance (all nets)	Each weekend and public holiday over the peak summer holiday period and every Wednesday from 21 December 2011 to 29 January 2012

* 'Inspected' means physically inspected by the Shark Meshing Supervisor.

'Observed' means covert surveillance of the netting operation.

Damage to shark nets

The following damage to shark nets was reported during the 2011-12 meshing season:

- Nets in the Sydney South region at Maroubra and Bondi were potentially damaged by SCUBA divers on the weekend of 8-9 October 2011.
- The Copacabana net on the Central Coast had the anchors cut in October 2011.
- The Sydney South Contractor reported damage to the Cronulla net on the weekend of 18-19 February 2012.
- On weekend of 25-26 February 2012 the Illawarra Contractor reported damage to the Coledale net.
- On 13 March 2012 the Sydney Central Contractor reported slight damage to the Curl Curl net.

Interference with shark nets

After the weekend 8-9 October 2011 the Bondi net was found washed up on the rock-platform at Ben Buckler with both anchor lines appearing to be cut at the bridle, and the Maroubra net was found cut in half and slashed at intervals along the net. This incident was thoroughly investigated by Fisheries Officers who undertook random overt and covert surveillance in the area over a period of 14 days. Fisheries Officers consulted with local lifeguards and shark meshing contractors to investigate the matter. No further interference with the net was observed and no compliance action other than advice to the public via a Media Unit release was taken.

NSW DPI received a report on 16 January 2012 that a dead Grey Nurse Shark had been recovered from the Coogee net on the 14 January 2012. The relevant contractor reported that no shark was present when the net was hauled, and that there was no evidence of a shark having been entangled. Further enquiries found that the carcass of a dead Grey Nurse Shark had been disentangled from the net by local surf life savers and subsequently disposed of at sea. NSW DPI subsequently contacted the person responsible to explain that interfering with shark nets is an offence under the *Fisheries Management Act 1994* and is a work health and safety issue due to the risk of a person becoming entangled and drowning while attempting to remove entangled animals. In addition, the subsequent disposal of the carcass meant that scientific samples and measurements could not be taken, resulting in a lost opportunity to collect valuable information on a critically endangered species.

After the weekend of 18-19 February 2012 the Cronulla net was found cut in two between the leadline and floatline. Fisheries Officers consulted with local lifeguards and shark meshing contractors to investigate the matter. No further interference with the net was observed and no compliance action was taken.

After the weekend of 25-26 February 2012 the Coledale net was found with a number of meshes cut. Fisheries Officers consulted with local lifeguards and shark meshing contractors to investigate the matter and found that Council Lifeguards had been called to attend a live turtle entangled in the net and had cut it free to release it. No compliance action other than advisory was taken.

Overall compliance

Compliance with contractual arrangements must be greater than the trigger point of 80% under the Management Plan.

Compliance exceeded 80% for the following tasks:

- Size, length, marking of nets 100% compliance.
- Pinger and whale alarms on 100% of nets
- Set times - around 87% of hauls occurred within 72 hours of nets being set.

- 100%* compliance with all covert and overt inspections

All issues were resolved to the satisfaction of the Shark Meshing Supervisor, there was nil* non-compliance identified during the 2011-12 meshing season.

* Note: During 2011-2012 some inconsistencies were found in meshing logsheets submitted by Contractors. Two Contractors and an Observer were interviewed regarding the inconsistencies. Specification requirements and responsibilities under the Shark Meshing Contract were made clear to those Contractors and the Observer.

1.1.4 Strategic research and Monitoring Program (Part 6 of the Management Plan)

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.

The Management Plan categorises research priorities into levels (levels 1, 2 or 3) relevant to the risks identified through the environmental assessment process to provide information necessary to support the objectives of the Management Plan:

a) **Level 1** (Planning): Within first 12 months of commencement of the Management Plan.

   i) Develop SMP research plan and identify budgetary requirements and funding sources.

b) **Level 2** (Actions): Immediate and ongoing.

   i) Research associated with ongoing actions undertaken to implement the Management Plan.

c) **Level 3** (Applied research): As required to meet the objectives of the Management Plan.

   i) Research requirements identified from the environmental assessment process to mitigate adverse impacts of the SMP.

Table 4 (overleaf) provides details of progress in achieving the objectives of the Strategic Research and Monitoring Program.

Table 4 Progress on achieving the objectives of the Strategic Research and Monitoring Program.

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. Reported 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: Commenced /ongoing. 2.1.1: *Review data collection methods used in the SMP.* Data collection methods are regularly reviewed and are adapted as technology and applicable uses are identified. The Shark Scientist informally reviewed sampling techniques used in the SMP during 2009 and conducted a workshop on 25 August 2011 to ensure observers and contractors were trained to collect appropriate material for DNA analysis and other uses. A complete wet lab training session was undertaken and a dissection kit was dispensed to each shark meshing boat. 2.1.2: *Develop refined catch data forms and identification resources.* The data catch reporting forms were refined and have been incorporated into the SMP since the 2010-11 meshing period with new forms and instructions for use dispensed at the pre-season training days for observers and contractors. OEH representatives were consulted with regard to any refinements that may be required for improved reporting of marine mammals, birds and reptiles. Weekly catch reporting to the Fisheries Compliance Management Officer continued in the 2011-12 meshing period. 2.1.3: *Identify associated training programs for observers and contractors.* The department's Shark Scientist and the Strategy Leader identify training needs for contractors and observers and develop the annual training program in conjunction with other members of the shark meshing team. OEH representatives are also being consulted with regard to developing any refinements that may be required for improved identification and management of captured marine mammals, birds and reptiles under the Management Plan. The most prominent training required for the 2011-12 meshing period for observers and contractors was reiterating tagging procedures for nominated shark species and disentanglement procedures for non-target species from OEH. Pre-season training days will occur for 2012-13 meshing period.
2.2 Review genetic samples to compare with reported species identification.	2.2.1: *Review shark genetic samples held by DPI and cross-reference with reported species identification.* Research is being conducted by the department's Shark Scientist and Macquarie University undertaking molecular forensics on whaler sharks. The primary objective of this research is to obtain a better understanding of the historical composition of whaler sharks caught in the SMP. The main outputs of the research includes:

Level 2: Data collection and review of existing data	
	1. Developing genetic markers suitable for rapid species identification of NSW sharks. 2. Genetically identifying sharks caught in the NSW meshing program during past years. 3. Correcting the SMP catch database to species level, particularly for whaler sharks. Samples held by DPI are being cross-checked with DNA markers to determine the level of accuracy in phenotypical (visual) analysis. Where inconsistencies are identified, catch records are updated. Ongoing training of contractors and observers is designed to improve accuracy of shark identification, specifically for the whaler shark family which are intrinsically hard to differentiate. Further analysis of catch records in relation to reports by contractors, the SMP database, and the genetic species identification are currently underway. 2.2.2: *Identify associated training programs/resources for observers and contractors.* Phenotypic analysis is being improved by provision of training to observers and contractors to identify common sharks encountered in the SMP. The use of the DPI publication '*Identifying Sharks and Rays, A Guide for Commercial Fishers'* was revisited during the August training day, with particular reference to the training of the new contractor for Sydney Central. This guide is designed to assist in the identification of sharks and rays potentially encountered in NSW waters (and the SMP). It contains simple, easy-to-use keys that highlight certain external distinguishing features of sharks and rays for identification purposes. The keys are further supported by detailed species information and illustrations so that identification can be made with confidence. Each contractor has a copy of the identification book for retention on their meshing boat. OEH representatives are being consulted with regard to developing / sourcing and providing training that may be required for improved identification and management of captured marine mammals, birds and reptiles.
2.3 Review data on temporal and spatial factors affecting the operation of the SMP.	Status: Commenced and ongoing. 2.3.1: *Review research being conducted by CSIRO Marine Research on White Shark movements*. DPI works closely with Dr Barry Bruce, principal investigator of the CSIRO White Shark Project, supplying data from White Sharks caught in the SMP and data of tagged sharks detected on DPI's arrays of underwater acoustic listening stations. Although the CSIRO research is yet to be finalised, the results of these studies will be used to develop a greater understanding of this potentially dangerous species and implications for the SMP. Early indications emerging from the research 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 (Russ Bradford, CSIRO White Shark Project, pers. comm. July 2010). The CSIRO provides weekly updates of satellite-tagged White Shark movements to the DPI's Shark Scientist. 2.3.2: *Review existing data on other species (e.g. Tiger Shark, Bull Shark).* The report into the SMP in 2009 reviews existing data on Tiger and Bull Sharks. There have been no substantial increases in knowledge or research on Tiger Sharks in NSW that would benefit the operations of the SMP. However, the DPI's shark biologist is contributing biological and genetic data to a Tiger Shark study being conducted in Queensland to ensure a holistic understanding of this species biology and ecology is obtained. Bull Shark movement research is being conducted using acoustic tags and over 400 listening stations that DPI has established in various areas along the coast of NSW. This research was instigated following the attack on the Navy diver in 2009 and will have direct relevance to shark protection and the SMP. Preliminary results have been displayed

Level 2: Data collection and review of existing data

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 23 media presentations during 2011.

2.3.3: *Review existing data on spatial and temporal movements of non-target species.*
The scientific literature on spatial and temporal movements of non-target species is regularly reviewed and all new information considered as an important component in decreasing potential impact of the SMP on near shore fauna. As a member of the OEH Marine Fauna Advisory Group and the IUCN Shark Specialist Group, DPI's Shark Scientist keeps abreast of new research outputs or management issues for species likely to be impacted by the SMP.

2.4 Review data on shark interactions and beach usage.

Status: Commenced and ongoing.

2.4.1: *Access / review data collection by various organisations.*
DPI's Shark Scientist 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.

Table 5 Number of sharks sighted by Surf Life Saving (SLS) NSW.

Region	Shark sightings 2011-12	Shark sightings 6-year average
Hunter	23	8
Central Coast	14	5
Sydney	61	46
Illawarra	3	3
Total	101	67

2.4.2: *Review data on beach usage rates and future usage predictions.*
From 2006 to 2036 the population of NSW is projected to grow by over 2.3 million as natural increase and net overseas migration drive growth, while Sydney's population is projected to grow by 1.7 million people during this period (2009, State of the Environment Report, CoA). An ongoing increase in beach usage in the area of the SMP can be expected into the foreseeable future given these predictions.

SLS NSW anticipates the visitation to beaches within the SMP area will increase proportionate to the general increase in population. SLS NSW is focussed on anticipated expansion in beach visitation outside the area of the SMP as roads and housing subdivisions increase access to beaches in regional areas. SLS NSW is focused on areas outside SMP because SLS NSW considers that the risk of drowning is highest at unmanned / unpatrolled beaches as demonstrated by drowning deaths in the past few years.

SLS NSW provided the beach visitation figures for the past five years for the beaches listed. The beach visitation is recorded at around 1pm for the period 25 September to 25 April each year.

Level 2: Data collection and review of existing data

Table 6 SLS NSW beach visitation data at around 1pm for the period 25 September to 25 April each year

Region	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	5-year average 06/07 – 10/11	5-year average 07/08 - 11/12
Hunter	88,645	102,322	140,441	122,910	152,788	286,798	121,421	161,052
Central Coast	313,682	343,587	278,333	237,751	295,034	412,764	293,677	313,494
Sydney	1,090,482	1,363,137	1,586,513	1,543,121	2,051,599	1,783,692	1,526,970	1,665,612
Illawarra	25,494	40,837	47,579	123,940	82,543	105,273	64,079	80,034
Total	**1,518,303**	**1,849,883**	**2,052,866**	**2,027,722**	**2,581,964**	**2,588,527**	**2,006,148**	**2,220,192**

Table 7 List of beaches included in NSW SLS beach visitation data (Table 6).

Hunter Beaches	Central Coast	Sydney	Illawarra
Catherine Hill Bay	Avoca Beach	Avalon Beach	Austinmer
Caves Beach	Copacabana	Bilgola Beach	Coledale
Cooks Hill	Killcare	Dee Why	North Wollongong
Dixon Park	MacMasters	Freshwater	Thirroul
Merewether	North Avoca	Manly	Wollongong City
Newcastle	Shelly Beach	Mona Vale	
Nobbys	Soldiers Beach	Narrabeen	
Redhead	Terrigal	Newport	
Stockton	The Entrance	North Curl Curl	
Swansea Belmont	The Lakes	North Narrabeen	
	Umina	North Steyne	
		Palm Beach	
		Queenscliff	

Level 2: Data collection and review of existing data	
	South Curl Curl
	Warriewood
	Whale Beach
	Garie
	Maroubra
	North Cronulla
	South Maroubra
	Wanda

The average summer beach visitation within the area of the SMP over the five years is around 2 million people per annum. Over the past five years the there is general upwards trend in beach visitations (Table 6).
Trends regarding time of day visitation are occurring will be examined in the next annual review process with data sought from SLS NSW to make more accurate observations about trends in visitation.

2.4.3: *Develop better links between agencies and develop systems to optimise collection and use data*.
Better links have been developed between DPI, SLS NSW (volunteers and paid lifeguards), Council Lifeguard Services and the Australian Shark Attack File. These links were initially forged during the development of the 2009 Shark Meshing Report and cooperative development of the SharkSmart awareness and education program (August 2009) where each organisation provided input into the program.

Data and information is shared freely between the groups and coordination of information is increasing during other shark-related matters such as shark attack responses and the provision of 'real-time' information to surf life saving groups during the aerial surveillance trials.

The accumulation and assessment of Shark Log data from SLS NSW and the aerial surveillance trials should lead to a better understanding of what data is usable and beneficial to the operation of the SMP in achieving the objective of the Management Plan – and in beach safety generally.

Better working relations have been established with OEH. Information on the catches of marine animals was conveyed in a timely manner to the appropriate OEH representative and whole carcasses were delivered for necropsy where requested. OEH is substantially involved in the training of contractors and observers to improve identification and outcomes for entangled marine mammals.

2.5 Review effectiveness of fishing operations used in shark control programs.	Status: Completed - ongoing. 2.5.1: *Review NSW shark meshing net configurations.* A research project investigating the SMP net configurations with a view to further reducing bycatch will be undertaken

Level 2: Data collection and review of existing data	
	depending on available funding opportunities and cooperation from contractors. The research will aim to validate the feasibility of setting the nets off the bottom to reduce bycatch of demersal species of sharks and rays, pending future research funding. 2.5.2: *Review the application of other shark control measures for use in NSW (e.g. drum lines).* A review of the potential for electric barrier technology to be used as a shark control measure off NSW was completed in 2007 (Peddemors, 2007). DPI's Shark Scientist has over 20 years experience in electro-repelling of sharks and is regularly reviewing any new technologies that may assist in developing non-lethal shark control measures. Trials using the SharkShield™ with small whaler sharks (*Carcharhinus galapagensis*) indicated that the technology was not able to deter these sharks if recognisable bait was presented. The data suggest that the electric shark repelling technology presently available may have limited effect in NSW coastal waters. The use of drum lines is not permitted under the operation of the SMP through the Management Plan as contractors are prohibited from using baits or lures. 2.5.3: *Use outcomes to trial gear-related modifications of the SMP.* No alternative to physical shark control measures are considered viable to trial.
2.6 Develop methodologies for standardising fishing effort and analysing comparative CPUE data.	Status: Ongoing 2.6.1: *Investigate the feasibility of standardising soak-times for shark nets.* Standardisation of fishing effort is one of the most important issues to allow accurate assessment of the status of shark stocks via catch per unit effort (CPUE) methodologies. The new JMA requirements will greatly assist in attempts to standardise soak times. 2.6.2: *Develop alternative approaches to standardised soak-times.* A review of the SMP catch and catch rates using standardised fishing effort have been published (Reid *et al*, 2011).

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
Level and Topic	**Status and Comment**
3.1 Research needs identified (e.g. environmental impacts of shark meshing).	Status: Commenced and ongoing 3.1.1: *Distribution, abundance, biology and ecology of target species affected by the SMP*. Collaborative research initiatives have been established with the CSIRO White Shark Research Project investigating inter-annual variability in White Shark presence on the NSW coast using microchemistry of vertebrae. Since 2009-10 the CSIRO researchers have participated in White Shark dissections at the Cronulla Fisheries Research Centre as part of their investigations into the biology and ecology of this species. This collaboration led to completion of a BSc (Hons)

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
	thesis through the University of Technology entitled: “Age, growth and movement signatures of the White Shark (*Carcharodon carcharias*) in southern Australia”. Collaboration is ongoing with the South East Queensland Tiger Shark Research Project being conducted through the University of Queensland and the Queensland Department of Employment, Economic Development and Innovation (DEEDI). The DPI research project investigating the ecology and movements of Bull Sharks in NSW has forged strong links with researchers from Griffith University and James Cook University, Queensland, and the Queensland DEEDI. Several new research projects investigating whaler (Dusky, Spinner and Blacktip) sharks in NSW and Queensland waters have been initiated with collaborations via Macquarie University, James Cook University and the Queensland DEEDI. 3.1.2: *Distribution, abundance, biology and ecology of non-target species affected by the SMP.* Although non-target species have, to date, not formed the focus of the DPI research efforts, research into Wobbegong Shark distribution, ecology and movements, is being conducted in collaboration with Macquarie University, Sydney Aquarium and OEH. DPI’s Shark Scientist has been nominally involved in advising on some Macquarie University cetacean research initiatives and, in collaboration with Macquarie University and OEH, will be involved in research into the efficacy of whale alarms on shark nets. As an international expert on acoustic dolphin deterrents (ADDs) popularly known as ‘pingers’ and member of the international World Wildlife Fund (WWF) Cetacean Bycatch Task Force, the department’s Shark Scientist is reviewing the efficacy of pingers in reducing dolphin bycatch in the South African shark nets in collaboration with the KwaZulu-Natal Sharks Board.
3.2 Establish DNA library of shark species taken in the SMP to improve accuracy of identification.	Status: Commenced - ongoing 3.2.1: *Conduct collaborative research with relevant research institutions*. An analysis of historical DNA samples taken from sharks caught in the SMP is ongoing in collaboration with Macquarie University. DNA samples from SMP-caught sharks are being incorporated in studies investigating east coast stock structure of various whaler sharks in collaboration with the Queensland DEEDI and James Cook University. 3.2.2: *Develop SMP DNA library.* A shark DNA library incorporating material from the SMP has been established by DPI and currently contains over 550 samples. Accessioning of new material from the SMP is ongoing. Through collection of genetic data the Australian Blacktip Shark, *Carcharhinus tilstoni*, which was previously not known from NSW waters (Boomer *et al*, 2010) was identified in the SMP catch.
3.3 Conduct scientifically-based shark attack risk assessment.	Status: Ongoing 3.3.1: *Compile data from research relating to identified high-risk elements*. Data is 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. The historical lack of accuracy in any such data has, to date,

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
	hampered the establishment of a suitable database. Further research in this area requires access to adequate funding. 3.3.2: *Apply standard risk assessment model (i.e. AS/NZ: 4360).* A first attempt at applying a standard risk assessment model to potential for shark interaction has been completed with the Royal Australian Navy relating to their diver work in Sydney waters. Ongoing data collection on abundance, distribution and movements of potentially dangerous sharks are being collected for use in the development of future models. As any future models for risk assessment of shark attack will need to include data on bather use of NSW coastal waters, it is imperative that these data be collected in a scientifically robust manner. The ongoing education program SharkSmart supports the risk assessment model as it promotes safe bather practices by informing bathers of the risks and ways to minimise the chance of a close encounter with a shark. Through a program looking to improve NSW Government delivery of mobility services (Collaborative Solutions – Mobil Government) hosted by NSW Trade & Investment in 2011, a prototype mobile application architecture was designed to draw on the key features of mobile computing devices such as smartphones and tablet computers to see if the SharkSmart program could reach a wider audience and provide better information based on a personalised risk assessment model. The design sought to identify where the user was in relation to a particular waterway using location based services (inherent in mobile devices) and then calculate the users relative risk based the current understanding of shark movement patterns and other potential risk factors. The concept was shared with mobile content solutions providers across the state for evaluation. A collaborative partnership was developed with three service providers each of whom validated that the design could be configured successfully on a mobile device. Three separate applications for funding were made to the Collaborative Solutions – Mobile Government program. None of the funding applications were successful due to there being “limited potential for export to other NSW agencies”. Although the funding was not achieved during this reporting period there have been significant advances in knowledge about the potential for mobile content delivery of the SharkSmart education program and other opportunities for funding are being evaluated in 2012-13.
3.4 Conduct morphometrics on sharks and other species caught in the SMP.	Status: Commenced and ongoing 3.4.1: *Identify need for morphometrics in meeting the needs of the SMP*. Quality morphometric data is needed to understand the efficacy of the shark nets in reducing interactions with potentially dangerous sharks. Also, the data provides information on the size classes and any possible size-based stock structuring of sharks off NSW. 3.4.2: *Include in research priorities document (1.1) if considered appropriate.* Understanding morphometric data will allow better assessment of the potential impacts of the SMP on shark stocks and enable better management and conservation initiatives to be implemented. All research priorities are detailed in the Strategic Research and Monitoring Plan.

Monitoring Program	
1. Shark Meshing Contractor Catch Report.	Status: Commenced and ongoing Weekly catch reports are required under the Tender Specification and telephone reporting commenced in the 2011-12 meshing period. Contractors provided weekly reports of catches or were called each Friday to obtain the report.
2. Shark Meshing DPI Catch Summary Report.	Status: Completed and ongoing. Monthly catch returns were submitted as required to the Fisheries Scientific Committee, Threatened Species Committee and OEH.
3. Tagging program.	Status: Commenced in 2010-11 meshing period. Shark and ray tagging educational material was developed by DPI in collaboration with the KwaZulu-Natal Sharks Board (KZNSB). Following discussions with the KZNSB, it was determined that the risk of impalement by the tail-barb is too high to allow contractors to tag rays. Tagging was continued in 2011-12, ten sharks that were tagged including, two Tiger, one Port Jackson, one Angel Shark, one Dusky Whaler and five White Sharks. Turtle tagging may be initiated in the future with assistance from OEH.
4. Routine DNA sampling and verification.	Status: Commenced and ongoing. Routine DNA sampling of all dead animals was undertaken. Sampling DNA from certain species of live sharks has not yet been undertaken and is still under development. Examination of the genetic material collected identified a new species, the Australian Blacktip Shark, in NSW (Boomer *et al*, 2010).
5. Shark vertebral and other tissue samples.	Status: Commenced and ongoing. All threatened and endangered fish species were sampled or whole animals provided for research purposes and, where practically possible, all dead sharks were sampled for biological material. Note: A total of 93 sharks were caught in the nets during the 2011-12 shark meshing season. Fifteen sharks were released alive and, as such, were not sampled. Of the remaining 78 individuals, most were biologically sampled, unless the animal fell out of the net during the retrieval process before samples could be collected. All threatened and endangered fish species encountered by the contractors were sampled or whole animals provided for research purposes.
6. Monitoring of all shark attacks.	Status: Ongoing. Where an attack occurs in NSW the department's Shark Scientist or delegate interviews the victims where they are

Monitoring Program	
	willing and seeks as much information and evidence of shark identification as can be attained. This includes scale-bar photography of wounds requested from 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. This is particularly important where the media is supplied with false or misleading information by individuals seeking to sensationalise media coverage thereby potentially heightening public concern.
7. Monitor technological advances in shark control measures.	Status: Ongoing. Aerial surveillance trials have been undertaken (refer to section 2.2 Aerial Surveillance Trial). No new shark control measures have emerged recently that can be reasonably considered as a practical alternative to meshing.
8. Patterns of movements of non-target marine animals.	Status: Ongoing DPI is working with relevant agencies and reviewing information as it becomes available (e.g. threatened species management plans).
9. Population trends and patterns of movements of dangerous sharks and attack behaviour.	Status: Ongoing DPI has sourced information from relevant agencies and is developing trends and patterns of movements of dangerous sharks through research programs (refer to section 2.3 Review data *on temporal and spatial factors affecting the operation of SMP*).
10. Patterns of recreational water contact activities in marine waters.	Status: Ongoing DPI has reviewed the information that is available from relevant agencies (refer to section 2.4 Review *data on shark interactions and beach usage*).
11. Threatened Species recovery plan reviews.	Status: Completed. *Black Rockcod Recovery Plan* The Black Rockcod recovery plan was finalised and adopted in February 2011. Black Rockcod have never been reported being caught in the SMP nets and the Fishery Scientific Committee's final recommendation to list the current shark meshing program in New South Wales waters as a key threatening process does not identify this species as being affected by the SMP. *White Shark Recovery Plan* The Commonwealth's Draft National Recovery Plan for the White Shark (*Carcharodon carcharias*) was exhibited in 2010, with the public comment period closing on 29 July 2010. At the time of preparing this report the plan remains a draft document. The draft plan contains a specific objective to monitor and reduce the impact of shark control activities on White Sharks.

Monitoring Program	
	Details of how the SMP is addressing the impacts listed in the draft plan is provided below under the relevant heading: *Shark control programs to continue to report protected species interactions.* All captures are reportable by contractors under the SMP Tender Specification. All catches are reported in accordance with the JMAs and Management Plan and the annual review report (this report) is made publicly available. DPI provides reports nationally and internationally by preparing and making the Annual Performance Reports publicly available on the department's website www.dpi.nsw.gov.au. *Maintain the current review process of the effect of shark control programs on other protected species.* The SMP is reviewed annually (this report) and a full review of the SMP is scheduled under the JMAs to be completed within five years from implementation 1 September 2009. The SMP will continue to operate in accordance with the JMAs and associated Management Plan. *Continue biological recording and sampling of white sharks caught in shark control programs.* In accordance with JMAs and Management Plan, all shark captures are recorded and all live sharks are to be tagged. For deceased protected species where possible the whole carcass is to be retrieved and in all instances biological samples collected from deceased captures. In 2011-12 biological samples were collected from all deceased White Sharks. Five of the White Sharks were dissected with the CSIRO and biological samples for a range of collaborative research projects collected. *Develop a tagging program for white sharks caught in shark control programs, in conjunction with existing programs.* In accordance with JMAs and Management Plan, all live sharks (excluding Grey Nurse Sharks) are to be tagged. In 2011-12 six live White Sharks were encountered in the nets. *Continue to evaluate alternatives to lethal methods of shark control.* DPI Shark Scientist will continue to monitor alternatives to the SMP for more details refer to section 2.5 Review effectiveness of fishing operations used in shark control programs. *Improve coordination of sampling programs, ensuring shark control programs are included, and coordinate the collation of results and the storage of genetic and biological material collected.* A genetic database has been established and sampling is occurring in the SMP for more details refer to section 2.2 Review genetic samples to compare with reported species identification and a range of collaborative research is being undertaken for more details refer to section 3.1 Research needs identified (e.g. environmental impacts of shark meshing). *Grey Nurse Shark Recovery Plan and Issues Paper - 2010* The Grey Nurse Shark Recovery Plan and Issues Paper 2010 was developed as part of the review process for the Grey Nurse Shark Recovery Plan 2002. The actions in the Recovery Plan are substantially based on the material that came out of a Grey Nurse Shark Workshop that was held on the 27 November 2009. The issues paper was reviewed to establish if any new or emerging threats relating to shark control measures have occurred. The draft plan is currently undergoing further review and is with the Commonwealth Department of Sustainability, Environment, Water, Population

Monitoring Program

and Communities at the time this report was prepared. The plan has not yet been released for public comment.

National Plan of Action for the Conservation and Management of Sharks
DPI continues to meet national and international commitments in shark conservation and management by implementing and reviewing the National Plan of Action (NPOA) for the Conservation and Management of Sharks (Shark-plan 1) and its ongoing role on the Shark-plan Implementation and Review Committee (SIRC) and the National Shark Recovery Group (NSRG).

The National Plan of Action for the Conservation and Management of Sharks was adopted in 2004 and had a 5-year life. A review of the plan commenced in 2009, and culminated in the public exhibition of the 2011 National Plan of Action for the Conservation and Management of Sharks. The 2011 draft plan was on public exhibition at the time this report was prepared, with the public comment period closing on 15 July 2011. The draft plan addresses a range of issues and sets out actions to address each of them. Several issues and the associated action required are of relevance to the SMP, each action listed in the draft plan is addressed under the following relevant headings:

Issue 1 - Improved identification of shark species by all resource users
Action 1. *Review existing shark species identification guides (and any in development) with a view to implementing the best available identification guides in all relevant fisheries:*
ensure guides are culturally appropriate, including the use of indigenous species names where appropriate.
ensure the best available guides have been provided to relevant user groups, including fishers, processors, compliance officers, observers and scientists.

Phenotypic analysis is being improved by provision of training to observers and contractors to identify common sharks encountered in the SMP. The use of the DPI publication '*Identifying Sharks and Rays, A Guide for Commercial Fishers'* was revisited during the August 2011 training day. This guide is designed to assist in the identification of sharks and rays potentially encountered in NSW waters (and the SMP). It contains simple, easy-to-use keys that highlight certain external distinguishing features of sharks and rays for identification purposes. The keys are further supported by detailed species information and illustrations so that identification can be made with confidence. Each contractor has a copy of the identification book for retention on their meshing boat prior to the commencement of the season.

OEH representatives were consulted and provided training to assist with improved identification and management of captured marine mammals, birds and reptiles.

Action 2*. Monitor the effectiveness of identification guides.*
Observer program ensures effective identifications and whole specimens are regularly collected and delivered directly to the departments Shark Scientist.

Scientific research that includes genetic analysis is being undertaken to validate cryptic species and where necessary correct the shark meshing catch database (for more details refer to section 2.2 Review genetic samples to compare with reported species identification).

Action 3. Investigate the potential for additional tools for shark identification, such as morphological diagnostic tools or DNA identification kits.

Monitoring Program	
	Identification guides are provided (refer to Action 1) and in 2011-12 routine DNA sampling of all dead animals and certain species of live sharks began, this was incorporated into the new contract specification. Scientific research that includes genetic analysis is being undertaken with a view to providing a tool that can be used to quickly identify cryptic species (for more details refer to section 2.2 Review genetic samples to compare with reported species identification). ***Issue 2 - Secure, accessible and validated data sets that record all catch data and are consistent over time with compatible resolution between jurisdictions over the full range of each species from all resource users*** ***Action 4.*** *Develop and implement national minimum data standards for all commercial, recreational, bather protection and Indigenous fishing operations that take sharks.* As a member of the IUCN Shark Specialist Group, DPI's Shark Scientist will cooperate and assist with development and implementation of national standards. ***Action 5.*** *Develop and implement data verification systems with clear objectives and performance measures.* Observers act to validate data when onboard the vessels. In 2010-11 a database was created to store all shark meshing data – the data is added to the database by one person and validated by a second person. The validated data was successfully used in 2011-12 to meet the monthly and yearly reporting requirements of the JMA and Management Plan. In addition, scientific research that includes genetic analysis is being undertaken to validate cryptic species and where necessary correct the shark meshing catch database (for more details refer to section 2.2 Review genetic samples to compare with reported species identification). ***Issue 4 - Coordination of shark research*** ***Action 9.*** *Investigate opportunities for collaborative research initiatives to address aims and objective of Shark-plan 2.* A review of research and information needs, funding requirements and possible sources of funding has been undertaken by DPI's Shark Scientists through a review of the relevant literature and consideration of funding opportunities. Collaborative research initiatives are already being undertaken and it is anticipated that this will continue as a better picture emerges of the research component needs for the SMP. ***Issue 5 - Maintain and improve the standard of stock assessments for target shark species in dedicated shark fisheries.*** ***Action 12.*** *Periodic assessment of ecological impacts of shark control programs for bather protection.* The SMP is reviewed annually (this report) and a full review of the SMP is scheduled under the JMAs to be completed within five years from implementation 1 September 2009. The SMP will continue to operate in accordance with the JMAs and associated Management Plan. ***Issue 10 - Assessment of shark handling practices for the conservation and management of sharks*** ***Action 19.*** *Investigate shark handling practices to identify any areas of concern.* All live sharks (except grey nurse) are tagged and released as quickly as possible with minimal handling. ***Action 20.*** *Implement solutions as required, with consideration of enforcement requirements.*

Monitoring Program	
	The observer program and compliance plan currently provide sufficient enforcement (for more details refer to section 1.1.2 Observer Program and 1.1.3 Compliance Plan). ***Issue 14 - Reduce or, where necessary, eliminate shark bycatch*** ***Action 29.*** *Assess the effectiveness of current shark bycatch reduction measures in reducing shark mortality (including cryptic mortality).* Since 2010-11 the frequency of net checking was increased to reduce bycatch mortality with nets to be checked at least every 72 hours weather permitting. This led to the successful release of 59 live animals. A review of research and information needs, funding requirements and possible sources of funding has been undertaken by DPI's Shark Scientists through a review of the relevant literature and consideration of funding opportunities. It is anticipated that possible bycatch reduction measures will be included in future research initiatives for the SMP. ***Action 30.*** *Initiate action (as required) to ensure effective bycatch reduction methods are developed and introduced in all fisheries in which shark are caught as bycatch, giving priority to species identified through risk assessment as 'high risk'.* The 2009 review of the SMP resulted in the program being managed in accordance with JMA and an associated Management Plan with the aim to reduce the environmental impacts of the program. ***Action 31.*** *Promote adoption of effective shark bycatch reduction measures internationally.* It is anticipated that any scientific studies undertaken will be published in the relevant scientific literature and in this way be available internationally. In addition, this and other annual reports will be available and accessible internationally through the department's website. ***Issue 15 - Better understanding of effects of shark fishing, control programs for bather protection and management practices on ecosystem structure and function*** **Action 32.** Undertake periodic assessment/support research of the impact of targeted shark fishing on non-target species (particularly threatened species). The SMP is reviewed annually (this report) and a full review of the SMP is scheduled under the JMAs to be completed within five years from implementation 1 September 2009. **Action 33.** Undertake periodic assessment/support research of the impact of fishing operations on structure and function of shark species/stocks. DPI's Shark Scientist has completed a review of research and information needs, funding requirements and possible sources of funding thorough a review of the relevant literature and consideration of funding opportunities. A review investigating trends in catch within various affected shark taxa over 60 years of SMP activity has been published in the scientific literature (Reid *et al*, 2011). ***Action 34.*** *Investigate methods for modeling the population ecology of sharks and distinguishing between natural vs fishing induced variation, so as to better understand population status and rates of recovery.* Research is currently being undertaken to better understand the distribution of Great White Sharks and Bull Sharks. For more details refer to section *2.3 Review data on temporal and spatial factors affecting the operation of the SMP*. The DPI Shark Scientist participated in a recent population modeling contract for the critically endangered Grey Nurse Shark.

Monitoring Program	
	Demographic data, including age and growth, are currently being analysed for Blacktip, Bull, Dusky, and Sandbar Whaler Sharks, plus Tiger and White Sharks. Demographic data are being collected for two species of non-target sharks, Angel and Smooth Hammerhead Sharks, for future analysis. Data will be incorporated in potential future modeling of these species' populations. Effective population size will be determined for at least two major whaler shark species using state-of-the-art genetic techniques in collaboration with Queensland DEEDI via a new project supported by the Fisheries Research & Development Corporation on behalf of the Australian government. ***Action 35.*** *Consider ecosystem structure and function in the development and implementation of management measures.* DPI's Shark Scientist has completed the *Strategic Research and Monitoring Plan* the addresses information needs, funding requirements and possible sources of funding thorough a review of the relevant literature and consideration of funding opportunities.
12. Contractor compliance.	Status: Completed for 2010-11 meshing season. This monitoring is conducted annually or when major non-compliance is detected. The Shark Meshing Supervisor advised that no major non-compliance was detected during the meshing period. For more details refer to section 1.1.3 Compliance Plan.
13. Monitor net locations by GPS.	Status: Completed for 2011-12 meshing season. GPS location of nets was completed during 2011 for the 2011-12 meshing season.
14. Shark Meshing Program Annual Performance Evaluation.	Status: Draft completed. This Annual Performance Report provides an evaluation of the performance of the SMP under the Management Plan. As required under the JMAs the 2009-10 and 2010-11 reports were made publicly available via the department's website as required by JMAs.

1.2 Performance Indicators

The following performance indicators/trigger points were specified in the JMAs and associated Management Plan to determine if the SMP is meeting the defined objectives.

1.2.1 Change in the number of human fatalities or serious injuries resulting from shark attack

The trigger point for this objective is: one fatality or serious injury per meshing season on a meshed beach. A serious injury means injuries from a shark attack that result in a threat to life or limb.

In 2011-12 there were eleven shark incidents in New South Wales. There was one serious injury, six minor injuries and four incidents which resulted in no injuries. Two of the eleven incidents occurred at meshed beaches – North Avoca and Redhead. The Redhead incident was classified as a serious injury – see Table 8 below.

Table 8 provides data for meshed beaches for the past three years.

Table 8 Fatal and serious shark attacks in the SMP area of operation in 2008-09 to 2011-12.

Meshing Period	Fatal	Serious	Total
2008-09	-	3	3
2009-10	-	0	0
2010-11	-	0	0
2011-12	-	1	1

Note: Shark attack information was cross-referenced with shark log records held by SLS NSW (Surf Life Saving Manager) and the Australian Shark Attack File (Curator: John West). These enquiries showed that no other attacks resulting in fatality or serious injury were recorded in the area of operation during the reporting period.

The trigger point for this performance indicator was tripped as a result of the serious injury in the 2011-12 reporting period that occurred on a meshed beach in the Hunter region (Redhead Beach). Consequently a review report will be prepared to investigate and identify the cause of the problem and identify what, if any, remedial action is required to return the performance indicator to an acceptable range.

Although the North Avoca shark interaction involved a White Shark bite on the forearm of a surfer, the resultant injury was not threatening to either life or limb and subsequently was not classified as a serious injury for the purposes of the performance indicator.

1.2.2 Change in the number of major or minor occupational health and safety (OHS) related incidents reported by contractors or observers.

The trigger point for this objective is: one major or minor incident OHS incident – a major incident is one that results in 5 or more compensable days off work and minor incident is one that results in less than five days off work.

There were no reported or recorded OHS incidents in the 2011-12 meshing season.

1.2.3 Change in the number of entanglements with non-target species and threatened species, populations and ecological communities in the SMP.

The trigger point for this objective is: entanglements of non-target species and Threatened Species over two consecutive meshing seasons exceed twice the annual average catch of the preceding 10 years for those species.

Catch statistics showed a total of 158 animals were reported entangled in the nets during the period from 1 September 2011 to 31 May 2012, of which 56 were released alive (Table 9). Species encountered alive by the contractors were all released, these included one Grey Nurse Shark, 33 rays, three Tiger Sharks, one Dusky Whaler Shark, four Angel Sharks, six White Sharks, one Mako and four Port Jackson SharksRays (Myliobatiformes sp.) continue to provide the largest component of all catches in each region (27% over all regions, 79% released alive). Whalers (Carcharhinus sp.) accounted for 24% of all catches in each region, Hammerhead Sharks (Sphyrna sp.) accounted for 23% and Angel Sharks (Squatina australis) accounted for 9%. Other species each contributed less than 10% of the total catch as detailed in Table 9. Three Grey Nurse Sharks, nine White Sharks, three turtles, and two dolphins were found deceased in the nets.

The indicators in Table 10 (↑ ↓ –) show whether the numbers of non-target or threatened species captured in the nominated meshing period exceeded (↑), did not exceed (↓), or was the same (–) as twice the average annual catch of the preceding 10 years. If the number exceeds twice the 10 year average annual catch of the preceding 10 years for two consecutive meshing seasons the trigger is tripped. No trigger points were tripped during the program in 2011-12.

Table 9 All species reported entangled in the beach nets during the program for 2011-12.

Scientific Name	Common Name	Hunter	Central Coast	Sydney North	Sydney Central	Sydney South	Illawarra	Total released alive	Total deceased	Total	% of total*
Target Species											
Carcharhinus brachyurus	Bronze Whaler Shark			1		1	2		4	4	3
Carcharhinus brevipinna	Spinner Shark										
Carcharhinus leucas	Bull Shark			1					1	1	1
Carcharhinus limbatus	Blacktip Shark	1			3	4	3		11	11	7
Carcharhinus obscurus	Dusky Whaler			1	1	3	3	1	7	8	5
Carcharhinus sp.	Whaler Sharks										
Notorynchus cepedianus	Broadnose Sevengill Shark				5		3		8	8	5
Carcharodon carcharias	White Shark	3		3		1	8	6	9	15	9
Galeocerdo cuvier	Tiger Shark				1	3		3	1	4	3
Isurus sp.	Mako Shark				2			1	1	2	1
Non-Target Species											
Alopias vulpinus	Thresher Shark										
Carcharias taurus	Grey Nurse Shark					3***	1	1	3	4	3
Sphyrna sp	hammerhead sharks **					3			3	3	2
Sphyrna zygaena	Smooth Hammerhead	2	2	9	6	1	13		33	33	21
Squatina australis	Angel Shark			6	1	7		4	10	14	9

Scientific Name	Common Name	Hunter	Central Coast	Sydney North	Sydney Central	Sydney South	Illawarra	Total released alive	Total deceased	Total	% of total*
Tursiops aduncus	Bottlenose Dolphin										
Delpinus delphis	Common Dolphin				1				1	1	1
Delphinidae	Unknown dolphin species			1					1	1	1
Chelonia mydas	Green Turtle				1				1	1	1
Cheloniidae	Turtle		1			1			2	2	1
Myliobatiformes	unidentified rays		1		4	3		8		8	5
Aetobatus narinari	White Spotted Eagle Ray										
Myliobatis australis	Eagle Ray	4		6	8	12		22	8	30	19
Rhinopteridae	Cownose Rays										
Trygonorrhina sp.	Fiddler Ray										
Dasyatis brevicaudata	Smooth Stingray			1	3			3	1	4	3
Dasyatis thetidis	Black Stingray										
Heterodontus portusjacksoni	Port Jackson							4		4	3
	TOTAL	**10**	**4**	**29**	**35**	**42**	**34**	**56**	**102**	**158**	**100**

*The percentage (%) has been rounded to nearest whole number, leading to rounding up of the total percentage to 101%. ** In May 2012 this group potentially contains three species two of which were declared threatened species by the FSC under the FMA. ***This includes one grey nurse shark reported by surf lifesavers and towed to sea

Table 10 Comparison of non-target and threatened species catch for the past three meshing seasons with twice the average annual catch over the past 10 years.

Scientific Name	Common Name	2 x 10 yr annual average*	2009-10	2010-11	2011-12	Trigger point tripped
Threatened Species						
Carcharodon carcharius	White Shark	14	5↓	6↓	15↑	No
Carcharias taurus	Grey Nurse Shark	3	2↓	3—	3—	No
Non-Target Species						
Sphyrna lewini	Scalloped Hammerhead	4	0↓	0↓	0↓	No
Sphyrna zygaena	Smooth Hammerhead	26	11↓	13↓	33↑	No
Sphyrna sp.	Hammerhead sharks	55	5↓	5↓	3↓	No
Alopias sp.	Thresher Shark	5	6↑	3↓	0	No
Squatina australis	Angel Shark	28	12↓	19↓	14↓	No
Heterodontus sp.	Port Jackson Shark	8	6↓	0↓	4↓	No
Myliobatiformes sp.	Rays	81	44↓	60↓	42↓	No
Osteichthyes	Finfish	2	0↓	0↓	0↓	No
Tursiops truncates	Bottlenose Dolphin	2	1↓	2—	0↓	No
Delphinus delphis	Common Dolphin	2	1↓	0↓	2—	No
Dugong dugong	Dugong	0	1↑	0—	0	No
Pinniped sp.	Seal	1	1—	0—	0↓	No
Cheloniidae sp.	Turtles	4	2↓	7↑	2↓	No

*Twice the average annual catch of the preceding 10 years is rounded to the nearest whole number and only lists those species caught in the past two meshing periods. Catch data from when the program was first introduced in Sydney in 1937 is in the previous annual reports and the 2009 document entitled 'Report into the NSW Shark Meshing (Bather Protection) Program - Incorporating a review of the existing program and environmental assessment'. In addition, details of decadal trends from 1950-2010 are provided in a recent publication (Reid *et al*, 2011).

As exact haul times are not recorded the haul times were determined in 24 hour blocks meaning that a net set on Monday and hauled on Tuesday would be considered as 24 hours between setting and hauling. Similarly, if set on Monday and hauled on the Wednesday it would be 48 hours between setting and hauling, and so on.

Beach meshing contractors are required to check their set net every 72 hours weather permitting. The average time between hauls was 49 hours (Table 11) and around 87% of hauls occurred within 72 hours of nets being set. Due to weather conditions the maximum time between sets was 192 hours on 22 occasions - around 0.4% of total number of sets

Table 11 Number of hauls at each beach during the program for 2011-12. The current contracts provide for 104 hauls of each net.

Region	Number of Beaches	Number of Contracted Hauls	Total Number of Hauls	Average Time Between Hauls (hrs)
Hunter	10	1040	1040	53
Central Coast	11	1144	1144	53
Sydney North	7	728	728	55
Sydney Central	8	832	850	48
Sydney South	10	1040	1043	41
Illawarra	5	520	520	43
Total	51	5304	5391	49

1.2.4 Extent to which the reporting requirements are met.

Trigger points and responses:

i) Monthly catch summary reports to be provided to OEH, the Scientific Committee and the Fisheries Scientific Committee.

DPI provided monthly catch summary reports to OEH - Department of Premier and Cabinet, the Scientific Committee and the Fisheries Scientific Committee, during the program in 2011-12. The last monthly report was provided on 25 May 2012 after the conclusion of the meshing period.

ii) Annual performance report submitted to the Minister for Primary Industries, Director-General of NSW DPI, Director-General of Department of Premier and Cabinet, the Scientific Committee and the Fisheries Scientific Committee by 31 July each year.

DPI has prepared this annual report with a view to providing it by the required date. A corrected and proofed version of this report will be made available publicly.

2 Other programs complementing the SMP:

2.1 The SharkSmart Public Awareness and Education Program

In September 2009, following a recommendation from the SMP report and submissions from the community, the public education and awareness campaign 'SharkSmart' was launched to reduce the risk of a close encounter with a shark. SharkSmart is the State's first ever education campaign designed to inform the public, through web and print, of how they can reduce their risk of a close encounter with a shark.

A website page was developed to establish a 24-hour platform for delivery of the information and a SharkSmart brochure (Appendix 3) was produced. The brochure is an informative guide to some common sense measures to increase safety in the water. The brochure includes a check list including such information as avoiding the water when sharks are most active (at dusk and dawn), not swimming or surfing near schools of baitfish, and avoiding murky water.

The department maintained the Sharksmart education program during the reporting period to reinforce the risks associated with sharks through with a continued presence on the internet www.dpi.nsw.gov.au/fisheries/info/sharksmart and through print media.

From 1 September 2011 to 30 May 2012 the department's web page www.dpi.nsw.gov.au displayed links to the Sharksmart material through a web page mechanism known as 'spotlighting' where links to highly topical information are presented at the first point of entry to the page making access to the information easy to find. Other web page enhancements were

undertaken including the establishment of more prominent links to allow users to download an electronic version of the printed Sharksmart brochure or submit requests for bulk quantities of the brochure for redistribution.

Several opportunities were taken during the reporting period to highlight the Sharksmart program's key messages in media releases associated with shark related issues.

During the reporting period the Sharksmart logo was submitted to IP Australia and accepted for registration as a trademark in Australia.

2.2 Aerial surveillance trial

A series of trials comparing observer shark sighting abilities from fixed wing aircraft and helicopters were evaluated. Two components were included in the trails during the 2011-12 meshing season: one incorporating two observers in one aircraft (inter-observer discrepancy trial), and another comparing sighting abilities between two aircraft 'types' (fixed-wing and helicopter).

For the latter trials and to ensure flights would be comparable and representative of their usual flight capabilities, the two aircraft flew the same track-line along the coast within minutes of each other. This design was to allow observers in both aircraft to search the same patch of water in similar environmental conditions (sun-glare, sea-surface state, wind speeds) and with the maximum opportunity of seeing the same shark. The faster fixed-wing aeroplane flew a few minutes ahead of the helicopter for maximal safety. As highlighted in the 2010-11 Annual Report, these flights were extended southward, beyond the SMP region, to determine possible variation between the netted and non-netted areas.

Touchdown Helicopters Pty Ltd and Australian Aerial Patrols (AAP) were engaged through an extension of their contract awarded following an open tender process to conduct flights over each weekend and public holiday during the high use holiday period. The trial in 2011-12 was planned for 21 days — each weekend and public holiday over the peak summer holiday period and every Wednesday from 21 December 2011 to 29 January 2012.

The aircraft were required to have an observer on board who was able to take high resolution digital photographs. The specified duties of the aerial surveillance observer were to:

- Look for sharks in the water and shoals of bait fish – where possible, accurately identifying species of sharks from the air.
- Provide accurate GPS location of each sighting, plus the estimated distance and angle from the aircraft.
- Record weather and environmental conditions for each flight, including recording the positions where these may have changed.
- Provide timely and adequate records of sightings to DPI, Surf Life Saving NSW (SLS NSW) and the Australian Professional Ocean Lifeguards Association (APOLA).
- Report all sightings by mobile phone to the relevant surf lifesaving groups (SLS NSW and APOLA) and DPI contact person.
- Capture high quality air photographs (images) of every shark and bait fish shoal using a high resolution digital SLR camera (e.g. minimum 12 Mega Pixel with 200mm zoom lens) with an attached GPS recorder. Metadata for each image was recorded including the date taken.

Six of the planned flight days were cancelled either due to inclement weather, AAP aircraft problems, or lack of volunteer AAP personnel (Christmas and Boxing Day). An additional four flights were not flown in their entirety due to inclement weather. This reduced effort resulted in few days suitable for data analysis comparing helicopter and fixed wing aircraft.

A maximum of 239 animal sightings were recorded during these south-bound flights, 51% of which were of fish schools. Only 8% of sightings were of sharks, 47% of which were hammerhead sharks, a non-target species in the SMP.

These results again highlighted the low sighting rates from aircraft, with less than 1 shark seen per 100 km flown, implying a considerable underestimation of the presence of many of the shark species known to frequent the coastal fringe area. These data corroborate previous survey results suggesting aerial surveys are an inefficient and expensive method to enhance bather protection from potential shark attack.

The second component of the 2011-12 aerial surveys flew between Wollongong and Newcastle using a twin-engine Partenavia high-wing aircraft. These flights were designed to assess discrepancies in marine animal sighting abilities between observers. One NSW DPI observer flew on all flights, with his data compared to those collected by the volunteer observers used by AAP. The two observers sat in tandem and were separated by a curtain to ensure independence of data collected. The NSW DPI observer instantaneously recorded all his sightings on a hand-held GPS, while the AAP observers recorded their sightings via the aircraft GPS to coordinate with their flight-log.

A total of 288 sightings were made by AAP observers. A total of 307 sightings were made by the NSW DPI observer. Of all sightings, 52% were of fish schools. Only 29% of records were of sharks, of which 93% were of hammerhead sharks, a non-target species of the Shark Meshing (Bather Protection) Program.

Less than 50% of sightings were seen by both observers. Less than 10% of these sightings can be confirmed as dual records of the same animal as they were recorded within 500m (10sec) of each other's GPS waypoint. However, in many cases substantial delay appears to have occurred between sighting and GPS logging for AAP observers. Further in-depth analyses of these records are being conducted.

Any sharks seen that may have posed a danger to swimmers or caused alarm were reported directly to appropriate surf life saving bodies to ensure that swimmers could be notified almost instantly of any increased risk or concern. While no beaches were closed during the trial, two beaches were evacuated as a precaution following shark sightings reported from the fixed wing aircraft to SLS NSW.

The first case was for an aggregation of more that ten hammerhead sharks off Wamberal Beach on 08 January 2012, for which the aircraft shark siren was sounded. A second warning siren was sounded at Windang Beach following sighting of an aggregation of hammerhead sharks. Surprisingly, no siren was sounded for a sighting of a 3m Great White Shark off Burning Palms Beach (29/01/2012).

On each occasion SLS NSW launched a rigid hull inflatable vessel to determine the location of the shark and ongoing risk, on each occasion the shark quickly moved into deeper water and bathers subsequently returned to the water. On four occasions the aircraft was requested to search for a shark following sightings by the local SLSC. On none of these was a shark seen from the air. Southbound surveys notified local SLSCs of shark activity three times, one of which included sounding of the siren following sighting of two hammerhead sharks off Manyana Beach. Two shark bites occurred within the region covered by the northbound inter-observer aerial surveys:

- The first shark bite was at North Avoca on 03 January 2012. Although there was no survey on this date, no sharks were seen by either observer on the preceding (02 January) or following day (04 January), even though additional orbits were conducted in the Avoca region on request from the SLSC.
- The second shark bite occurred on 18 January 2012 at Redhead Beach at 16:45.

The aerial survey aircraft flew over this beach at 11:31 northbound and 12:56 southbound. Although hammerhead sharks were seen off Redhead Beach on both transects, no non-hammerhead sharks were seen by observers throughout either flight between Wollongong and Newcastle.

These data again imply the ineffective nature of aerial surveys in providing an additional bather safety network against potential shark attack. The results of the various studies undertaken over

several years to date raise serious concerns about the utility of aerial beach patrols as an early warning system for sharks.

3 Other issues

3.1 Listing of new threatened species

The Scalloped Hammerhead (*Sphyrna lewini*) was listed as an Endangered species and the Great Hammerhead (*Sphyrna mokarran*) was listed as a Vulnerable species on the threatened species schedules of the *Fisheries Management Act 1994* on 18 May 2012. Upon listing, both species become totally protected. Both of these hammerheads are non-target species of the SMP. The Fisheries Scientific Committee has identified the shark meshing bather protection programs as a threatening process affecting both species.

Green *et al.* 2009 identified that modifications made to the SMP following a major review in 1972/3 (change from surface set nets to bottom set nets) resulted in the SMP catching more hammerheads, and shifted the dominance away from whalers and angel sharks. Green *et al.* (2009) reported high initial catch of hammerheads and subsequent continual decline and suggested that the SMP may be having a substantial effect on local shark populations.

In accordance with cl.9.1 of the JMAs, the listing of a new threatened species that may be directly and detrimentally impacted by the SMP requires the JMA to be reviewed by the Minister for Primary Industries and the Director-General of DPI. Similarly, the listing of a new threatened species that may be detrimentally impacted by the SMP is a potential trigger for an amendment to the Management Plan in accordance with cl.50.

The SRMP contains a commitment to investigate and trial suspended nets (i.e. set approximately 1 m off the bottom) to assess their ability to further reduce by-catch of non-target shark and ray species. In response to the listing of the Scalloped Hammerhead and Great Hammerhead this action will be prioritised subject to the availability of research funding and cooperation from contractors. Given that this is an existing commitment, no changes are recommended to the Management Plan as a result of the listings.

NSW DPI and the Minister for Primary Industries have reviewed the JMA and deemed that no changes are required to the JMA given the existing commitments in the Management Plan to trial gear related modifications in the SMP.

3.2 Administrative changes

Following the state government election in 2011, a range of administrative changes were made through the *Public Sector Employment and Management (Departments) Order 2011.* Of relevance to the Management Plan were changes arising from:

- amalgamation of the former Department of Environment, Climate Change and Water with the Department of Premier and Cabinet. Following the amalgamation, references to the Department of Environment, Climate Change and Water in the Management Plan are to be construed as a reference to the Department of Premier and Cabinet.
- the name of the former Department of Industry and Investment was changed to Department of Trade and Investment, Regional Infrastructure and Services and the Department of Primary Industries was established as a division of the Government service. Following the changes references to the Department of Industry and Investment in the management plan are to be construed as a reference to the Department of Primary Industries.

In the interests of maintaining the currency and accuracy of the Management Plan, an amendment is recommended to update all relevant references to agency names to reflect changes arising since the Management Plan was adopted.

Similarly, following contract variations introduced after the commencement of the JMAs and Management Plan, a new administrative region was created (Sydney Central). This administrative change resulted in the largest SMP region being broken into two smaller regions.

The total number and location of the beaches did not change. The new Sydney North Region consists of Palm, Whale, Avalon, Bilgola, Newport, Mona Vale and Warriewood beaches. The Sydney Central Region consists of North Narrabeen, Narrabeen, Dee Why, Curl Curl, Harbord, Queenscliff, North Steyne and Manly beaches. An amendment is recommended to update the Management Plan to recognize the existence of the new administrative region.

Finally, in the interests of consistency and to improve general understanding, the Newcastle administrative region is recommended to be renamed the Hunter region. The beaches included in the region will not change (i.e 10 beaches between Stockton and Catherine Hill Bay). This administrative change provides improved consistency with the Illawarra region, and more accurately reflects the region in which the meshing operations occur.

4 Recommended Management Plan changes

In accordance with cl.47(1)c) of the Management Plan, the following changes are recommended:

i) Nature of the proposed change:

- Change all references to the Department of Environment, Climate Change and Water in the Management Plan to the Department of Premier and Cabinet.
- Change all references to the Department of Industry and Investment in the Management Plan to the Department of Primary Industries.
- Amend cl.20 of the Management Plan to include the Sydney Central region.
- Amend all relevant clauses and tables in the Management Plan to rename the Newcastle Region the Hunter Region.

ii) Reason why the proposed change is required:

- To maintain the currency and accuracy of the Management Plan.

iii) Effect of making the proposed change:

- The Management Plan will be revised and all relevant references changed. The changes will not affect total effort of meshing operations in any way, and will not amend the individual beaches that are meshed within the program.

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Appendix 1 – Letter from the NSW Fisheries Scientific Committee

The Hon Katrina Hodgkinson MP
Minister for Primary Industries
Level 30
Governor Macquarie Tower
1 Farrer Place
SYDNEY NSW 2000

Dear Minister

Annual Performance Report for the Shark Meshing (Bather Protection) Program

The NSW Shark Meshing (Bather Protection) Program (SMP) operates under two Joint Management Agreements (JMAs) and a management plan, which provides for improved environmental outcomes and is required by legislation under the *Fisheries Management Act 1994* and *Threatened Species Act 1995*.

As required by Section 221Y of the *Fisheries Management Act 1994*, the Fisheries Scientific Committee's (FSC) role regarding the JMA is to:

(1) conduct a review of the performance of all parties to the joint management agreement, and
(2) advise the Minister of any deficiencies in implementation of the joint management agreement by any party to it.

The FSC has reviewed the performance of all parties as outlined in the SMP 2011-12 Annual Performance Report. Although operational aspects of the SMP were largely fulfilled, the FSC has significant concerns in relation to the scientific and research aspects of the performance and subsequent report. Many of these issues have been stated previously in reviews by the FSC but appear to have been ignored.

The Annual Performance Report contains little scientific data or information with which to evaluate the success or lack thereof of the program itself. The statement that "The SMP has been effective at providing a safer environment for swimmers" is unsubstantiated because no formal comparison of shark numbers or attacks has been made between meshed and unmeshed beaches. This is the same criticism that the FSC had in both the 2009-10 and 2010-11 assessments of the SMP, but which has not been addressed in the 2011-12 report. We urge the SMP to provide this information in the 2012-13 Annual Performance Report so that the program can be properly assessed. An assessment of the program is important because it is listed as a Key Threatening Process for several species of sharks. If the program is not effective at providing a safer environment for swimmers in meshed beaches than unmeshed beaches, then there may be a need for modification or discontinuation of the SMP.

We understand the description of trigger points in the last paragraph on page 33, but these appear to be different from the descriptions in the footnote of Table 10 on page 36. The Committee understands that a review is triggered when more than twice the ten-year average is caught in two successive years. We are concerned, however, that no review is triggered when catch rates decline by a similar extent as they have

for great white sharks, scalloped hammerhead, smooth hammerhead, hammerhead species, angel sharks, Port Jackson sharks, rays, etc. This is a major concern for the Committee as it may suggest collapse of the populations. The FSC encourages the SMP to conduct reviews of species in these circumstances.

The FSC considers that several of the research projects that commenced in the 2010-11 meshing period are crucial to our understanding of the impact of the program on both individual shark species and NSW shark stocks. The FSC looks forward to receiving the full results of the various studies currently underway relating to aerial surveys, reducing catch rates of hammerhead sharks and research on the movement of sharks. However, given that the aerial surveys have been shown yet again to be ineffective at sighting sharks, some thought could be given to alternative technologies for understanding the movements and behaviours of sharks such as acoustic tagging of sharks.

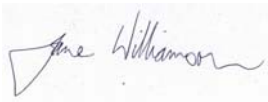
The Committee would like specific reporting and analyses on the following key issues:

- Whether the mortality rate is related to set time. The Committee would like to know whether mortality is higher in nets set more than the prescribed 72 hour soak time and, if there are any available data on whether mortality is lower for shorter soak times of 24 hours or 48 hours.
- At the individual shark level, an understanding of shark movements around nets and the beaches of NSW. Such data would provide crucial information in the assessment of public safety and the efficacy of nets in preventing shark attacks.
- A rigorous scientific comparison of data within each management zone on shark sightings, shark attacks and beach usage rates between meshed and unmeshed beaches.
- Reviews of species whose catch rates decline substantially over time as they have for many of the elasmobranch species in this report.
- A measure of variation (i.e., standard error, 95% CI, etc.) to be included for all data that are averaged within the report.

The FSC considers that meshing methods must be altered by setting nets at a depth of one or more metres off the bottom, to minimise or eliminate bycatch of rays and benthic non-target shark species, such as angel sharks.

Has the review of possible sources of funding referred to at various points in the Strategic Research and Monitoring Plan (e.g. Table 4 Level 1.1, Issue 4 p. 29, Action 29 p. 30 and Action 33 p.31) identified any likely alternatives to State Government Funding? If not, how does the Government intend to fund ongoing research under the JMA? The FSC is extremely concerned that without substantial government financial support for the Strategic Research and Monitoring Program in the SMP, we will again be faced with an inability to assess the impact of the SMP scientifically, as per the requirements of the JMA and Management Plan. The FSC therefore urges the government to allocate a suitable budget to the science and research component of the SMP to ensure all JMA and Management Plan requirements are met.

Yours sincerely



Dr Jane Williamson
Chairperson
Fisheries Scientific Committee
29th November 2012

Appendix 2 - A4 flyer to alert commercial fishers to shark net locations

Redhead / Swansea-Blacksmiths Beaches Shark Net Alert

Fishing trawler operators are asked to be mindful of the shark nets at the 51 beaches listed in table 1. Recently shark nets have been damaged in the Newcastle area.

These nets forms part of an important public safety measure but can be damaged by fishing operations, especially during prawn trawling activity.

Reasons to avoid the shark net:

- Damage to the net may put swimmers at increased risk of shark attack
- Entanglement may result in damage to fishing gear, loss of manoeuvrability and vessel control
- Interference with set fishing gear is an offence and may result in legal action and replacement costs

Table 12 The 6 regions and the 51 beaches of the SMP meshed during the 2011-12 meshing period.

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

The net is present from 1 September to 30 April each year. It is 150 metres in length and bottom-set. The net is identified at both ends with floats marked ‘Shark Net’.

For further information (e.g. GPS points for the nets) please contact:

John Turpin on 4428 3402 or
Tony Andrews on 0419 185 373
Fisheries & Compliance Branch
Department of Primary Industries NSW

Thank you for your co-operation.

Appendix 3 - SharkSmart awareness and education program brochure

SHARKSMART

Safety tips for swimmers, surfers, divers, snorkelers and spearfishers

Know the risks and reduce your chances of a close encounter with a shark at NSW beaches and estuaries

www.dpi.nsw.gov.au/info/sharksmart

NSW GOVERNMENT | Department of Primary Industries

Sharks live in healthy oceans

Sharks are a natural part of healthy oceanic and estuarine environments. When people enter open water, they are entering the shark's domain.

Shark attacks are rare events. Millions of us swim in oceans, harbours, coastal rivers and lakes each year, with just a handful of attacks. The only way to completely rule out a close encounter with a shark is to swim in a pool or other enclosure, or to stay on the shore!

However, a better awareness and understanding of sharks and their behaviour can help everyone to safely enjoy water sports, particularly younger people and tourists, as well as surfers and divers who choose to swim outside patrolled areas.

NSWDPI 11349_July2012

Shark meshing in NSW

The Shark Meshing (Bather Protection) Program helps provide a safer environment for swimmers and surfers and has proven effective in greatly reducing the number of shark attacks.

The program sees specially designed nets placed along 51 high-use beaches from Newcastle to Wollongong from 1 September to 30 April. The nets deter sharks from establishing territories—reducing the odds of an encounter. They are not meant to form a physical barrier.

There has only been one fatal attack on a netted beach since 1937 but there are no 100% guarantees against a shark attack.

While committed to the program, the NSW Government is conscious of the potential impact nets have on other marine life. Specialist contractors free any non-target sharks or other marine life caught where it is practical and safe to do so. Nets are not set during the majority of the whale migration season. When nets are set, special sound devices are used to deter dolphins and whales.

AUSTRALIAN LIFEGUARD SERVICE | APOLA | SHARKSMART

www.dpi.nsw.gov.au/info/sharksmart

SHARKSMART

SharkSmart swimmers and surfers

- Swim at a patrolled beach, between the flags—lifesavers and lifeguards are there to monitor risks and maximise swimmer safety
- Tell an on-duty lifesaver or lifeguard if a shark is spotted near swimmers or surfers
- Leave the water if a shark is spotted or alarm is sounded
- Don't swim too far from shore
- Swim in groups
- Avoid surfing alone
- Avoid swimming and surfing when it's dark or during twilight hours
- Avoid murky water and waters with known effluents or sewage
- Avoid areas used by recreational or commercial fishers
- Do not swim/surf near or interfere with shark nets
- Avoid areas with signs of baitfish or fish feeding activity—watch for diving seabirds
- Do not rely on dolphins to indicate the absence of sharks—they often feed together
- Avoid having pets in the water with you
- Be aware that sharks may be present between sandbars or near steep drop offs
- Avoid swimming in canals, and swimming or surfing in river/harbour mouths

SharkSmart divers, snorkelers and spearfishers

- Find out about the kinds of sharks you might encounter and what behaviour to expect from them
- Realise diver safety becomes increasingly difficult with decreasing visibility at night or in turbid water, and with increasing depth and current
- Discuss dive logistics and contingency plans such as hand signals, entry and exit considerations and separation procedures with your dive partner before you enter the water
- Be aware that using bait to lure fish may attract sharks
- Don't chase, grab, corner, spear or touch a shark
- Don't use bait or attempt to feed sharks—feeding may radically change behaviour and lure other sharks
- Be aware of the behaviour of fish—if they suddenly seek cover or appear agitated, leave the water as quickly and quietly as possible
- Don't attach a speared fish to your body or keep them near you—use a float and line to keep your catch away