Government of **Western Australia**
Department of **the Premier and Cabinet**

Review

Western Australia Shark Hazard Mitigation Drum Line Program 2013-14

June 2014

Government of **Western Australia**
Department of **the Premier and Cabinet**

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1. EXECUTIVE SUMMARY

Since 2008, the Western Australian Government has been working to address the issue of human-shark interactions. More than $22 million has been committed up to 2015-16 for a broad range of shark hazard mitigation measures including aerial and beach surveillance, beach enclosure trials, community awareness and education programs and a range of research initiatives.

There have been 10 deaths from shark attacks in Western Australian waters in the last 10 years, with seven of these in the last three and a half years. Following the latest fatal attack at Gracetown on 23 November 2013, the Western Australian Government decided in the interest of public safety to complement the existing shark hazard mitigation strategies with the deployment of a limited number of drum lines over a limited time period of the metropolitan and south west coasts. Drum lines have been a component of successful measures to reduce the risk of shark attack in Queensland, South Africa and Brazil.

Design and implementation of the program drew upon a wide range of shark control programs that operate nationally and internationally. Stakeholders, including the Commonwealth Department of the Environment (DoE), Department of Fisheries (DoF) and the Department of Parks and Wildlife (DPaW), were consulted. Adaptations were made to suit the Western Australian marine environment and reduce potential environmental impacts.

The program aimed to enhance public safety by capturing potentially dangerous sharks which came into close proximity of popular beaches and surfing spots during summer. The program provided the public with a further element of assurance when making assessments of risk and decisions on their own water use.

A comprehensive risk assessment of the potential environmental impacts of the drum line program was completed by DoF. This assessment concluded that the program posed a negligible risk to the target species of sharks, non-target species of marine fauna and the broader ecosystem. The Environmental Protection Authority (EPA) later found that the environmental impact would be negligible and determined that the 2013-14 summer deployment should not be subject to a full environmental assessment (EPA 2014).

On 25 January 2014, a drum line program commenced within two Marine Monitored Areas (MMA). A contractor was employed in the south west and DoF managed the metropolitan program. The total cost of the program was $1.28 million.

Between 25 January and 30 April 2014, a maximum of 60 static baited drum lines were set off popular swimming beaches and surf spots in the metropolitan and south west regions of Western Australia. Lines were set approximately 1km offshore and monitored for twelve hours a day, seven days a week. The drum lines were designed to target species of concern to public safety - white shark (*Carcharodon carcharias*), tiger shark (*Galeocerdo cuvier*) and bull shark (*Carcharhinus leucas*) with a length of three metres or greater.

A total of 172 sharks were caught. No white sharks were caught, however 50 sharks three metres or greater were captured on the drum lines, including a 4.5 metre tiger shark off Floreat Beach in the metropolitan region. All of these large sharks were tiger sharks, a

target species under the program. Tiger sharks are identified as one of the three species accounting for almost all fatalities from shark attack globally over the last 30 years.

It is considered likely that capture of a significant number of large sharks close to high use swimming and surfing areas reduced the risk of shark attacks. The trial has been short, and shark attacks generally too infrequent, to have generated substantial quantitative data to measure the reduction in risk. It is recommended that the program be extended for another three years and then be reviewed again.

For most species, catch levels were consistent with the predictions (low for most species) presented in the initial DoF risk assessment. For some species the level of capture was lower than predicted (e.g. dusky sharks), only the catch of tiger sharks was higher than expected.

Eight individuals from non-shark species (seven rays and one North West blowfish) were caught as bycatch. The measures taken to minimise environmental impacts, including reducing bycatch and interactions with non-target species were effective. These included:

- the use of a large approximate 25/0 circle hook;
- the removal of the lines from the water prior to the commencement of seasonal whale migrations along the coast;
- placement of hooks at a sufficient depth to reduce the risk of interactions with sea birds; and
- daily monitoring of the drum lines.

As a result of the above measures, a short period of deployment, excluding the use of nets and deploying a relatively small number of drum lines, the program is considered to have had minimal environmental impact. Compared to shark control programs that operate in other jurisdictions, the Western Australian program has a much lower environmental risk.

In response to a proposal from the Western Australian Government for the drum line program to continue for the next three summers a Public Environmental Review process has been initiated by the EPA to meet Commonwealth and State requirements for environmental assessment and approval of the program. This process will examine environmental issues in greater detail and will include the opportunity for public input.

Following the cessation of the drum line program, a wide range of consultation meetings were held with stakeholders and interest groups in May 2014. Consultations did not occur with environmental groups as their position was already known as a result of a legal challenge and through information provided on their respective websites, as referred to in this report.

The feedback fell mainly into two categories; potential operational matters and program considerations. These will be taken into account, as appropriate, in the design and implementation (if approved) of the drum line program for the next three summers that is recommended.

Operational matters included: providing more comprehensive training at the commencement of the program; more information on the Government's overall shark hazard mitigation strategy; modifications to the gear to include additional swivels and replacing chain on the hook line with wire trace; increasing the length of the hook line to allow greater freedom of movement and reduce stress; and increasing the area of the

Department of Transport exclusion zone around each drum line and inclusion of the vessel attending the line in the exclusion zone.

Program considerations centred around the need for more research (even though academics generally did not support the program) based on collection and analysis of more data and analyses of specimens, both of which would contribute significantly to our understanding of shark behaviour.

While direct comparisons between catch rates of programs operating in other jurisdictions is difficult because of the different populations, species, habitats and areas involved, a cursory examination of the Western Australian program indicates lower levels of non-shark bycatch and an environmentally sensitive approach.

Perhaps the most prevalent criticism of the program is that it is not based on science. In considering this criticism, science indicates that fatal shark attacks are infrequent, and in Western Australia they are predominantly made by white sharks. However, science also cites the white, tiger and bull shark as responsible for most shark attacks, and that the number of unprovoked attacks is rising. Incorporating scientific evidence into public policy is complex, but science alone will not provide the basis for the development of public policy, rather it informs public policy.

The Western Australian Government's drum line policy: is a response to an unprecedented rate of shark fatalities in Western Australia in the last three and a half years (for which the science does not offer a conclusive explanation); is part of a broader range of responses (that are frequently cited by critics as alternatives, but not recognised as already being undertaken); was developed with due consideration to similar programs in other jurisdictions which appear to operate with success (but appear to have been subjected to less scrutiny by commentators); uses methods aimed at specifically minimising environmental impacts (which appear to be overlooked by critics); and is fundamentally about protecting water users (and not primarily about killing sharks).

2. BACKGROUND

History of shark attacks in Western Australia

The Australian Shark Attack File (ASAF), maintained by Life Sciences Operations of the Taronga Conservation Society Australia, records the details of provoked and unprovoked shark attacks in Australian waters.

Table 1. History of Shark Attacks in Australia

Shark Attacks	Queensland	New South Wales	**Western Australia**	South Australia	Victoria	Tasmania	Northern Territory
Last 100 Years	72	47	**20**	19	4	3	2
Last 10 Years	3	2	**10**	4	0	0	0

Western Australia has experienced the third highest occurrence of fatal shark attacks in Australia over the past 100 years. Of significance is that in the last 10 years, Western Australia has experienced 10 fatal attacks, the highest number in Australia. In the same time period, South Australia has recorded four fatalities, Queensland three, New South Wales two and Victoria, Tasmania and the Northern Territory experiencing no fatalities (Table 1).

Of the 20 fatal shark attacks in Western Australia in the last 100 years white sharks have been confirmed as responsible for 11, and are considered most likely to be responsible for a further two. Tiger sharks have been confirmed as responsible for two of the 20 fatalities and are considered most likely to be responsible for a further three. A bull shark is considered most likely to be responsible for one fatality (Appendix 1). [1] In all cases where a size has been recorded, the shark has been three metres or greater in length.

Ten fatal attacks have occurred in the last 10 years, seven of these in the last three and a half years. This unprecedented density of fatalities over a short period of time has had a significant impact on people's perceptions of the ocean and their enjoyment of water based activities.

The seasonal peak in water based activities in Western Australia takes place between the summer months of October and April with Surf Life Saving WA patrols and other activities developed to coincide with this peak usage period. Surf Life Saving WA beach attendance statistics suggests an increase through time in beach usage in both the metropolitan and south west regions of Western Australia (see Appendix 2 for a full list of statistics). The Western Australian Government has continued to provide additional funding to Surf Life Saving WA since 2008 to address the resources necessary to effectively patrol beaches as part of an overall shark hazard mitigation strategy.

While there is conjecture about the reasons for recent increases in shark attacks in Western Australian waters, there is currently insufficient evidence to clearly establish a cause. Theories include the increase in migrating humpback whale populations, an increase in seal and sea lion populations, changes in water temperatures, increasing white shark populations, increased beach usage and changes to the commercial shark fishery. Shark hazard mitigation is therefore a complex issue, with no clear cause established for the increase in attacks and as such no simple solution.

[1] There is no information available on the shark species responsible for a fatal attack in 1916.

Seasonal trends for attacks

Data from the ASAF shows that, of the 20 fatal attacks to have occurred in Western Australia in the last 100 years, six have occurred in November and 11 have occurred between November and March (Figure 1). The number of non-fatal attacks in the last 10 years is relatively evenly distributed throughout the year with half (19 of 38) occurring between December and April (Figure 2). Water based activities between May and October are undertaken in the absence of beach and aerial patrols and associated Surf Life Saving WA support (see Appendix 3 for a full description of Surf Life Saving WA patrol schedules). Humpback and southern right whale migrations also take place off the Western Australian coastline between May and October, which in turn can attract marine predators to inshore areas.

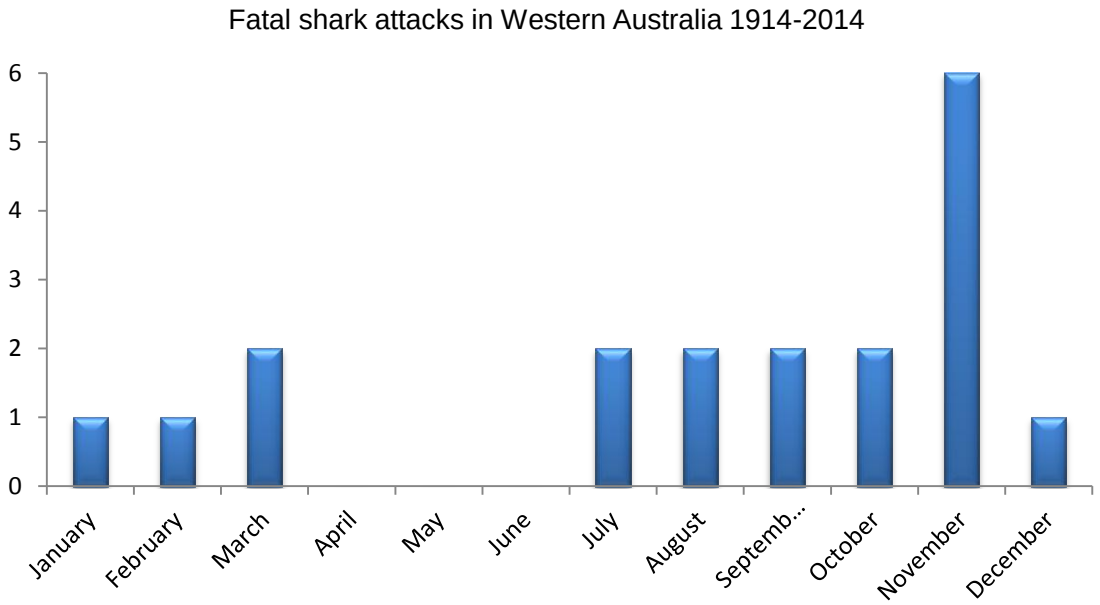

Figure 1. The number of fatal shark attacks in Western Australia in the last 100 years by month of attack.
(n=19 as the month in which an attack on a pearl diver occurred in 1916 is unknown.)
Source: Australian Shark Attack File, unpub. data: received March 2014

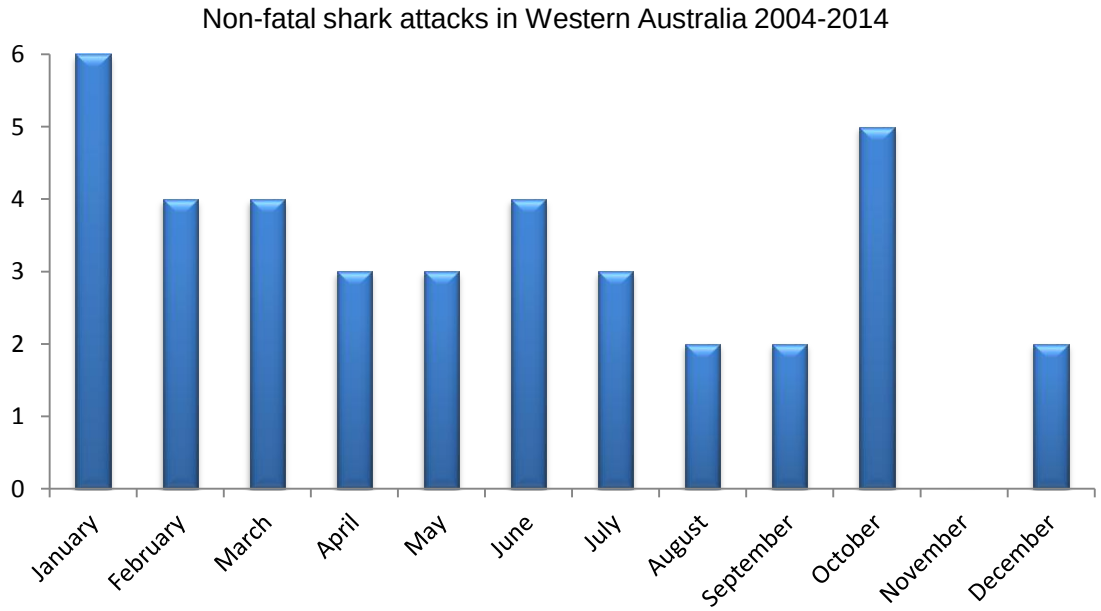

Figure 2. Non-fatal shark attacks in Western Australia over the last 10 years by month of attack.

Source: Australian Shark Attack File, unpub. data: received March 2014

The Western Australian Government response to the attacks

On 27 December 2013, the Hon Colin Barnett, Premier announced that the State Government would deploy baited drum lines off metropolitan and south west beaches to enhance protection to beachgoers from potentially dangerous sharks. This formal announcement followed an earlier statement by the previous Minister for Fisheries and the Premier on 10 December 2013 at which it was announced that the State Government would implement new shark hazard mitigation measures following the most recent fatality of a surfer in the south west in November 2013. What followed was:

- the development of a specific drum line deployment program based on consultations with relevant stakeholders;
- a formal procurement process for the delivery of drum line services;
- a challenge, subsequent review and upholding of the procurement process;
- application for and subsequent granting of appropriate exemptions and licences under Commonwealth and State legislation;
- threat of legal action by a tourism operator, which was not pursued;
- legal action by an environmental lobby group and family member of a shark attack victim which was decided in favour of the Government;
- an appeal against the above decision, which was subsequently withdrawn by the appellant;
- a third party referral to the Environmental Protection Authority (EPA) which resulted in over 20,000 submissions and a decision not to subject the program to an environmental assessment;
- a petition tabled in the Western Australian Parliament;
- two protest rallies at Cottesloe Beach attracting thousands of participants;
- 12 Freedom of Information requests;
- 28 Western Australian Parliamentary Questions, many with multiple sub questions;
- 765 separate articles on sharks in local, state and national newspapers;
- 1,100 radio news bulletins on sharks (Western Australia);
- 850 radio talk back comments on sharks (Western Australia);
- 290 television news items on sharks (Western Australia);
- 286,000 emails and letters to the Department of the Premier and Cabinet (DPC) on sharks (a significant number of which were pro forma emails); and
- a significant number of postings on Twitter and Facebook on the Government's drum line strategy (some of which were offensive and contained personal attacks on members of the Government and staff involved with the program).

Not all the print and electronic media coverage of sharks noted above was about the Government's drum line policy, in fact a number of items related to shark sightings, but a very significant sub set of this total did.

The announcement of the Government's new drum line policy was one part of a much broader shark hazard mitigation strategy that had evolved over the past several years and included the following:

- 8 May 2014 – an additional $175,000 per annum to Surf Life Saving WA for their jet ski program;
- 29 January 2014 – launch of the Sharksmart website;

- 31 December 2013 – announcement of $967,000 for four shark mitigation research projects;
- 18 October 2013 – announcement of beach enclosure trial at Dunsborough;
- 30 August 2013 – launch of the 'BeachSafe' smartphone application;
- 2 February 2013 – extension of aerial beach patrols for the March long weekend and Easter;
- 5 January 2013 - $300,000 for a watchtower at Cottesloe Beach;
- 15 December 2012 – commencement of jet skis deployment by Surf Life Saving WA for improved beach patrols;
- 7 December 2012 – announcement of funding to four research institutions to undertake research into shark hazard mitigation strategies;
- 27 September 2012 – announcement of $6.85 million funding over four years for shark hazard mitigation strategies (including tagging and detection of sharks, imminent threat policy, applied research, equipment for Surf Life Saving WA, setting of drum lines in the event of shark threat and community awareness programs – some of which are identified above);
- 8 July 2012 – announcement that regulations would be introduced to rule out tourism ventures based on attracting sharks (for example cage diving operations);
- 15 November 2011 – funding for shark response unit at DoF; $2 million per annum for aerial patrols of beaches to be extended to April each year;
- 1 December 2010 – increased funding for aerial patrols of beaches;
- 8 November 2009 – additional funding for aerial patrols of beaches;
- 3 January 2009 - the Western Australian Government in conjunction with West Australian Newspapers announces joint funding of extra patrols during school holidays; and
- 5 December 2008 – announcement of funding for helicopter patrols by Surf Life Saving WA.

In summary, the State Government has committed over $22 million in funding for a comprehensive suite of shark hazard mitigation strategies which includes commitments for research into shark behaviour, shark deterrents and detection, acoustic tagging, aerial patrols, equipment for Surf Life Saving WA, a beach enclosure trial, a beach watchtower and community awareness initiatives. The latest addition to the strategy is the deployment of a limited number of drum lines. Further details of the Western Australian Government's shark hazard mitigation strategy can be found at Appendix 3.

3. DESCRIPTION OF THE DRUM LINING PROGRAM

The drum lining program was designed to offer increased protection to swimmers and surfers by reducing the chance of large, and potentially dangerous sharks entering coastal waters at popular swimming and surfing beaches during periods of highest use. It was foremost a strategy to address a public safety issue.

Up to 60 baited drum lines were set at approximately 1km offshore of selected high use beaches and surfing spots within designated MMAs in the metropolitan and south west coastal regions of Western Australia between 25 January and 30 April 2014. Twelve drum lines were kept in reserve for responding to a shark threat or incident.

The metropolitan MMA extended from Quinns Rock Beach (-31°40.680', 115°41.640') approximately 40 km north of Perth, to Warnbro Beach (-32°19.080', 115°44.340'), approximately 50 km south of Perth (Appendix 4). The metropolitan MMA represented 91km², or 0.08% of Western Australian waters. Up to 30 static drum lines were set within the MMA between Mullaloo and Port Beach between 31 January and 30 April 2014, covering a distance of 28 km, or 0.22% of the Western Australian mainland coastline.

The south west MMA extended from Forrest Beach (-33°34.080, 115°27.840'), approximately 200 km south of Perth, to Prevelly (-33° 58.9200', 114° 59.3834'), approximately 280 km south of Perth (Appendix 5). The south west MMA represented 114km², or 0.1% of Western Australian waters. Drum lines were deployed in two phases within this MMA; phase one between Quindalup and Cape Naturaliste from 25 January to 10 February 2014 covering 11 km, or 0.09% of the Western Australian mainland coastline and phase two between Yallingup and Lefthanders from 11 February to 30 April 2014 covering a distance of 31 km, or 0.24% of the Western Australian coastline.

While the physical deployment of the drum lines is over a very small part of the Western Australian coastline, it was acknowledged that some of the species of shark that could be caught are migratory and the impact may extend beyond the immediate confines of the program. It is for this reason that specific strategies were developed to minimise the environmental impact, which arguably is far less than shark hazard mitigation strategies in Queensland, New South Wales and South Africa.

A contractor was procured by the Western Australian Government to undertake the required drum lining activities in the south west region, and DoF undertook the required operations in the metropolitan region. Contract management was undertaken by DPC.

An exemption from Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was granted by the Commonwealth Minister for the Environment on 10 January 2014 for drum lining activities to take place until 30 April 2014 in accordance with Schedule 2 and Addendum 1 of the Request for Tender DPC1596 (Shark Drum Line Deployment, Management and Associated Services).

Prior to the commencement of operations the contractor and DoF were provided with the following:

- service protocols;
- maps of the MMAs;
- GPS coordinates and maps for marine protected areas;
- suggested GPS coordinates for drum line placement;

- a shark species identification guide “Field identification guide to Western Australian sharks and shark-like rays” (McAuley *et al.* 2002);
- a waterproof and shock proof Olympus Tough camera;
- contact lists for DoF operations managers and response services;
- copies of log book data sheets; and
- criteria for determining a response to a shark threat.

Beaches for drum line deployment were selected in consultation with Surf Life Saving WA and with consideration of beach attendance statistics and patrol times (Appendix 2; Appendix 6). Surfing WA and local recreational water users were also consulted to identify popular surfing spots.

Target species were any white shark (*Carcharodon carcharias*), tiger shark (*Galeocerdo cuvier*) or bull shark (*Carcharhinus leucas*) with a total length of three metres or greater.

Drum lines were monitored from 6.00 am to 6.00 pm, seven days a week in both regions.

The drum line configuration included a minimum of two Polyform buoys and an approximate 25/0 stainless steel circle hook. The hook sat approximately two metres below the surface of the water, and was anchored to the sea bed using an approximately weighted 8-12 kg anchor by a length of polypropylene rope (length dependent upon water depth and local conditions). Each component of the rig was sectioned using swivel shackles (Appendix 7). A third float was added to some of the rigs for more effective handling of an animal, in particular in rough sea conditions (Appendix 8).

Any sharks that were less than three metres total length, and which were in a condition to be released, were tagged using a conventional fin tag (Appendix 9), photographed, measured, and data recorded on a daily log sheet. The DoF Operations Manager was notified of the size, sex and species of any shark which was released in the vicinity of a popular beach. Notifications were published on the Surf Life Saving WA Twitter feed.

Target species that were three metres or greater in length were destroyed using a firearm. Animals that were dead or destroyed were photographed, tagged using a numbered kangaroo tag (Appendix 10), and transported offshore for disposal. All disposals took place within State waters.

Meetings between the contractor, DoF and the contract manager were held prior to the commencement of operations to ensure clear lines of communication, understanding of all contract requirements and appropriate support for implementation of the program. Meetings following the completion of the program between the contractor and the contract manager and between DoF and the contract manager were also held. Outcomes of these meetings are detailed in Section 5.

Data sheets containing information on the size, sex and species of animals captured on the drum line, the animal’s condition, action taken, and tag numbers were maintained (Appendix 11) and provided, to the contract manager on a weekly basis. Public reporting of catch data occurred three times over the course of the 14 week program via publication on DoF’s website, allowing time for data verification and species identification where necessary.

To ensure that the contractor and DoF complied with contract, permit and legislative requirements and conditions, four observer trips in the metropolitan and eight observer

trips in the south west regions were undertaken (Appendix 12). Observations were made in relation to operational performance, and adherence to protocols and contractual and legislative conditions. Observers were officers from DoF, DPC, DPaW and WorkSafe.

Metropolitan operations

Fisheries Officers from DoF were granted an exemption from the *Fish Resources Management Act 1994* (FRMA) to conduct drum lining activities. This exemption was valid up until, and including, 30 April 2014. As agents acting for the Crown, Fisheries Officers were not required to apply for a licence to take fauna under the *Wildlife Conservation Act 1950* (WC Act) and *Wildlife Conservation Regulations 1970* (WC Regulations).

DoF vessels PV Hamelin and PV Houtman were used to undertake drum lining activities in the metropolitan region (Figure 3). Both vessels have a length of 20 metres and displace approximately 45 tonne each. Both vessels are equipped with 1500 kg pot hauling winches, an Automatic Location Communicator (ALC) and ramps on the stern for animal handling. A 12 gauge powerhead (non-hydraulic) was used to euthanise animals.

Figure 3. PV Houtman and PV Hamelin, the DoF vessels used to undertake drum lining activities in the metropolitan region.

Services began in the metropolitan region on 31 January 2014 with 10 lines initially deployed between Mullaloo and Port Beach. The number of lines was increased to 30 by 2 March 2014. A map of the metropolitan drum line locations at Mullaloo, Trigg, Scarborough, Floreat, City, North Cottesloe, Cottesloe, Leighton and Port Beaches is at Appendix 13.

Bait used in the metropolitan region included a combination of bonito, mackerel, tuna, salmon and demersal fish. Sharks captured on drum lines were measured using a Ryobi RLM30 digital measuring device following an initial assessment of size. Three tiger sharks in the metropolitan region were fitted with acoustic tags.

Surface ropes were shortened during April due to the early presence of humpback whales and one gray's beaked whale inshore of metropolitan beaches.

Catch data for the metropolitan region between 31 January and 30 April 2014 is detailed in Section 4.

South west operations

The south west operations were undertaken by Bouvard Fisheries, the successful respondent for the south west region to the Request for Tender DPC1596.

The contractor applied for, and was granted, a Licence to take Fauna for Public Purposes under the WC Act and WC Regulations. The licence expired on 1 May 2014. The contractor was granted an exemption from the FRMA to conduct the drum lining activities which was valid up until and including 30 April 2014.

The vessel FV Boranup Beach is a licenced fishing vessel with a length of 13.9 metres, a draft of 1.3 metres, a winch capability of 1500 kg, an average cruising speed of 14 knots and a maximum cruising speed of 21.5 knots (Figure 4). The vessel has two opening sea doors, the rear one of which was modified during operations to include a ramp to facilitate more efficient hauling of animals onto the vessel (Figure 5).

Figure 4. The FV Boranup Beach, the vessel used to undertake drum lining activities in the south west region.

Figure 5. The rear sea door of the FV Boranup Beach, modified to include a ramp to allow for more efficient hauling of animals onto the deck where required.

A Thrane and Thrane 3027 ALC was fitted to FV Boranup Beach prior to the commencement of operations in line with conditions of the exemption granted under the FRMA. The contractor had a valid firearms licence and securely stored a Voere bolt repeater 0.22 calibre rifle on the vessel. Following advice regarding the adequacy of the rifle for dispatching large sharks, the contractor also brought onto the vessel a single shot

12G calibre shot gun. The contractor developed safe work practice guidelines for the use of firearms on board the vessel and worked within a risk based assessment to determine the appropriate firearm for use according to each situation.

The contractor marked the side of the vessel to indicate a three metre measurement from the winch, to give an initial indication of size of sharks brought up on the lines. For more accurate measurements the shark was brought onto the deck, via the rear ramp of the vessel.

Services began in the south west region on 25 January 2014, with 10 lines deployed in Geographe Bay between Quindalup and Meelup. This was increased to 15 lines between Quindalup and Cape Naturaliste by 27 January, with five lines kept on board for responding to a shark threat. A map of the final drum line locations for phase one of the south west deployment is at Appendix 14. On 11 February 2014 services were moved south west from Geographe Bay to popular surfing spots south of Cape Naturaliste, coinciding with both the cessation of Surf Life Saving WA patrols in the region and the end of school and university holidays. Fourteen lines were deployed between 11 and 20 February, increasing to 22 lines on 21 February, up to a full deployment of 30 lines between Yallingup and Lefthanders by 3 March 2014 (Appendix 15).

Bait used in the south west included a combination of school shark heads, mackerel, snapper and tuna heads, and local fresh salmon.

Surface ropes were shortened during April due to the early presence of humpback whales (Figure 6).

Figure 6. Shortening surface ropes on the drum lines in the south west region in April 2014 in response to the early presence of a small number of humpback whales.

Presence data for mako sharks caught in the south west region was entered into the online Atlas of Living Australia (www.ala.org.au) to add to the knowledge of the species.

Catch data for the south west region between 25 January and 30 April 2014 is detailed in Section 4.

Responding to a shark threat

There was a requirement for DoF and the south west contractor to respond to identified shark threats within the MMAs. The criteria used for determining a shark threat and associated response actions are at Appendix 16.

In the event of the presence of a shark considered to be posing a threat to public safety within the MMA, the on-water vessel was requested to attend the scene and deploy up to five drum lines. No more than 60 static drum lines were in the water at any one time, therefore providing capacity to deploy temporary drum lines whilst ensuring that no more than a total of 72 drum lines were in the water at any time.

The drum lines used in a response scenario were of a similar configuration to those described at Appendix 7. Drum lines were set for a maximum of one hour in response to a sighting and were continuously monitored for this time. None of these deployments captured the shark targeted, with noise from helicopters and activist's boat hampering efforts.

Details of requests to deploy temporary drum lines in response to sharks considered to be posing a threat to public safety between 25 January and 30 April 2014 are detailed in Table 2.

Table 2. Deployments in response to confirmed sightings of sharks considered to be posing a threat to public safety between 25 January and 30 April 2014.

Date	Time	Region	Action
02/02/2014	08:25	Metropolitan	Five lines deployed
08/04/2014	11:42	Metropolitan	Five lines deployed
08/04/2014	12:51	Metropolitan	Five lines deployed
08/04/2014	14:45	Metropolitan	Five lines deployed
08/04/2014	16:15	Metropolitan	Five lines deployed

4. CATCH DATA ANALYSIS

The following is an analysis of the catch data for the 14 weeks over which the program operated. It is largely descriptive as the program was in place for a short period of time.

All catch data from record sheets submitted by the contractor vessels were provided to DoF and species identifications were validated by cross-referencing against photographs. The catch data for each MMA were then tabulated and checked for completeness and errors (such as transcription mistakes) prior to undertaking analyses and reporting of all captures in each MMA. The level of analysis that could be undertaken for individual species was determined by the relative number caught. For those species that were caught rarely, only the number caught was assessed. Because tiger sharks (*Galeocerdo cuvier*) were caught on a more frequent basis, detailed analyses such as examination of catch rates and size frequencies were completed.

Given the significant difference in the oceanographic and habitat characteristics of the northward-facing, relatively protected waters of waters of Geographe Bay (Forrest Beach to Cape Naturaliste) compared to those of the more exposed waters off the westward-facing Capes coast (Cape Naturaliste to Prevelly) these two sub-areas of the southern MMA were assessed separately.

Overview

Catches (all species)

Catches by the Western Australian drum lines during the period January 25 – 30 April 2014 mostly comprised tiger sharks (91% of the total numerical catch; Table 3). These captures are therefore considered in detail. The very small number of individuals for the other species caught by the drum lines (0–7 individuals per species) did not allow for more detailed analyses to be completed. Species lengths are recorded as total length (TL).

Table 3. Number of animals caught on the drum lines.
The 'dead' category includes target species that were destroyed based on their size (≥300 cm TL) and all species that were dead upon hook retrieval or destroyed due to a very low likelihood of survival.

	Total catch		Metropolitan		Geographe Bay		Capes	
Common name	**Dead**	**Released alive**	Dead	Released alive	Dead	Released alive	Dead	Released alive
Tiger shark	**64**	**99**	34	75	15	5	15	19
Shortfin mako	**4**	**1**	0	0	2	0	2	1
Dusky shark	**0**	**1**	0	1	0	0	0	0
Spinner shark	**0**	**1**	0	0	0	1	0	0
Bull shark	**0**	**1**	0	1	0	0	0	0
Unidentified shark	**0**	**1**	0	0	0	0	0	1
Ray	**0**	**7**	0	7	0	0	0	0
North-west blowfish	**0**	**1**	0	1	0	0	0	0

Non-target species

Sharks

In total, nine individuals of non-targeted sharks species were caught (Table 3). This included five shortfin mako sharks (*Isurus oxyrinchus*) which were caught in the south west (ranging from 170 – 264 cm TL), one of which was tagged and released, three of which were dead upon gear retrieval and one which was destroyed because it was unlikely to survive release. A single dusky shark (290 cm TL) and a single spinner shark (180 cm TL) were caught and each was tagged and released. One unidentified shark removed itself from the hook and swam off before it could be identified.

Non-shark

Seven rays (species unknown) were caught in the metropolitan region, all of which were released alive. Two of the rays were identified as sting rays (Family Dasyatidae). A single north-west blowfish (*Lagocephalus sceleratus*) was caught and released alive.

Target species

White Sharks

No white sharks were caught during the trial drum line program.

Bull Sharks

A single bull shark (197 cm TL) was caught in the metropolitan region and was released.

Tiger sharks

In total, 163 tiger sharks were caught (67% in the metropolitan; 12% in Geographe Bay and 21% in the Capes). Ninety-nine (61%) were released with a greater proportion released in the metropolitan region (Table 3; Figure 7).

A total of 17 (10%) were found dead upon gear retrieval. These were distributed across all regions and throughout the duration of the program. Twenty-nine percent of tiger sharks were destroyed either because they were 300 cm TL or greater or in three instances because the sharks were considered not in a condition to survive.

The tiger sharks captured in this trial period ranged in size from 153 – 450cm TL (mean size = 270 cm TL, SD = 63 cm, n = 155 tiger sharks) (Figure 8) with a larger range of sizes captured in the metropolitan region. The overall sex ratio significantly differed from parity (χ^2 = 34.1, $p < 0.0001$) with more females being caught at all three locations (Figure 9). Released sharks ranged in size from 153 – 299 cm TL while those that died (either because they were dead upon gear retrieval or due to their size) were from 182 – 450 cm TL (Figure 10).

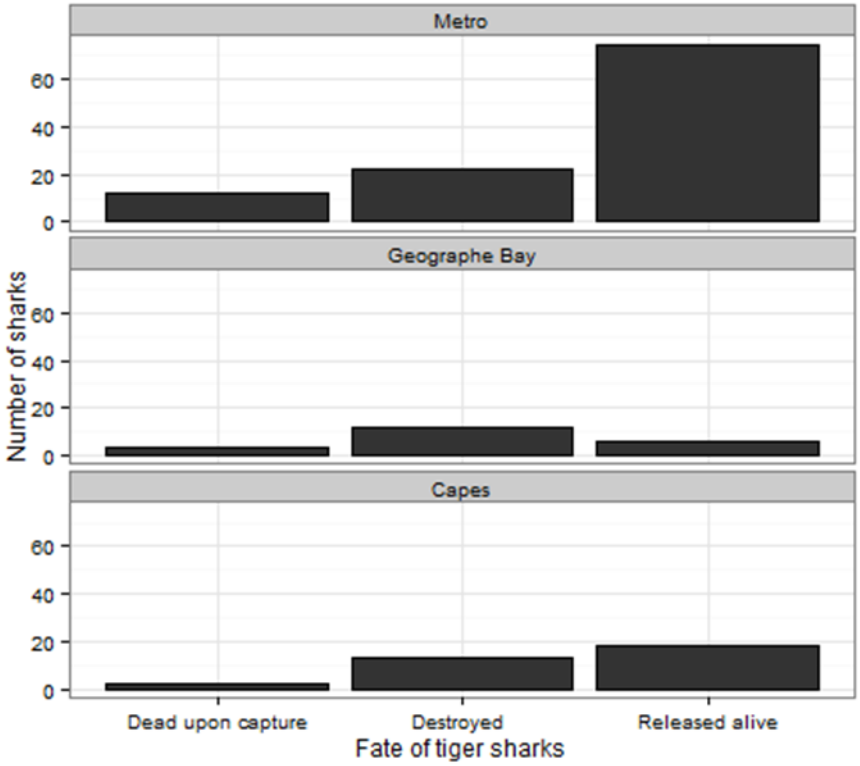

Figure 7. Fate of tiger sharks caught on drum lines by region.

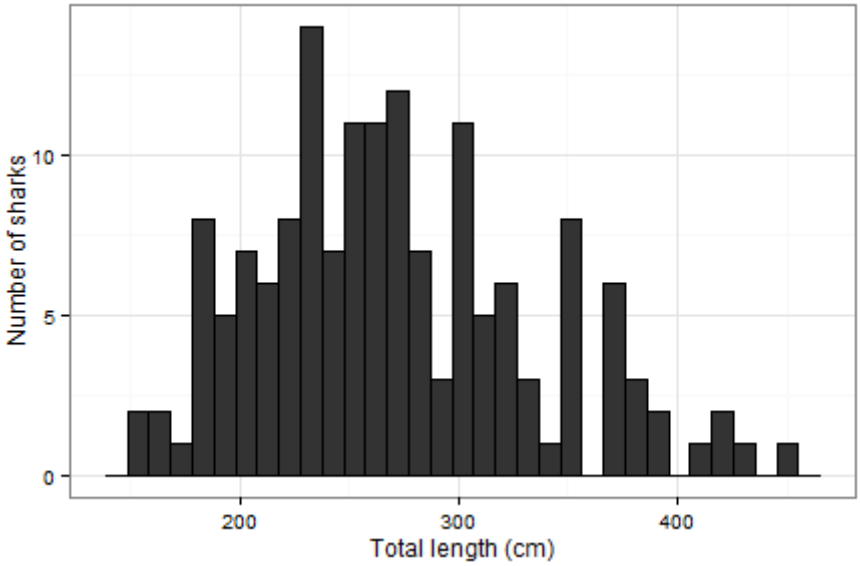

Figure 8. Size frequency of tiger sharks caught from all regions

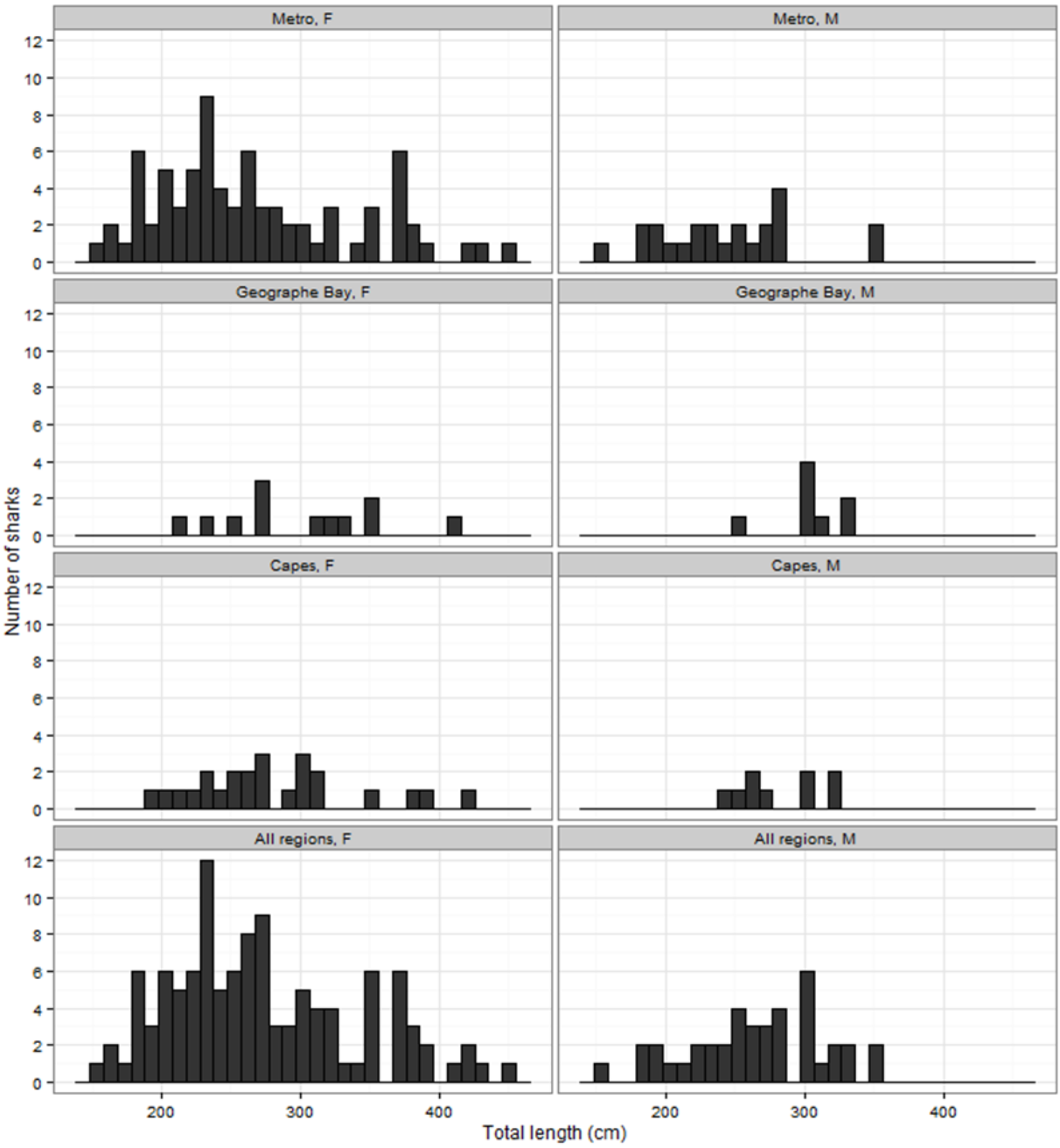

Figure 9. Size frequency and sex (F = females, M = males) of tiger sharks caught by region.

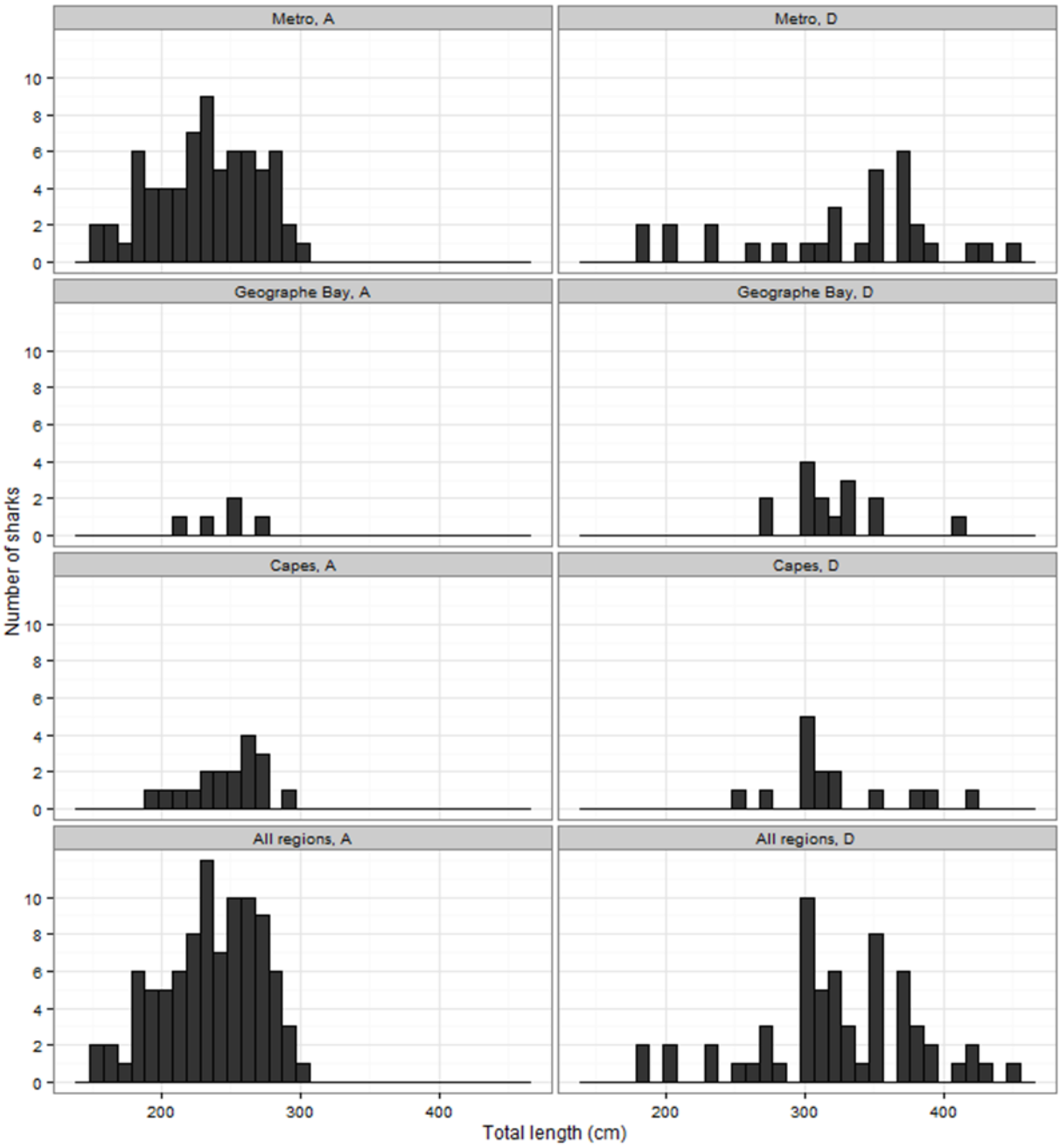

Figure 10. Size frequency and fate (A = alive/released, D = dead) of tiger sharks caught by region. The dead category includes sharks that were dead upon gear retrieval and those destroyed due to their size.

Of the 99 tiger sharks that were released, 90% were tagged with a conventional dorsal fin tag. To date, none of these tagged sharks has been recaptured. Of the three tiger sharks that were fitted with internal acoustic tags, one (230 cm TL female) is confirmed to have died immediately after release; one (251 cm TL female) was detected by a VR4G receiver approximately two km from its release site 30 minutes after release and the third (173 cm TL female) has not been detected following her release (noting no data from the more widely spread VR2 receivers are available for this time period).

Based on length-weight conversions from northern Australia (Stevens & McLoughlin 1991), the estimated weight of tiger sharks destroyed during this program (assuming 100% survival of released sharks) would be approximately 17 tonnes. More than half of this was taken in the metropolitan region (Table 4).

Given the potential for at least some released sharks to have died, total mortality is likely to be higher than this estimate. The maximum weight, assuming no survival of released sharks, is approximately 25 tonne (Table 4).

Table 4. Estimated total weight of tiger sharks destroyed. The lower limit and upper limit assume survival of released sharks of 100% and 0%. Respectively.

Region	Lower limit (tonne)	Upper limit (tonne)
Metropolitan	9.5	15.3
Geographe Bay	3.5	4.0
Capes	3.9	5.5
Total	16.9	24.8

Catch rates (tiger sharks only)

The catch per day at all three sites was highly variable with many of the days having no captures, particularly in the Capes region (Figure 11). The overall rate of capture (sharks captured per day) in the metropolitan region was very similar to that in Geographe Bay (1.2 tiger sharks per day) with catch rates for both of these regions being higher than for the Capes (0.4 tiger sharks per day). The lower average catch rates in the Capes region may reflect either distributional differences (lower abundance in the southern region) and/or differences in susceptibility in this region. Furthermore the different geography of each of these two south west sub-regions (e.g. sheltered waters at Geographe Bay versus more exposed waters off the Capes) may also have influenced the relative catch rates of this species.

The catch rates for tiger sharks in the metropolitan region were highest in early-mid February (e.g. nine captured on 14 February) (Figure 11A). This was followed by lower, more stable daily catches of tiger sharks for the remainder of the trial program. The daily catch data for both locations in the south west showed no trends across time (Figure 11 B and C) .

The decline in catch levels after February may reflect some level of depletion of tiger sharks in the metropolitan region but their continued capture up to the last day of the program indicated tiger sharks were still present within the region. There was no evidence of any depletion within the two south west areas with the catch level remaining at consistent levels for the duration of the drum line deployment at both Geographe Bay and the Capes (Figure 12 B and C).

The catch rate of tiger sharks 300 cm TL or greater (all of which were destroyed) showed no pattern at any sites (Figure 12). This may be an indication of different distribution and residency patterns for small compared to larger tiger sharks but the data are too few to be conclusive.

More detailed analyses may subsequently be able to explore the extent to which the observed spatial and daily differences in catches may have been influenced by differences in local oceanographic and benthic conditions and hook density (i.e gear competition/saturation effects) or bait type.

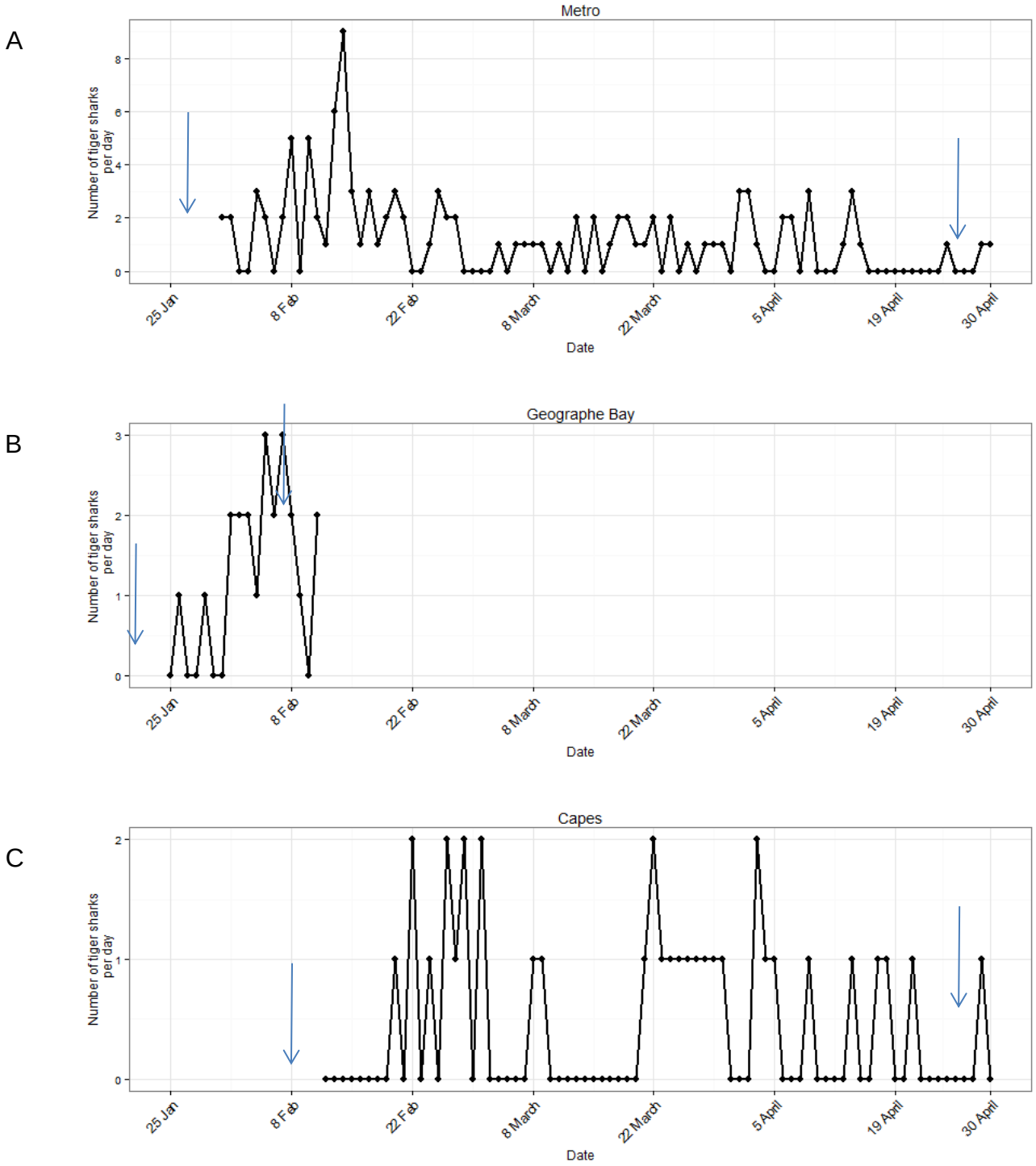

Figure 11. Daily catch of all tiger sharks captured in the (A) Metropolitan, (B) Geographe Bay and (c) Capes regions. Blue arrows represent the start and finish of fishing within each region. Note the different scales of the y-axis for each region.

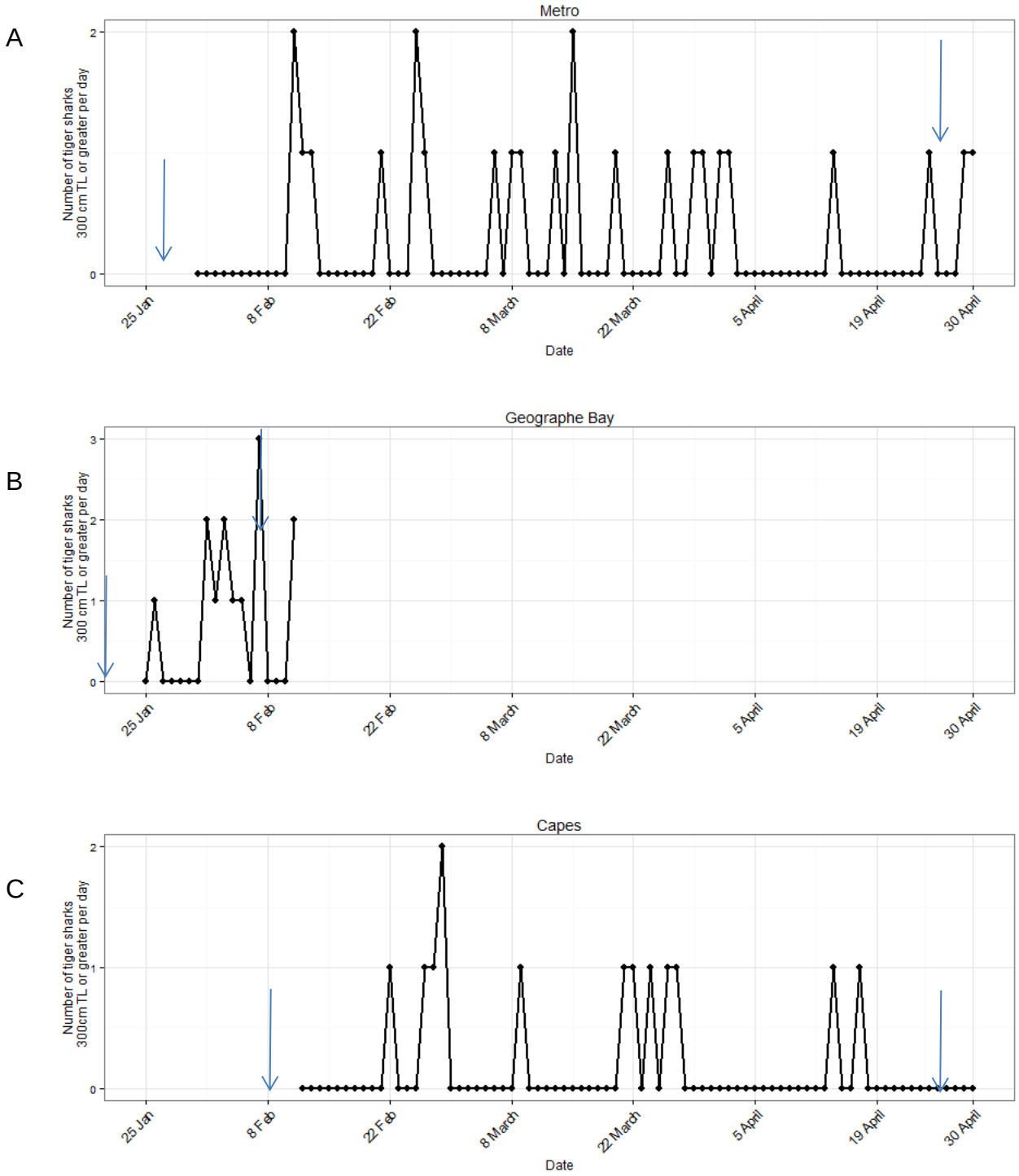

Figure 12. Daily catch of tiger sharks ≥ 300 cm TL in the (A) Metro, (B) Geographe Bay and (c) Capes regions. Blue arrows represent the start and finish of fishing within each region. Note the different scales of the y-axis for each region.

Acoustic detections

The Shark Monitoring Network (SMN) was established to collect data on acoustically tagged sharks using arrays of acoustic receivers which can provide data on the presence of acoustically-tagged sharks detected within the MMAs. These data were examined for the period of drum line deployment in 2014 compared with the same period in 2013 to assess the hypotheses that (i) drum lines capture all sharks in their vicinity and/or (ii) attract more sharks to the area than would otherwise have been the case. To reduce confounding by recent captures, this analysis did not include the sharks that had acoustic tags inserted during the drum line operations.

At the time of generating this report, a full set of validated acoustic data was only available from the remotely-accessible satellite-linked VR4G receiver data (Table 5). The data from sub-surface (VR2W) receivers will also be examined in the latter half of 2014 after these units are retrieved for data-download and servicing.

Table 5. Shark detection data for satellite-linked (VR4G) receivers within MMAs.

Species	Original capture date	Size (Fork length in cm)	Number of days detected at surface receivers in proximity to drum lines (Jan-Apr 2013)*	Number of days detected at surface receivers in proximity to drum lines (Jan-Apr 2014)
Tiger shark	13/11/2012	211	4	1 (Metro)
Bronze whaler	5/10/2013	226	-	4 (Metro)
Bronze whaler	4/11/2013	242	-	1 (Geographe Bay)

*These detections are restricted to receivers deployed in proximity to where drum lines were used in 2014 to test the hypothesis that drum lines attract sharks

Three sharks (acoustically tagged prior to the drum line program) were detected during the trial program in 2014 at receivers in close proximity to baits. Despite their proximity to baited drum lines, none of these were caught. This indicates that drum lines do not catch all sharks that come into the vicinity of the drum lines.

Given the small number of observations in each year, the data are not sufficient to fully address the hypothesis concerning the level of attraction of sharks to these areas through the deployment of drum lines.

Discussion

Ecological impacts and observed versus expected catches

For most species or species groups, the observed levels of catch by the drum line program were consistent with the predictions (low for most species) that were presented in the initial risk assessment (DoF 2014, Table 6). For one species the actual level of capture was lower than predicted (dusky sharks). Only the actual catch of tiger sharks was higher than expected. The comparison of the actual versus predicted capture levels of each of the main species or groups is considered below.

Table 6. Summary comparison of actual catch levels versus predictions presented in the risk assessment (DoF 2014).

Species/Group	Level of capture consistent with predictions?	Comments
White shark	Yes	-
Bull shark	Yes	-
Tiger shark	No - Higher	Possible effects of increased water temperatures in recent years
Dusky shark	No - Lower	Drum lines inshore of migration route
Grey nurse shark	Yes	-
Demersal scalefish	Yes	-
Dolphins	Yes	-
Seals/Sea lions	Yes	-
Whales	Yes	-
Turtles	Yes	-

Target species

Tiger sharks

Tiger sharks are a relatively abundant, tropical and subtropical shark species with a geographic distribution that extends from the west coast of Western Australia over the northern half of Australia to southern New South Wales. The drum lines deployed for the trial were only located in small areas at the southern end of the tiger shark range on the west coast of Australia (Figure 13). This species is currently subjected to only minor levels of exploitation elsewhere along the Western Australian coast.

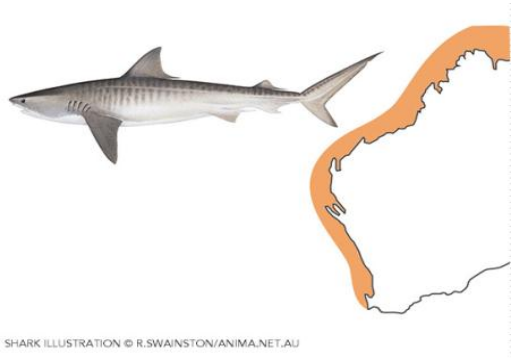

Figure 13. Distribution of the tiger shark in WA

The predictions were that most of the captures of this species were expected to be released, with the number expected to be killed in the order of 10-20 individuals. The level of catch of tiger sharks in the drum line trial program was higher than expected. Thus, while the proportion that was released alive was consistent with predictions (being over 60%), the actual number killed was 64.

Having a higher than expected number of tiger sharks off the west coast of Western Australia is however, consistent with the observed trend in warming water temperatures

occurring off this part of the coast and, moreover, in the past four to five years this region has experienced marine heat wave events (Pearce *et al.,* 2011). These have been associated with major effects on a number of species including affecting their distributions (Caputi *et al.,* 2014), which could have also led to increased numbers of this mainly tropical species being located towards the southern extent of their distribution off Western Australia. Additional monitoring of this species would be required to determine whether the catch rates experienced in 2014 are now typical or not.

Despite a higher number encountered in the trial program than was anticipated, the initial risk assessment indicated that the number of tiger sharks that would need to be killed before even a measurable change in their total population would occur was likely to be in the order of 100s. The number known to have died during the trial (see Table 3), while higher than expected, was still less than the levels considered necessary to potentially have a material effect on total stock size.

The levels of mortality generated from the trial period are not considered to have exceeded those outlined within the risk assessment which would generate more than a negligible risk. However, the higher than expected level of captures obtained in the trial period and the possibility of high levels of post-release mortality has prompted a more detailed examination of the risks associated with this level of capture should this same level be maintained for a number of years.

Bull sharks

All available information that has been obtained by DoF's shark research program over the past two decades suggested that within the MMAs this species' distribution is largely confined to the Swan/Canning system. Consequently, given their apparent scarcity in near-shore marine waters off south-western Western Australia, the expected number of bull sharks caught in this program was considered to be negligible. Consistent with this prediction, only one bull shark was caught in the trial period.

White sharks

Based on the low rates of capture of white sharks during the targeted fishing operations (which have been designed to enable tagging of these sharks) completed off Western Australia in the past few years, especially between January and April, it was expected that the capture of white sharks would be small (< 10). The lack of any white shark captures in the trial period within the MMA locations is consistent with this prediction and that white sharks are more common in winter and spring when water temperatures are lower (DoF 2012).

Dusky shark

One of the most important and economically valuable species that was considered to be a potential by-catch of this drum line program was the dusky shark (*Carcharhinus obscurus*). There were initial concerns that the level of captures of this species may be relatively high and if it were to exceed 30, this would represent a moderate risk to the stock. Only one was caught in the trial period, which was much less than predicted.

It is likely this lower than predicted catch is due to the drum line gear being set well inshore of what emerging data suggests is this species' offshore migratory pathway.

Shortfin mako shark

Due to concerns for populations of shortfin mako (Isurus oxyrinchus) elsewhere in the world this species has been included in Appendix II of the *Convention on the Conservation of Migratory Species of Wild Animals*. Therefore it has been listed as a migratory species under the EPBC Act and has been considered separately in this report.

There are no particular concerns about anthropogenic impacts on shortfin mako in Australian waters with continued recreational and commercial catches still allowed after listing. Moreover the very small number caught in the trial program (five) would have negligible impacts on this species' Australian population.

Grey nurse shark

The number of captures of this species was expected to be very low and their survival prior to release should be high given their ability to buccally ventilate and maintain neutral buoyancy. Consistent with the predictions, no individual of this species of shark was caught in the trial program, supporting the initial assessment that the risk to this population is negligible.

Demersal scalefish

The design of the gear (e.g. size and design of hooks) made it highly unlikely that any demersal scalefish species would be caught in the drum line program. As no demersal scalefish were caught on drum lines in the trial program this is consistent with the prediction.

Seals and sea lions

The size and design of the hooks made it a remote likelihood that any individual pinniped (seal or sea lion) would be captured in the program. Consistent with the predictions, none of these species were caught during the program.

Turtles

Turtles are not common in the more temperate regions where the MMAs are located. Individuals of most turtle species are highly unlikely to be in the vicinity of the MMAs and therefore to even interact with the drum lines. The size and design of the hooks make it a remote likelihood that any turtle would be captured on the drum lines. Consistent with the predictions, none were captured in the trial period.

Whales

The trial period (January–April) occurred outside the typical migration seasons for the whale species that migrate along the Western Australian coast, reducing the likelihood of encountering drum line ropes. In addition, the positioning of these lines well inshore of where the majority of whale movements occur reduced the likelihood of entanglement. Consistent with the predictions, no interactions with whales occurred during the trial period.

Dolphins

Given the size and shape of the hooks used, it was highly unlikely that dolphins would be captured by the drum line gear. Consistent with the predictions, no dolphins were captured during the trial period.

Broader ecosystem effects

The footprint of the operation is extremely small compared to the distribution of the species most likely to be directly affected, with only very small numbers of species other than tiger sharks captured and/or killed. As outlined above, the program has therefore generated only negligible impacts on each of the affected species.

There was nothing captured in the trial drum line program that would significantly affect the original assessment that this program would have negligible impacts on the ecosystem. Consistent with this prediction, no effects to other species have been identified.

The removal of up to 25 tonnes of a common species of shark (i.e. tiger shark) in one year distributed across effectively three small areas of the west coast bioregion by this trial program is still unlikely to have had any measurable effect on the functioning of the broader mesoscale, Leeuwin-Naturaliste ecosystem (which extends across this part of the West Coast bioregion). Nonetheless the potential effects of this level of capture extending over a number of years will be assessed in more detail in the revised risk assessment.

5. CONSULTATION AND FEEDBACK

During the first two weeks in May 2014 officers from DPC conducted post-operational meetings with stakeholders to gather feedback on the program and discuss final catch data (Table 7).

Table 7. A summary of post-operational meetings undertaken by officers from DPC.

Organisation[2]	Date
Bouvard Fisheries (SW Contractor)	2 May 2014
The West Australian Fishing Industry Council (WAFIC)	5 May 2014
WA Police	5 May 2014
Department of Fisheries - Operations (5)	5 May 2014
Department of Fisheries - Research (2)	5 May 2014
Oceans Institute University of Western Australia	5 May 2014
Oceans Institute University of Western Australia (2)	6 May 2014
Department of Parks and Wildlife	6 May 2014
Surf Life Saving WA	6 May 2014
EventsCorp WA	6 May 2014
RecFishWest	7 May 2014
Department of Transport	7 May 2014
Western Australian Marine Science Institution (WAMSI)	7 May 2014
Surfing WA	8 May 2014
WA Sports Federation	8 May 2014
Open ocean swimmers (2)	9 May 2014
Wildlife Marine	9 May 2014
Environmental consultant	9 May 2014
Margaret River Board riders	9 May 2014
Margaret River recreational surfers (3)	9 May 2014
Margaret River Recreational Surfers	9 May 2014
WA Undersea Club	12 May 2014
Curtin Centre for Marine Science and Technology	15 May 2014
Oceans Institute University of Western Australia	15 May 2014
Queensland Shark Control Program	15 May 2014
James Cook University	16 May 2014
Kwazulu-Natal Sharks Board (3)	4 June 2016

Feedback from the consultations focused on operational issues and program considerations, with water user groups generally in favour of the drum line program and academics generally not in favour of the program. The following is a synopsis of the feedback received through these consultations.

Operational matters

- Significant media and public interest which should have been dealt with more effectively. More public information should have been made available and in a variety of formats including: inclusion in industry and association newsletters; public announcements in newspapers and appropriate websites; literature (sticker and or pamphlet) for boat users; and literature (pamphlet) for distribution in dive, surf, and tackle shops (others did not support all of these measures as it could give a perception of a problem which conversely may impact on businesses).

[2] Consultation did not occur with the Conservation Council of WA and the Sea Shepherd Organisation however information from the websites of those organisations is provided in the summary of the consultation section.

- Specific improvements to gear, bait and operations including:
  - shortening of anchor rope;
  - use of a wire trace instead of chain, although some felt sharks could bite through the wire;
  - more swivels to prevent twisting of ropes;
  - black rope to be replaced because it is harder to see and encourages growth on lines;
  - use of bonito and southern blue fin tuna which were found to be successful;
  - use whole fish, and pierce the skin once or twice only;
  - longer hook lines to enable animals to swim more freely and reduce stress;
  - ramps on vessels to reduce stress on animals;
  - pumping of sea water over the gills of captured animals; and
  - greater flexibility in hours of operation.
- More intensive training to be provided to contractors at the commencement of the program to agree on standard descriptions, terminology and protocols for measurement, photographs and other logistical requirements.
- Consideration should be given to bringing the drum lines closer to shore; one kilometre is too far out.
- Need for clear communication protocols with respect to the operation of the program to ensure information is communicated and distributed accurately and appropriately.
- The Department of Transport 50 metre exclusion zone around each drum line does not provide sufficient separation from protestor boats. There should also be an exclusion zone around the vessel servicing the drum lines.
- Having a specific start and end date for the proposed three year program assists in notifying mariners of the deployment and location of the drum lines.
- The program will only be effective if it is conducted year round.
- Surfing organisations support the Government's shark hazard mitigation policy. There could be better consultation with surfers on the location of drum lines at surf breaks.
- Mammals or fatty meat should be used as bait (noted that these are prohibited), conversely experience in South Africa indicates that the use of whole fish is more effective.

Program considerations

- A number of researchers from academe said that they understood the rationale for the program, but did not feel the program had been effective in reducing the risk of shark attack as no white sharks had been caught. These researchers also suggested adopting the catch and release policy employed in Brazil.
- Researchers from universities also expressed interest in obtaining specimens for research from the program, but raised concerns about the logistics of obtaining fresh samples. Researchers also offered assistance in providing information on animal handling techniques to reduce stress in captured animals.
- Additional information on condition of bait, where hooked, other measurements, description of shark status on release and associated metrics should be collected.
- Effective range of baits could be up to one kilometre depending on ocean conditions and composition of baits.
- The program had considered many of the strategies to minimise environmental impact.
- Measures to reduce non shark by-catch appear to be effective.
- Number of sharks will likely increase as the potential for sick and injured whales also increases due to over population.

- It is hoped that current research programs in DoF and the universities will lead to effective alternative measures to the drum lining program.
- A briefing directly to commercial fishers could have assisted in gaining support for, and providing a better understanding of, the drum lining program.
- Availability of data was considered a positive.
- Water users felt safer because of visual references - contractor and DoF vessel on the water, aerial patrols overhead and jet skis in use. Conversely, the sight of drum lines and the contractor and DoF vessels made some water users nervous.
- Organisers of water based events, especially those with interstate and international participants, were concerned about the perceived shark problem in Western Australia as reported in mainstream and social media, and not specifically the drum line policy.
- There is anecdotal evidence of an increase in confidence of water users over the summer period.
- Drum lines are not a solution in themselves, but are useful as part of a multi-faceted strategy and there should be greater promotion of the various elements of the Government's overall strategy.
- Support for drum lines going in earlier (during winter months) and the need for a fast response boat to deal with shark threats more quickly, especially in the south west. Noted that these comments would be considered, however unlikely to receive approval under the current environmental approval process.
- Queensland shark related fatalities decreased prior to the implementation of their shark mitigation program.
- There are a number of other non-lethal means of deterrents, however none appear to be available commercially and are either in testing phases or identify unintended other consequences (potential harm to other species such as whales or dolphins in the case of sonar or electromagnetic deterrents).
- Tiger sharks should not be targeted because they are essentially scavengers and not shown to be responsible for recent attacks. Conversely some commenters singled out tiger sharks as highly dangerous.
- A 14 week trial is insufficient to determine the success or otherwise of the program, and a lengthier implementation over a number of years is more appropriate from a science and research perspective.

Other

- Misinformation, offensive allegations, abuse and baseless attacks on contractors through social media were difficult to address.
- People supporting the drum lining program have stayed silent due to the high level of abuse and vilification received.
- There were difficulties in sourcing bait, and salmon appeared to attract rays. Demersal heads and frames seemed most effective in the metropolitan region. The use of sharks caught on the lines that are not commercially or totally protected should be considered for use as bait.
- The SharkSmart website could be better promoted to more effectively provide community awareness information. Overall there is a need for more a proactive approach to providing information on the program. Information could be disseminated using community organisations involved in marine recreation.
- Debate on the issue has been clouded by emotional responses and disproportionate media coverage.

The main themes emerging from the consultation were that there is a need for more research; the program took effective measures to minimise its environmental impact; there was considerable misinformation; media coverage of the issue was disproportionate; water users groups generally supported the program; and academics/researchers generally did not support the program. Interestingly, facts and data were not always agreed and sometimes contradicted; and there was a lack of understanding or information by a number of those interviewed on the Government's overall strategy and shark mitigation programs in other jurisdictions.

The Conservation Council of Western Australia and Sea Shepherd Australia were not directly consulted, having made their position clear through information contained on their websites and legal action brought against the State.

With respect to the Conservation Council of Western Australia the following was extracted from their website on 14 May 2014:

> *'The WA Government has announced a brutal policy to kill endangered White sharks in the hope this will reduce the incidence of shark attack on WA beaches.*
>
> *There is no scientific evidence that culling endangered sharks using baited drum lines would reduce the already very low risk of shark attack.*
>
> *Baited hooks used to kill sharks will also kill other marine life including turtles, dolphins and other non-target sharks. These animals will inevitably die after prolonged suffering.*
>
> *Non-lethal methods such as early detection, alarm systems, community education and increased scientific research should be much higher priorities than the indiscriminate killing of sharks and other marine animals'*

Sea Shepherd's website has 11 separate news items between 26 January 2014 and 8 May 2014, with the general proposition that there should be a stop to the Western Australian Government's drum line component of its overall shark hazard mitigation strategy.

Regional consultation

Officers from DPC and DoF met with representatives of local government councils in the south west on 10 March 2014 to discuss support for regional centres as part of an overall shark hazard mitigation strategy. Concern was expressed by some about not having a clear set of guidelines to enact beach enclosures, whereas others were satisfied with the processes they had in place. There were also issues raised about the text messaging system for shark sightings, support from Surf Life Saving WA in the south west and need for standardisation of signage.

In response to the issues raised in this meeting the following occurred:

- Information was provided to the south west councils on the text messaging system for shark sightings – clarification was provided on how the system works, who gets the messages and how they are accepted and disseminated.
- Information was provided on factors to consider in taking precautionary actions with respect to shark sightings, emphasising that in the absence of patrolled beaches, local

factors such as time of day, water usage, water conditions, and other priorities would also provide the context for such decisions.

- Information was provided on Surf Life Saving WA's prescribed protocols for securing beaches for councils to use should they wish to adapt their processes.
- Contact was made between the Shire of Augusta-Margaret River and Surf Life Saving WA to explore the possibility of Surf Life Saving WA's twitter feeds being incorporated into a phone application being developed by the Shire.
- DPC has raised the issue of extended coverage in the south west by Surf Life Saving WA and it is understood that opportunities exist for aerial patrols to be extended in 2014-15, and then again in 2015-16. A Surf Life Saving WA patrolled beach option however is more difficult to implement because this essentially relies on a significant volunteer base.
- Another meeting with local councils, DPC, DoF, Surf Life Saving WA, and others is being organised by the Shire of Augusta-Margaret River later in the year to further explore issues and responses.

6. PROCUREMENT PROCESS AND COSTS

A tender for drum line services in the metropolitan and south west area (Request DPC1596 for the provision of Shark Drum Line Deployment, Management and Associated Services) was issued on 23 December 2013 with a closing date of 3 January 2014. In developing the tender and during the subsequent period it was open, the following factors were considered:

- addressing public safety concerns following the latest shark fatality in November 2013;
- provision in the State Supply Commission's Open and Effective Competition policy which provides for exemptions from the minimum advertising period of 10 days;
- exemption provisions under Free Trade Agreement Guidelines; and
- the specific nature of the service requirement.

Eighteen submissions were received for the request for tender, of which one withdrew for commercial reasons before a decision was made.

A panel consisting of two officers from DPC and one from DoF, supported by three staff from the Department of Finance, assessed the tenders and identified a commercial operator for the metropolitan area at $745,000 and one for the south west area at $610,000. This was a total of $1.35 million against a pre tender estimate of $1.3 million. The preferred respondent for the metropolitan area later withdrew in response to comments they received via telephone and email. Subsequently DoF replaced the preferred respondent for the metropolitan area on the basis that there were no other respondents that met all of the criteria for the contract or there were subsequent conditions that would have been difficult and time consuming to negotiate.

Table 8. Program Costs: metropolitan and south west.

Metropolitan (31 January to 30 April)	**$757,000**
South West (25 January to 30 April)	**$524,568**
Total	**$1,281,568**

The metropolitan component of the program was higher than the south west indicating that DoF was a more expensive option. However, the following should be noted:

- the DoF costs are similar to those submitted by the private contractor for the metropolitan component;
- the DoF costs include approximately $100,000 for equipment associated with the construction of the drum lines, which were used in the metropolitan and south west deployments. When the totals for each region are adjusted for the cost of the equipment the total cost of the metropolitan deployment is approximately $707,000 and the south west deployment is approximately $575,000;

- the majority of the DoF costs were for staffing arrangements noting that:
    - the metropolitan deployment operated with a crew of three and the south west with a crew of two; and
    - shift penalties, transportation costs and allowances applied to the DoF operations, whereas they did not to the south west operations; and
- the breakdown of the DoF component of the program was:
    - $152,000 Standard Hours
    - $170,000 Overtime
    - $ 17,000 Bait
    - $ 10,000 Security
    - $100,000 Equipment
    - $163,000 Fuel
    - $145,000 Operating Costs (Accommodation, Transport etc).

TOTAL $757,000

DoF already had an allocation of $262,000 in its budget for staffing and vessel operations that were directly applied to this program, leaving a balance of $495,000. It is intended that these funds will be sought through budget supplementation if internal reprioritisation and savings cannot be identified.

Comparisons with other programs are problematic because no two programs are the same, different procurement and delivery strategies are employed, in some cases labour costs will vary because of jurisdictional issues and there may also be different legal, health, safety and environmental requirements. With this strong qualification, the following approximate costs of three other programs are provided for context, not comparison.

The Queensland net and drum line program runs throughout the year, with drum lines inspected 20 days each month. Total costs are approximately $2.7 million per annum.

The New South Wales beach netting program runs for eight months of the year, with inspections every two to three days, and the cost is approximately $1.6 million per annum.

The Kwazulu-Natal Sharks Board net and drum line program (deployment, monitoring, and maintenance) involves 120 people, 15 boats, 19 vehicles, four Zodiacs, a two engine plane, 11 base stations and a headquarters for a cost of 32 million Rand per annum. The total program cost (with the addition of research, community education, schools program, information, and administration) is $53 million Rand per annum for a workforce of 270.

7. ADDRESSING THE CRITICISMS OF THE PROGRAM

The following is a summary of the main criticisms directed at the Government's drum line deployment from the over 286,000 emails and letters DPC received, and from a significant subset of the over 1,100 radio news bulletins, over 850 talkback comments, over 290 television news items and 765 newspaper articles generated on sharks between 10 December 2013 and early May 2014.

1. The level of risk of shark attack is low compared to other activities

Despite 20 fatal shark attacks in the last 100 years in Western Australia the trend is towards an increasing risk of attacks with 10 of the recorded fatalities occurring in the past 10 years and seven of those in the last three and a half years.

It is acknowledged that the risk of a shark attack and/or fatality is rare, and considerably less when compared to road trauma, drowning and other activities that result in loss of human life. However this argument ignores recent research that indicates an increase in unprovoked shark attacks (McPhee 2014); an undeniable spike in shark attacks in Western Australia; and considerable funding and strategies to mitigate against other activities that lead to loss of human life (e.g. road safety campaigns, swimming lessons, legislation and standards regarding pool fencing).

The national data shows three species to have been responsible for fatalities in Australia over the past 20 years; the white shark, bull shark and tiger shark (West 2011).

Although a study by DoF showed that swimmers close to the shore are at less risk than water users at a greater distance from the beach (FOP 109 2012), the disappearance of a swimmer at Cottesloe in 2011 and the fatal attack at North Cottesloe in 2000 substantiate the objective of minimising the potential for dangerous sharks to come into close proximity of popular swimming and surfing areas.

2. The drum line program was introduced without adequate research or consultation

As part of the development of the program input was sought from more than 40 stakeholders including scientists at DoF, academe, water user groups and managers of shark control programs in other jurisdictions.

The program was introduced following a risk assessment prepared by DoF that concluded that the drum line program posed only negligible risks to the target shark species, most non-target species and the broader ecosystem. A significant factor in this determination was the mitigation measures associated with the program, including the large size circle hook, and limited spatial and temporal scale of the deployment.

Drum line locations were selected in close consultation with Surf Life Saving WA and with consideration of beach attendance statistics and patrol times. Surfing WA and local recreational water users were also consulted to identify popular surfing spots in the south west region.

Interestingly, there is interest shown by the shark control programs at Reunion Island and Durban on the use of the hooks in the Western Australian program which are shown to have a much lower rate of bycatch than the programs at both of these other locations. This in part is recognition of the level of investigation and planning that went into the Western Australian program and the focus on minimising environmental impacts, both of

which are recognised by programs that have been operating outside of Australia and for considerably longer periods of time.

In summary:

- The program was a response to an unprecedented number of shark fatalities off the Western Australian Coast (10 in 10 years, compared to 10 in the previous 90 years) – recent research by McPhee (2014) supports that the number of unprovoked shark attacks has increased.
- Shark mitigation programs are also in place in New South Wales, Queensland and South Africa, with two employing a combination of drum lines and nets, and all three successful in reducing the number of shark fatalities. Some critics have referred to drum lines as 'old technology'; however they are used in Queensland and South Africa, and in combination with long lines in Recife Brazil. Further, after recent successful trials, some nets in the Queensland and South African programs are being replaced with drum lines because they reduce incidents of by-catch.
- The program has identified white, tiger and bull sharks as those to be caught and destroyed with critics noting that fatalities in Western Australia have predominantly been the result of white sharks. While this may be true, recent research confirms white, tiger and bull sharks to be responsible for the majority of unprovoked shark attacks around the world (McPhee 2014). At Recife in Brazil, tiger sharks are responsible for the majority of the shark attacks and at Reunion Island, bull sharks are responsible for a high percentage of shark attacks. In addition, the presence of so many tiger sharks of metropolitan and south west waters (more than previously predicted) is surprising and has caused some concern, especially as the largest shark caught in the program was a 4.5 metre tiger shark off a popular swimming beach in Perth.
- Considerable research and consultation went into the design of the drum lines and the monitoring schedule. The size and shape of hook was significant in minimising non shark by-catch (something that is prevalent in other programs) and increasing the chance of survival of animals caught. Deployment of the lines was outside the whale migration season so as to minimise the risk of entanglement (as a consequence white sharks which are assumed to follow whale migrations were not caught and this was seen as a failure of the program – see section on white sharks). Hooks were placed at least two metres below the surface of the water to minimise the risk of interactions with sea birds and lines were monitored daily to improve the chances of successful release of non-target species. Finally, drum lines were chosen ahead of nets based on the experience of other jurisdictions which indicated that nets were far less discriminating in what they caught.

3. Abrogation of duties and responsibilities under national and international conservation instruments.

The Western Australian Government obtained the necessary exemptions required under State and Commonwealth legislation prior to the commencement of the drum line program. The processes taken in obtaining the exemptions have been tested at law. Following a legal challenge by Sea Shepherd the Supreme Court of Western Australia ruled that the exemptions made under the FRMA were valid.

An exemption was granted under s 158 of the EPBC Act on the grounds that impacts on public safety and the economy are considered matters of national interest. In granting the exemption, the Commonwealth Minister for the Environment acknowledged the Western Australian Government's investment into non-lethal shark deterrents and commitment to ongoing scientific research.

The Commonwealth Minister for the Environment also considered the measures committed to by the Western Australian Government in its approach to the drum line program, including the use of a large hook size for reducing metropolitan by-catch, the depth below water at which the hooks are set to avoid interaction with sea birds, the timing of the program to avoid interaction with whale migrations, and a requirement for daily patrols of the drum lines to improve the chance of successful release of. The Western Australian Government has referred the continuation of the drum line program to the Commonwealth for consideration under the EPBC Act.

While white sharks are listed for protection it is considered the Western Australian drum line program will not have a significant impact on white shark population levels. Following scientific advice and examination of catch data from the program, the EPA determined that, based on the limited timeframe and geographic scale, the program was unlikely to have a significant impact on the environment, and therefore an environmental assessment was not warranted (EPA 2014).

In 2005 the Threatened Species Scientific Committee (the committee) examined the case for listing the New South Wales and Queensland shark control programs as a Key Threatening Process (KTP) under the EPBC Act. The committee investigated potential impacts of the programs on a number of species at risk, including white sharks. Advice to the former Minister for Environment and Heritage from the committee recommended that the programs not be listed as a KTP in the EPBC Act as they did not constitute an increased risk of population decline to species at risk (DoE 2005).

Given that the Western Australian program is over a much more limited spatial scale than either of the programs in the eastern states, and based on the findings of the committee in its review of the impact of those programs on white sharks, the Western Australian drum line program is not considered to constitute a threat to white sharks.

Five shortfin mako sharks were caught during the program, one was released and four were dead upon gear retrieval. It has been commented that mako sharks are a protected species. Mako sharks are listed as a migratory species under Appendix II of the international *Convention on the Conservation of Migratory Species of Wild Animals.* Consequently they are listed as a migratory species under the EPBC Act and therefore afforded protection in Commonwealth waters. The drum line program occurs in State waters, in which there are presently no concerns for the Western Australian population of mako sharks and as such no protected status under State legislation.

4. As the program did not capture a white shark it did not reduce the risk of attack

This criticism assumes that the program set out to catch a specific number of white, tiger and bull sharks, or that because the majority of shark fatalities in Western Australia are attributed to white sharks, not catching one means that the program failed.

What is being confused and possibly ignored is that the identification of targeted species for the program was a strategy to minimise environmental impacts by clearly identifying which sharks will be destroyed and which will not - some other shark mitigation programs are not so discerning. More importantly, the policy objective of the drum line program has been public safety, not catching a specific number of sharks.

The 2014 drum line program was in place for 14 weeks and at a time when there are assumed to be lower numbers of white sharks in the area. In the future it is planned that the program will commence in mid-November. Some will still argue that even this is too

late to catch a white shark. However, what is being balanced in this public policy response is public amenity (there are fewer water users in cooler months, and a greater number in warmer months) and environmental considerations (the risk of whale entanglements is higher in cooler months because of migratory trends).

Although no white sharks were caught, 50 tiger sharks three metres or greater were captured on the drum lines. Critics note that tiger sharks have not been responsible for a shark fatality in Western Australia for at least 20 years and even then it was in the North West. What is ignored however, is that the Global Shark Attack File identifies tiger sharks as one of the three species accounting for almost all fatalities from shark attack over the last 30 years (McPhee 2014); tiger sharks are assumed to have been involved in shark attacks not resulting in death; and there are higher numbers of tiger sharks in the metropolitan and south west areas than previously predicted.

Finally, the program was designed to offer an additional degree of protection during periods of high water activity, which occur outside the whale migration season. It is not the only form of protection and ultimately no strategy will provide total protection or safety, rather it is up to individual water users to assess risks and take appropriate precautions and action.

5. Concerns about capture of non-target sharks and other species

The equipment used in the Western Australian program is designed to minimise the capture of non-target species and smaller sharks. Drum lines are more selective than nets and greatly reduce by-catch, and for this reason the South African shark control program is selectively replacing netting with drum lines (Dudley *et al*. 1998). In addition the use of large (25/0) hooks reduces the number of smaller sharks caught. Circle hooks are fitted to the lines, as the use of these hooks has been shown to be effective in increasing post-release survival of sharks (Godin *et al.* 2012). This was an important consideration as non-target species and target sharks less than three metres are released in the Western Australian program.

Catch data for the period of deployment of the drum lines to 30 April 2014 shows that eight non-shark species were captured on the lines, a north-west blowfish and seven rays, all were caught in the metropolitan region and were either self-released or released alive.

Although a high proportion of the catch is tiger sharks less than three metres in length, recent studies of the post-release survival of tiger sharks in Brazil showed almost no mortality if released using adequate protocols, and concluded that this species seems to be resilient to the stress induced by capture (Afonso & Hazin 2014). Accordingly, as part of proposed future deployments, animal handling protocols will be improved; there will be mandatory requirements including for a ramp apparatus; the flow of sea water over the gills of a captured animal will be increased; and other strategies to reduce the stress on animals will be developed.

6. Drum lines attract sharks

Concerns have been raised that the baited drum lines may attract large sharks inshore, increasing the risk to people using these waters. Some research indicates that scents from bait can travel up to one kilometre based on water conditions and type of bait used (work by Gilbert & Hodgson 1978), whereas other research indicates that the distance over which scent is an attractant for sharks is of the order of hundreds of metres as opposed to kilometres, therefore only those sharks in the vicinity of protected beaches would be likely to be attracted to the baits (Springer & Gold 1989).

An analysis of the data from the recent drum line program shows that tagged sharks were in close proximity to baited drum lines, yet not one tagged shark was caught on a drum line. While the number of incidences of a tagged shark setting off an acoustic receiver in close proximity to a drum line was small, the indications are that drum lines do not necessarily attract sharks.

It should be noted that in order to reduce the environmental impact of their shark control programs, authorities in Queensland and South Africa are replacing nets with drum lines. South Africa has replaced approximately four kilometres of nets with 76 drum lines (Cliff & Dudley 2011) and Queensland now has approximately 366 drum lines in place (Queensland DPI 2006). There is no evidence from either of these programs, or the drum line program in Recife, Brazil that drum lines attract sharks.

Feedback from the shark control program in South Africa is that the amount of bait used on drum lines is a significantly small component of the total bait thrown into the ocean by onshore anglers at swimming beaches in and around Durban. Neither the bait on the drum lines nor the bait used by anglers is considered an attractant to sharks. This is confirmed also in recent work undertaken at Reunion Island where it was concluded that bait did not necessarily attract sharks.

7. Impacts on our oceans and key industries

There have been claims that the Western Australian Government did not consider the environmental or commercial costs of the program against the perceived benefit. In recent years Western Australia has experienced an unprecedented number of fatalities from shark attacks. In addition to the cost to individuals and their families, these attacks have led a large proportion of the population to reconsider their water use and have raised concerns about the state as a destination for water based tourism.

It is acknowledged that some species of shark are migratory and therefore the impact of a drum line program may extend beyond its geographical deployment, however what is ignored are the steps taken by the program to minimise environmental impacts, and based on the analysis of the current data there appear to be no significant impacts on shark population numbers - noting of course that further research and analysis is required in order to reach a more definitive position.

Concerns about the potential for the drum line program to capture dusky sharks and therefore impact on commercial operations appear - based on the current data - to be unfounded. One dusky shark was caught in the trial and it was released alive.

8. Pre-emptive killing of white sharks that have posed no risk is illogical

Queensland, South Africa and Brazil employ drum lines to reduce the risk of shark attack by fishing for potentially dangerous sharks that come into close proximity of a protected beach. In Queensland there has been only one fatal attack at a protected beach in 44 years of operation (Queensland DPI 2006).

Only three shark species are considered to have been responsible for fatal attacks over the past 20 years in Australia. These are the white shark, the bull shark, and the tiger shark (West 2011). Of the 20 fatal shark attacks in Western Australia in the last 100 years white sharks have been confirmed as responsible for 11, and are considered most likely to be responsible for a further two. Tiger sharks have been confirmed as responsible for two of the 20 fatalities and are considered most likely to be responsible for a further three (see

Appendix 1). A bull shark is considered most likely to be responsible for one fatality. In all cases where a size has been recorded, the shark has been three metres or greater in length.

9. Failure to provide adequate management of contractors

To ensure that the contractor undertaking the drum lining activities complied with contractual, permit and legislative requirements and conditions, 12 observer trips were undertaken between 25 January and 30 April. The observer's role was to observe the performance of the contractor and ensure contractual and legislative conditions were being met. Observers were officers from DoF, DPaW, DPC and WorkSafe.

Meetings between the contractor and contract manager were also held to ensure clear lines of communication and understanding of all contract requirements prior to the operational phase of the program. Post-operational meetings were also held in early May following the completion of the program.

10. Alternatives exist to the capture and destruction of sharks

a) Capture and translocation – Brazil

A number of jurisdictions have undertaken to release all sharks considered to be in a condition to survive, including potentially dangerous species. The Western Australian Government considered the approach of a 'catch and release' program, however concluded it to be inappropriate for dealing with captured sharks in Western Australia. Although data from tagged tiger sharks released in Brazil shows that the animals remain at a distance from the coast for a period of time (Afonso & Hazin 2014), there is also evidence that they return to other coastal areas. In considering public safety, determining acceptable release locations for potentially dangerous sharks is challenging and presents additional public liability risks. Moreover, transporting large sharks offshore is logistically difficult, with the additional stress placed on the animals from extended transport likely to lead to either mortality of sharks in transit, or decreased chance of post-release survival.

With regard to the program undertaken in Recife, Brazil there was a significant decrease in shark attacks following the implementation of their shark control program, however in addition to drum lines the Recife program relied on extensive use of long lines (Hazin & Afonso 2013) with approximately 300,000 hooks deployed to cover a 15 kilometre coastline, for which 60% of the catch was non shark and there was a total mortality rate of between 22% and 25% (Hazin 2014). Surfing was also banned in the area which is likely to have had some impact on the reported decline in shark attacks. The Western Australian Government has no desire to deploy long lines near areas of the coastline, and is equally unlikely to ban surfing off metropolitan and south west beaches.

Worth noting also is some recent research by Holmes (2014) which found that most of the 18 tiger sharks caught and released relocated to deeper waters, but often only for a week or so before returning to their 'normal' movement behaviour. While we must be cautious in using and interpreting research because conditions vary across jurisdictions, this research at least suggests the possibility that tiger sharks released offshore will not remain offshore.

Shark spotters

Shark Spotters is a 2.5 million Rand per annum program that uses 26 people at eight beaches in five hour shifts observing white sharks from cliff and hill tops of between 50 – 100 metres. It is a specific response to a specific issue in a specific location. The topography of the land lends itself to observing white sharks which swim close to the surface, in an area that has previously had a high number of white shark attacks. The key

point of the spotter program is the elevated position, made possible by the topography of the coastline in the area. The Western Australian coastline is largely unsuitable for this kind of surveillance opportunity, noting as well that it has a very limited coverage and is resource intensive.

In addressing the need for beach patrols and surveillance the Western Australian Government has invested:

- over $2 million in aerial surveillance contracted through Surf Life Saving WA;
- construction of a watchtower at the popular Cottesloe beach; and
- research into acoustic and sonar detection systems.

b) Personal shark protection
The Western Australian Government has provided $300,000 to SharkShield to develop a new electronic deterrent for surfboards, as the current device limits the manoeuvrability of surfboards. The new device will work through the fins on surfboards and should be suitable for installation on any board.

The SharkShield company also produces a device for divers, however as the device emits an electronic field, it is not suitable for use at swimming beaches. Consequently, funding has been provided to researchers to test other electronic deterrents for use on swimming beaches with a view to finding ways to improve their effectiveness.

c) Research into shark behaviours
The Western Australian Government is supporting research into shark behaviour through research at DoF and a funding program for external researchers.

Over $2 million has been invested to use animal tracking technology to monitor shark movements in Western Australia through the DoF Shark Monitoring Network. As part of the program:

- fisheries researchers fit acoustic tags to target shark species enabling individual sharks to be identified when the acoustic signal emitted by the tag is detected by a receiver located either on the ocean floor or attached to a mooring;
- the receiver network comprises 250 data recording and 24 satellite-linked real-time reporting devices;
- as at March 2014 over 350 sharks had been tagged since the program commenced in 2009, including more than 140 white sharks, 200 whaler sharks and 20 tiger sharks; and
- the satellite linked receivers have generated almost 700 detection alerts from which numerous beach closures have been instigated, contributing to Western Australian beach users' safety since 2009.

The Government has also invested $2 million in an applied research program with grants of up to $300,000 over a period of up three years provided to Western Australian-based organisations including universities, research institutes and industry. The applied research programs are focusing on developing systems to detect and deter potentially dangerous sharks. The following projects have been funded:

- sonar imaging and detection of sharks;
- advanced vision system for automatic shark detection and tracking;
- development and testing of a low impact acoustic-based shark detection system;

- development and testing of novel shark deterrents;
- testing and enhancement of existing shark deterrents;
- integrated surfboard electronic shark deterrent to protect surfers (SharkShield);
- characterisation and masking of acoustic signatures of beach-goers that may attract sharks; and
- discovering the sensory cues that trigger shark attacks.

More information on these research projects is at Appendix 3 Table A2.

d) Beach Enclosures
Beach enclosures provide a physical barrier that prevents sharks from entering an area without killing the sharks or other marine life.

Following a study on the feasibility of beach enclosures, the Western Australian Government provided $165,370 to the City of Busselton to construct a trial enclosure. In January 2014 an enclosure at Old Dunsborough was constructed in the State's south west. The enclosure extends approximately 100 metres from the shore, runs parallel with the beach for 300 metres, and is constructed from heavy gauge netting. The specifications for the enclosure are similar to the barriers used successfully on the Gold Coast in Queensland and are designed to prevent sharks from entering the area.

Enclosures are most effective at low energy beaches and are therefore not suited to all coastal environments. The enclosure remained in place until the end of April 2014. Following removal of the barrier the Council will provide the Government with a report on:

- the logistics of the deployment i.e. how long the enclosure takes to deploy and retrieve, what damage the enclosure incurred through storms, wave action and accident;
- cost effectiveness i.e. the actual cost versus budgeted costs for enclosure establishment and operation;
- the public and social benefits i.e. the number of swimmers at the enclosure location and at a radius 150 metres of the enclosure pre and post enclosure deployment, the number and types of submission to the Council or Council Officers including complaints, compliments and suggestions; and
- the environmental impact of the enclosure i.e. water quality within and beyond the enclosure, tidal patterns, beach condition, weed build up and beach topography.

Initial feedback from the City of Busselton and beachgoers has been positive. Pending the outcome of the review, additional suitable areas for enclosures along the Western Australian coastline may be identified.

The Eco Shark Barrier company constructed a beach enclosure at Coogee Beach in December 2013 for a three month trial. The construction cost of the structure was in the order of $250,000. The 300-metre wide enclosure stretches 73 metres out into the water is made of interlocking cross connectors constructed out of stretchable and durable engineering polymer and is held in place by a series of anchors and buoys.

On 8 May 2014, the City of Cockburn approved a recommendation to lease the Eco Shark barrier for a further three years.

e) Public education campaigns
The Government's shark education program is a facet of the policy that will see Western Australians accessing more facts about sharks and other hazard mitigation measures. The

SharkSmart website (www.sharksmart.com.au) provides advice to swimmers and other water users on how to minimise their risk when entering the ocean, as well as providing information on current research initiatives, how to report shark sightings and information on common shark species found off the Western Australian coast.

11. The program is not based on science

The program is a response to an increase in shark related fatalities; is based on successful drum line programs in Queensland and South Africa; carefully considered a number of strategies to minimise by-catch which based on the trail implemented and catches in other jurisdictions proved to be effective; and targets the three most aggressive species of shark in the world as identified by scientific research.

It should be noted too that the science and data don't always agree. Some of the researchers consulted in this review identified tiger sharks as scavengers and very unlikely to attack humans which is totally at odds with the experience in other jurisdictions, most notably Recife, Brazil where tiger sharks account for the greatest percentage of shark attacks in that area.

The science indicates that fatal shark attacks are infrequent, and in Western Australia they are predominantly made by white sharks. However, science also cites the white, tiger and bull shark as responsible for most shark attacks, and the data show that the number of unprovoked attacks is rising. Incorporating scientific evidence into public policy is complex, but science alone will not provide the basis for the development of public policy, rather it informs public policy.

12. The policy is environmentally irresponsible

The drum line program has been carefully designed to minimise environmental impacts, and arguably to a greater extent than shark mitigation strategies in Queensland, New South Wales and South Africa. In summary:

- a small number of drum lines are used, over a small geographical area and for a much more limited period;
- drum lines are used in preference to nets which have far higher rates of catch and by-catch;
- only three species of shark are targeted;
- large hooks are used as one strategy to minimise by-catch;
- circle type hooks are used as these have been shown to increase survival rates;
- hooks are placed two metres below the surface of the water to mitigate against capture of sea birds; and
- drum lines are patrolled more frequently to improve survival rate of non-target species.

Interestingly, much of the early criticism of the drum line program was on the basis that dolphins, seals, turtles, birds and whales would be caught (as at 14 May, 2014 the Conservation Council of WA's website still claimed that the drum lines would kill other marine life including turtles and dolphins). What are ignored are the steps the Government took to mitigate these captures and the fact that in the trial completed on 30 April 2014 not one dolphin, seal, turtle, bird or whale was captured.

13. The policy is ill-defined and a knee jerk reaction

The drum line program is part of a muti-faceted shark hazard mitigation strategy put in place by the Government over the past several years. The overall strategy includes a

broad range of initiatives, many of which are cited by critics as alternatives, but ignored as already being in place.

The drum line program is a public policy response that has been construed by some as a cull or a program to kill sharks. However the simple, undeniable and often stated objective of the policy is public safety, something that some critics refuse to accept as a valid or appropriate objective.

8. COMPARISON OF SHARK CONTROL PROGRAMS

A number of shark control programs operate both nationally and internationally. Many factors make direct comparison of programs difficult, including differing environmental and oceanographic conditions, variations in shark species, populations and behaviours and levels of beach usage. Assumptions that a strategy implemented in one jurisdiction may be successful in a different location or jurisdiction should therefore be made with caution. However, cross-jurisdictional collaboration is still considered worthy of investment. Knowledge and experience gathered from shark control programs around the world should be shared with the aim of minimising the environmental impacts, and maximising the effectiveness, of all programs.

Western Australia

The Western Australian program operated over the summer months between January and April 2014. The program deployed up to 60 drum lines each with a customised 25/0 circle hook. The lines were set approximately one kilometre offshore in designated MMAs in the metropolitan and south west areas. The hooks were baited in the morning and as needed during the course of the day. The drum lines were monitored from 6am and 6pm, seven days a week for the duration of the program. The program targeted white sharks, tiger sharks and bull sharks, three metres or longer in length. A proposal to implement drum lines for a further three years was referred to DoE and the EPA in early April 2014.

Queensland

The Queensland program commenced in 1962 and deploys a combination of approximately 366 drum lines and 6.5kms of nets along 85 beaches with gear deployed year round. The drum lines are equipped with 14/0 or 16/0 J hooks (often baited with shark) and are serviced every second day. A number of beaches are protected solely by drum lines. There has only been one fatality in Queensland at protected beaches since the program began (Queensland DPI 2006). Sharks targeted under the Queensland program are bull whaler sharks, tiger sharks, “other whaler sharks”, great white sharks and hammerhead sharks (Queensland DPI 2006).

New South Wales

The New South Wales Government has operated a program of netting beaches for the protection of swimmers and surfers against shark attack since 1937. A total of 51 beaches from Wollongong to Newcastle are netted with up to 7.65kms of nets between 1 September and 30 April each year. Contractors are required to set and check nets each weekend day and for nine weekdays per month. The program has been effective in reducing shark attacks with only one fatality on a netted beach since the program began (Green *et al.* 2009). The use of netting in this program precludes the targeting of specific species.

South Africa

In 1952 seven gill nets were deployed along the Durban beachfront. The Natal Sharks Board was established in 1962 and is now responsible for shark control in the province of KwaZulu-Natal. The program uses a combination of 23.4kms of nets and 79 drum lines (as at June 2014). The drum lines utilise 14/0 or 16/0 J hooks baited with catch from commercial fisheries. On average the gear is checked 20 times per month (Monday to Friday). Most beaches are protected either by two nets or one net and four drum lines. The program runs all year, with the exception of the annual sardine run when equipment south of Durban is removed between June and July (Cliff & Dudley 2011). The program has

reduced the number of attacks per annum by over 90% (Curtis *et al.* 2012). The operations component of the program (deployment, monitoring, management and maintenance of nets and drum lines) employs 120 people and uses 19 boats, four zodiacs, 15 vehicles and a two engine plane. In addition to the headquarters in Durban there are 11 separate base stations at which boats are stored, equipment maintained in fully equipped workshops and bait held in sea container freezers.

Recife Brazil

The Shark Monitoring Program of Recife in Brazil commenced in May 2004 and is still operating. The program uses a combination of long lines and drum lines. Long lines were composed of a four kilometre line fitted with 100 hooks. Drum lines were fitted with 9/0 J hooks and 17/0 circle hooks,[3] and fished continuously from Fridays through to Tuesdays on a weekly basis (Hazin & Afonso 2013). The program targets a series of contiguous beaches along a 20km stretch of coastline. The drum lines are checked and re-baited each day during the fishing operations. Between 2004 and December 2011 a study showed that the shark attack rate diminished by about 97% during the period of the program (Hazin & Afonso 2013). It should also be noted that surfing was banned in the Recife area, which may also have had something to do with the diminished shark attack rate.

New Zealand

Beaches at Dunedin in New Zealand were netted between 1969 and 2011. The program commenced following four shark attacks between 1964 and 1968 (three fatal) (Dudley & Gribble 1999). In the latter stages of the program two nets were set permanently at three beaches between December and February. Each net was approximately 100 metres long and 5.5 metres deep. The nets were inspected three times a week (Francis 1998). There was one attack at a nearby beach in 1973 but no further attacks have been recorded since 1973. White sharks were targeted in the program. Community opposition to the cost of the netting program and by-catch led to cessation of the program.

Hong Kong

Following three fatal attacks in 10 days, barrier nets were trialled and subsequently installed at 17 beaches. These nets use similar material to aquaculture cages and act to form a barrier preventing the entry of sharks to beaches. The nets remain in the water for an average of nine months each year and can only be installed at low energy beaches. The cost of initial installation is high, with ongoing maintenance of the enclosures proving somewhat problematic (Green *et al*. 2009). No individual species is targeted in Hong Kong.

Hawaii

There were seven shark control programs in Hawaii between 1959 and 1995, with no impact on the number of attacks. These programs employed long lines in localised programs targeting tiger sharks. The programs were suspended when it became clear that tiger sharks, which were responsible for the majority of attacks, spent long periods beyond the catch zones.

La Réunion

In 2013 following five fatalities since 2011 the authorities in La Réunion initiated a program to kill 90 sharks in addition to 24 already killed (Huffington Post 2013). The program

[3] Both J and circle hooks were used on a trial basis until May 2006 when circle hooks were adopted exclusively for the duration of the program.

targets tiger and bull sharks and takes place in the areas where the fatal attacks occurred. Currently size 14/0 circle hooks are used, and the program has registered interest in sourcing the larger approximately size 25 circle hooks used in Western Australia because of their effectiveness in reducing bycatch.

Key points from comparison with other jurisdictions

- As stated earlier, direct comparisons between programs are difficult because different populations, species, habitats and areas exist. However, a program in place for some time may be considered mature and possibly result in lower targeted and by-catch species.
- The results of measures taken to reduce by-catch in Western Australia compare favourably with other jurisdictions. There is a close correlation between the use of nets and long lines and increased by-catch of non-shark species. Table 9 shows that the decision to base the Western Australian program on the exclusive use of drum lines, and measures taken to minimise environmental impacts, have been effective in reducing by-catch of non-shark species. These benefits have not been acknowledged by opponents of the program.
- Compared to the current programs in the other States, South Africa and Brazil the Western Australian program is more limited in scope in terms of the period of deployment and the catch effort.
- Unlike the situation in other jurisdictions, the Western Australian program does not attempt to reduce the overall population of a species in the area at risk. The program is targeted at dangerous sharks moving into areas of high use. Even though a relatively high number of tiger sharks have been caught in the Western Australian program, compared to some jurisdictions, the program is deployed at the southern boundary of the species habitat and DoF researchers are confident that the impact on population levels has been negligible.

Table 9 provides a comparison of catch data between jurisdictions employing shark control programs.

Table 9. Presentation of catch data from other jurisdictions

Shark Control Programs[4] Catch Data Presentation [5]			
Sharks	Other Species	Total	Publication
Western Australia (25 Jan 2013-30 April 2014)			
172 (no white sharks)	1 NW Blowfish 7 Rays	172 Sharks 8 non shark species	Data was published on three occasions over the 14 weeks of the trial.
Queensland[6] (2013 catch data)			
686 (6 white sharks)	Not published	686 sharks	Shark catch data published monthly. No publication of by-catch.
New South Wales[7] (2012-13 catch data)			
70 (6 white sharks)	34 Rays 2 Turtles 2 Humpback whales	70 Sharks 38 non shark species	All catch data reported in the Annual Review Report which is released to the public.
South Africa[8] (2006-2010 average annual catch)			
590 (28 white sharks-average p.a.)	35 Dolphins 8 Whales 211 Rays 4 Birds 27 Fish	590 sharks 285 non shark species	Data is published regularly.
Brazil[9] (total catch May 2004-December 2011)			
353 (no white sharks)	600 Fish 9 Turtles	353 Sharks 609 non shark species	Program data not released outside academic studies.

[4] The type and extent of fishing gear is different for each jurisdiction and will determine the range of species and number of individuals caught.

[5] A set of uniform statistics for any one year is not available. Hence caution should be taken in directly comparing the catch data presented.

[6] 2013 Catch data figures: Source. Queensland DPI: NB Queensland program operates all year.

[7] 2012-13 Catch data figures: Nets in water 1 September – 30 April. Source: Shark Meshing (Bather Protection) 2012-13

[8] Annual Average Catch 2006-2010. Source: Kwa-Zulu Natal Sharks Board at http://www.shark.co.za/CatchStatistics

[9] Only the total catch data is available from May 2004 to December 2011. It should be noted that over this period fishing was suspended on several occasions due to budget constraints. The target species were tiger and bull sharks – no white sharks were captured. Source: Hazin and Afonso, 2013.

Reducing the environmental impact of shark control programs

Across these jurisdictions, a number of approaches have been taken to reduce the capture of non-target species and the survival of captured non-target animals. These initiatives include:

- The use of acoustic pingers to reduce the capture of dolphins and whales in nets. These devices have reduced dolphin catches in New South Wales (Green *et al*. 2009) however results in Queensland are currently inconclusive. The devices do not appear to reduce dolphin catches in nets in South Africa (Cliff & Dudley 2011).
- Replacing nets with drum lines. A trial deployment of drum lines in Kwazulu-Natal, confirmed drum lines to be a far more selective shark control measure than nets (Cliff & Dudley 2011). This trend led the Western Australian Government to reject nets as an option in an effort to minimise environmental impacts.
- The use of circle hooks in place of J hooks. Numerous studies have shown the use of circle hooks to decrease on board mortality of non-target animals and increase post release survival compared to the use of J hooks (Godin *et al.* 2012). For this reason the Western Australian and Brazilian programs have committed to the use of circle hooks. In addition the Western Australian Government committed to the use of a large 25/0 circle hook to further reduce the potential for catching small sharks and other non-target species.
- Removing equipment during times of high probability of capture or entanglement of non-target species. The Kwazulu-Natal program removes gear from certain beaches during the annual sardine run, which attracts large predators. The Western Australian program ceased during the annual period of whale migration between May and October.
- High frequency of monitoring. The frequency of monitoring of equipment is an important factor in the survival of non-target species. For this reason the Western Australian drum lines were monitored from 6am to 6pm, seven days a week for the duration of their deployment.

9. WATER EVENTS AND ACTIVITIES

Water events

During the deployment of the drum line strategy from 25 January to 30 April 2014, three significant water events took place in the Metropolitan and south west areas in the vicinity of drum line deployments. Drum lines were removed for one of these events, but not the other two.

Rottnest Island Channel Swim 14 February 2014
In 2014 the Rottnest Island Channel swim attracted over 2,000 competitors. In response to queries from competitors the event organisers requested that drum lines be removed for one week prior to the event on the basis of anecdotal evidence that the drum lines attracted sharks. In discussions with event organisers it was noted that in Queensland where baited drum lines are used in the vicinity of surf events, the drum lines stay in the water and organisers plan their routes 200 metres away from them. Nonetheless organisers of the Rottnest Channel Swim were anxious about the competitors' perceptions. In response the Government removed drum lines at Cottesloe and North Cottesloe five days prior to the event day. This decision was based on the drum line program being a new phenomenon in metropolitan waters which naturally made swimmers anxious, and anecdotal evidence about the attraction of sharks to drum lines.

Some research indicates that scents from bait can travel up to one kilometre based on water conditions and type of bait used (work by Gilbert & Hodgson 1978), whereas other research indicates that the distance over which scent is an attractant for sharks is of the order of hundreds of metres as opposed to kilometres, therefore only those sharks in the vicinity of protected beaches would be likely to be attracted to the baits (Springer & Gold 1989). In South Africa drum lines are replacing nets and in Queensland a number of beaches are protected by drum lines alone. Both programs have a long standing record of success in protecting beach users and would not deploy drum lines in proximity to beaches if there was evidence that they attracted sharks to the area.

In 2015 the Government will discuss again with the organisers of the Rottnest Island Channel swim their requirements regarding the removal of drum lines (pending environmental approval). Separate to this, it is likely that all drum lines will be removed the day before the event, primarily to avoid damage to the lines caused by the large number of vessels on the water during the day. During the 2014 event two drum lines were accidently damaged by water craft and subsequently retrieved.

Australian Surf Life Saving Championships 31 March – 6 April 2014
Over 5,000 individuals competed in the Australian Surf Life Saving Championships conducted at Scarborough beach from 31 March to 6 April 2014. Organisers of the event did not make a request to have drum lines at Scarborough or nearby beaches removed, therefore the drum lines remained in place. No incidents or interactions between competitors and the drum lines were reported or recorded during the event.

Margaret River Pro 2 – 13 April 2014
Approximately 50 of ranked men and women surfers in the world participated in the Drug Aware Margaret River Pro from 2 to 13 April 2014. The presence of prominent surfers attracted large numbers of amateur surfers to surf breaks around Margaret River at the time of the event. Organisers of the event did not make a request to have drum lines at

any beaches removed, therefore they remained in place. No incidents or interactions between competitors or recreational surfers and the drum lines were reported or recorded during the event.

Dive operations

In late January a dive operator in the south west region advised of potential legal action if drum lines were placed within certain distances of dive trails and wrecks. The operator was advised that based on the experience of drum lines in Queensland:[10]

- the "Scottish Prince" ship wreck has five drum lines in close proximity, with the nearest being 120m away and they have been in place for 17 years; during that time there appear to have been no issues with divers/sharks and the positioning of the gear;
- a snorkel trail in Nelly Bay has nine drum lines placed in the bay;
- a wreck dive site at Picnic Bay has five drum lines placed in the bay;
- a wreck site and snorkel trail in Geoffrey Bay has 15 drum lines either side of the trail in an approximate 0.5 nautical mile radius;
- there are 42 drum lines around Magnetic Island which has extensive boating, swimming, diving, snorkelling, jet skiing and fishing activities all year; and
- there are eight drum lines located just off Bagara where there is a reef dive site accessible from the boat ramp that extends one kilometre off shore.

Consideration was given to the location of the drum lines in the proximity of the south west dive site wreck, however it was concluded they were of a sufficient distance from the wreck (minimum of 0.5 nautical miles) to not warrant removal.

[10] Source Queensland Department of Agriculture, Fisheries and Forestry at http://www.daff.qld.gov.au/fisheries/services/shark-control-program/shark-control-equipment-and-locations

10. RESEARCH

In consultation with local research institutions, it is considered desirable to facilitate access to carcasses and/or specimens of sharks which are destroyed or found dead as part of the program. The provision of access to animals would add value to existing research projects within Western Australia. Authority to consign shark carcasses or specimens to research institutions has been sought as part of the proposed action to DoE. Authority for shark researchers to conduct sampling *in-situ* on a drum lining vessel, and/or transport samples back to relevant institutions or laboratories has also been sought. The relevant permits for possession of protected species would be sought by the research institutions independently. Relevant authorisations to conduct research on protected fauna under the FRMA and the WC Act will be sought at a state level.

The trial program has provided for a greater understanding of the logistical and practical considerations and requirements of undertaking the drum lining operations and therefore an indication of the capacity of the contractor to undertake more extensive data recording. Future contractors may be required to record a greater diversity of information and based on standardisation of terminology and metrics.

This information will provide useful data for the research into western white shark population levels funded by the Australian Government's National Environmental Research Program Marine Biodiversity Hub (NERP Hub). This program is an extension of the studies on the eastern population of white sharks using aerial surveys, and DNA fingerprinting studies on juvenile white sharks. The expansion of the research to the western population is a joint NERP Hub project with CSIRO and DoF.

There is significant scope for greater research to be undertaken into understanding the species caught and using the species caught to examine related topics. Specifically there could be further analysis of data from aerial patrols and drum line catches; analysis of data from acoustic receivers; greater opportunities for acoustic tagging; greater opportunities for biological samples; and associated research. All of these activities can be undertaken by researchers external to Government, contingent on appropriate approvals being received, funding implications and logistical considerations.

Shark control programs in other parts of Australia and outside of Australia already provide data and biological samples to academics undertaking a wide range of scientific research, as such there is considerable scope for any future drum line deployment in Western Australia to incorporate a significant research component. Discussions have already commenced with the University of Western Australia about how this research can be facilitated so that it is achievable within the constraints of the program, and equitable in terms of its access to researchers other than those at the University of Western Australia.

11. RECOMMENDATIONS

Recommendations

1. Continue the drum line program for a further three years from 15 November to 30 April (period of higher ocean usage and to avoid whale migrations).

2. DPC to remain the contract manager of the program in its first year, and thereafter engage in discussions with DoF for them to become the contract manager for the remaining two years.

3. Deployment of drum lines to be similar to the 2014 trial (30 static drum lines in the metropolitan area, 30 drum lines in the south west and 12 held in reserve for temporary deployments).

4. Seek the necessary environmental approvals for the three year deployment (a proposal has been submitted to DoE and the EPA and a bilateral assessment agreed).

5. Future deployments to include improvements as follows:
   - inclusion of additional swivels on gear to reduce twisting of ropes;
   - consideration to be given to increasing the length of the hook line to allow greater freedom for captured animals and reduce stress;
   - consideration be given to replacing chain on hook line with wire trace;
   - provision of more comprehensive training for contractors in animal handling techniques, standardisation of reporting, responding to activists, safe work practices and biological sampling techniques;
   - consideration to be given to trialling different baits and techniques for attaching baits;
   - consideration to be given to the fitting of 'acoustic pingers' to deter whale and dolphin interactions and possibly line detection monitors – both of which may be achievable in the first or second year of the three year operation;
   - increasing the exclusion zone around drum lines to 100 metres and implementing a 100 metre exclusion zone around contractor vessels; and
   - reducing the size of the metropolitan and south west MMA's to more closely align with the actual locations of drum line deployment

6. Establish protocols between DoF, Department of Transport and WA Police in responding to breaches of exclusion zones and interference with gear and/or fishing operations.

7. Issue a tender for the provision of services by private contractors in June/July, but with a clear condition that commencement of services will be contingent on whether environmental approval has been given and subject to the appropriate exemption and licences being received under State legislation.

8. Pending the outcome of the evaluation of the shark enclosure in Dunsborough, give consideration to the continued funding of this enclosure in Dunsborough and several other suitable beaches.

9. Liaise with the local surfing community on placement of drum lines near surf breaks in the south west.

10. Refine and improve community information and engagement, including:
    - advertisements in relevant media to advise of drum line program and exclusion zones several weeks prior to commencement of program and at least once during the deployment;
    - development of appropriate information on the Government's overall shark hazard mitigation strategy (including drum lines) for dissemination to industry and 'water user' associations, environmental groups, 'water use' businesses such as dive, tackle and surf shops, and for inclusion on the Government, DPC and DoF websites;
    - promotion of SharkSmart website; and
    - development of fact sheets for dissemination to the media.

11. Release catch data on a monthly basis on the DoF website.

12. Meet with DoF and external researchers to negotiate additional requirements with respect to research, including but not limited to:
    - expanded reporting requirements for measurements, condition of bait, status of animal on release, and water conditions;
    - biological and tissue samples;
    - protocols for distribution and handling of specimens by researchers;
    - greater use of acoustic tags and telemetry tags on non-target sharks; and
    - possibility of a researcher being placed on one or two vessels on a regular basis.

13. Continue to add presence data for relevant species captured as part of the program to RedMap or the Atlas of Living Australia where appropriate.

14. Continue to be receptive to new technologies to complement or ultimately replace drum line deployments, but only if fully tested and viable.

15. Establish a closer working relationship with shark control programs in other jurisdictions.

16. Liaise with organisers of the Rottnest Island Swim on their requirements for the removal of drum lines.

17. Remove all metropolitan drum lines the day before the Rottnest Island Swim (and reinstall the day after the swim) to minimise the risk of damage to lines by water craft.

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13. APPENDICES

1. A summary of the 20 fatal shark attacks in Western Australian waters in the last 100 years

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Day	Month	Year	Location	Shark ID / Most Likely	Basis of ID	Victims Activity
		1916	Condon Creek – Broome (area)			Pearl Diving
27	1	1923	Swan River, Claremont	Most Likely: Bull shark	Sharks behaviour & injuries inflicted	Swimming
24	11	1923	Condon creek - Broome (area)	Most Likely: Tiger shark	Sharks behaviour, location, date, size & injuries inflicted	Shallow water - cleaning shells
24	11	1923	Condon creek - Broome (area)	Most Likely: Tiger shark	Sharks behaviour, location, date, size & injuries inflicted	Shallow water - cleaning shells
22	11	1925	Cottesloe Beach	Confirmed: Tiger shark	Shark captured	Swimming
2	2	1957	Cape Leveque	Most Likely: Tiger Shark	Sharks behaviour, size & injuries inflicted	Swimming - presumed
19	8	1967	Jurien Bay	Most Likely: White shark	Shark common to site, behaviour, size, location, time of year	Spearfishing - snorkelling
21	11	1993	Roebuck Bay, Broome	Confirmed: Tiger shark	Shark captured	Hookah diver
11	9	1995	Starvation Bay, Hopetoun	Confirmed: White shark	Witnesses report	Scuba diver
6	11	2000	Cottesloe Beach	Confirmed: White shark	Shark sighted	Swimming
10	7	2004	Margaret River, Gracetown	Confirmed: White shark	Examination of shark bite	Surfing on board
19	3	2005	Houtman Abrolhos off Geraldton	Confirmed: White shark	Witnesses report	Snorkelling
27	12	2008	Port Kennedy Beach, Perth	Confirmed: White shark	Witnesses report	Snorkelling - collecting crabs
17	8	2010	South Point Beach, Cowaramup Bay	Confirmed: White shark	Shark behaviour, size, location, time of year, injuries inflicted	Surfing on board
4	9	2011	Bunker Bay	Confirmed: White shark	Confirmed by WA fisheries investigator	Surfing on body board
10	10	2011	Cottesloe Beach	Confirmed: White shark	WA fisheries inspector report	Swimming
22	10	2011	Rottnest Island	Confirmed: White shark	Identified by witness	Scuba diver
31	3	2012	Stratham Beach, Bunbury	Most Likely: White Shark	Identified by WA fisheries officer	Scuba diver
14	7	2012	Wedge Island, north of Perth	Confirmed: White shark	Identified by WA fisheries officer	Surfing on board
23	11	2013	Umbies Break, Gracetown	Confirmed: White shark	Fisheries investigation of teeth found in victim	Surfing on board

(Source: Australian Shark Attack File, unpub. data: received February 2014)

2. Surf Life Saving WA beach attendance statistics

Surf Life Saving Patrolled Beach	2012/2013	2011/2012	2010/2011	2009/2010	2008/2009	2007/2008	2006/2007
Albany (Middleton Beach)**	44,160	47,492	44,938	53,995	280,015	21,741	8,492
Binningup*	5,572	6,901	17,153	15,370	15,612	4,718	3,215
Broome (Cable Beach)*	17,200	18,388	14,066	11,424	14,285	4,678	34,721
Busselton*	1,658	525	2,757	1,149	978	NA	NA
Champion Bay*	8,314	8,537	7,419	6,956	1,988	4,725	2,707
Bunbury*	20,749	19,777	14,761	15,902	20,509	16,739	7,652
City Beach**	566,856	300,207	343,551	404,556	236,977	227,299	207,090
Coogee*	33,820	53,175	51,201	51,366	44,497	34,916	29,645
Cottesloe**	602,683	800,041	1,032,618	737,771	603,862	352,547	329,538
Dalyellup*	3,307	4,311	2,951	19,178	1,677	101	NA
Denmark*	6,849	5,220	6,790	5,283	3,340	3,631	7,126
Dongara Denison*	10,706	10,393	8,331	14,162	5,183	12,169	932
Esperance*	5,517	5,538	4,051	5,168	2,930	3,972	2,603
Floreat**	131,253	46,635	54,236	41,165	29,491	19,884	15,419
Leighton*	158,414	144,868	117,429	193,828	266,227	241,371	80,422
Geraldton**	26,759	32,000	22,463	23,166	25,885	14,668	9,103
Mandurah (San Remo Beach)*	4,033	3,854	5,701	3,498	4,091	3,812	1,380
Mullaloo**	363,269	349,741	306,579	293,069	293,933	152,218	107,860
North Cottesloe*	50,354	39,905	41,274	35,764	51,065	39,260	25,435
Port Bouvard*	7,658	9,949	8,515	8,003	8,945	7,900	4,248
Quinns Mindarie**	62,162	51,120	61,188	48,415	41,756	21,952	9,242
Scarborough*	190,624	192,959	126,528	164,665	122,055	274,726	15,035
Secret Harbour**	290,947	195,783	175,090	128,873	99,126	73,263	23,242
Smiths Beach^	127,960	80,855	95,364	138,168	173,779	29,566	55,941
Sorrento**	154,661	114,629	135,729	121,270	143,567	50,015	40,223
Swanbourne*	14,253	7,769	18,428	3,878	3,224	4,886	4,863
Trigg Beach*	98,209	113,637	89,516	94,273	77,914	99,594	45,851
Yanchep**	110,343	110,652	141,700	123,797	108,195	25,963	19,551
Rottnest Island (The Basin)**	46,364	74,643	NA	NA	NA	NA	NA
Bunker Bay**	119,947	89,783	NA	NA	NA	NA	NA
Meelup**	175,789	135,290	NA	NA	NA	NA	NA
Yallingup**	112,409	151,109	136,059	144,398	208,510	33,282	67,731
Penguin Island^	61,143	15,663	NA	NA	NA	NA	NA
Hillary's^	227,993	107,276	124,289	131,414	79,134	39,392	49,064
Margaret River (Rivermouth)**	NA	NA	140,047	73,592	NA	NA	49,051
TOTAL	**3,861,935**	**3,348,625**	**3,210,675**	**3,039,924**	**2,968,750**	**1,818,988**	**1,208,331**
Key							
* weekends only							
** seven day a week patrols							
^ weekday patrols only							

3. Overview of the State Government's shark hazard mitigation strategy

The Western Australian Government has already committed more than $22 million over four years to 2015-16 for a broad range of shark hazard mitigation measures in direct response to the number of recent shark related fatalities.

Aerial surveillance contracted through Surf Life Saving WA (2012-2017)
In the metropolitan region, helicopter surveillance operates between Dawesville (Mandurah), Capricorn (Yanchep) and Rottnest Island. Aerial patrols operate between 6.30am and 4.30pm seven days a week between 1 September and 30 April each year. This represents approximately 221 flying days per year. In the 2012/13 season the Surf Life Saving WA metropolitan helicopter reported 123 shark sightings (Table A1).

In the south west region, helicopter surveillance operates between Bunbury and Margaret River. Aerial patrols operate between 7am and 5pm seven days a week between late November and early February, with exact dates adjusted annually in line with school and university holidays. This represents approximately 72 flying days per year. In the 2012/13 season the Surf Life Saving WA south west helicopter reported 162 shark sightings (Table A1).

Metropolitan Helicopter Surveillance (2012/13 and 2013/14):

Area:	Dawesville (Mandurah) – Capricorn (Yanchep) – Rottnest Island
Operational Range:	1 September – 30 April
Availability:	6.30am - 4.30pm daily
Frequency:	Monday – Sunday (September weekends only)
Flying Days:	221 days

South West Helicopter Surveillance (2012/13 and 2013/14):

Area:	Bunbury to Margaret River
Operational Range:	24 November – 3 February
Availability:	7.00am – 5.00pm daily
Frequency:	Monday – Sunday
Flying Days:	72 days

Since December 2008 when aerial operations commenced, the skill set and expertise of the crew is considered to have improved substantially.

Operational days, number of shark sightings and species recorded by the Surf Life Saving WA helicopter patrols in the metropolitan and south west regions for the 2012/13 and 2013/14 seasons.

2012/13		Q1 (Sep-12)	Q2 (Oct-Dec 12)	Q3 (Jan-March 13)	Q4 (Apr-Jun 13)	**Total for 2012/13**
Metro	Operational Days	10	92	90	30	222
	Shark Sightings	0	66	44	13	123
	Species	seals, whales and dolphins	Elevated Tiger shark feeding activity at Trigg (16 sharks) 19/12/12	24 of 44 were Tigers	Majority hammerheads	~10% whites
South West	Operational Days	NA	38	40	1	79
	Shark Sightings	NA	52	109	1	162
	Species	NA		6 whites, 12 hammerheads, 3 tigers, 88 unidentified	1 hammerhead	Mixed, with ~90 sharks unidentified
2013/13		Q1 (Sep-13)	Q2 (Oct-Dec 13)	Q3 (Jan-March 14)	Q4 (Apr-Jun 14)	**Total for 2013/14**
Metro	Operational Days	9	92	90		
	Shark Sightings	0	36	19		
	Species		2 white, 4 tiger, 2 bronze whaler, 3 hammerhead. Remainder unidentified	1 white, 2 tiger, 1 bronze whaler, 1 hammerhead, 14 unidentified		
South West	Operational Days	NA	39	41		
	Shark Sightings	NA	55	35		
	Species	NA	2 white, 5 tiger, 10 bronze whaler, 1 hammerhead. Remainder unidentified	2 whites, 1 tiger, 2 bronze whaler, 6 hammerhead, 25 unidentified		

Jet skis for enhanced beach patrols
In December 2012 Surf Life Saving WA was granted additional funding of $500,000 for the acquisition and implementation of additional resources to allow for extended beach patrol services through the use of jet skis. The funding provided for the acquisition of twelve new jet skis, modification to equipment, personal protective equipment, program operational costs and recruitment and training of additional operators. Jet skis operate between 6am and 10am on weekdays, and between 6am and 8am on weekends and public holidays. For the period November 2013 to February 2014 this represented 600 weekday patrol hours and 410 weekend and public holiday patrol hours.

Positive benefits to shark hazard mitigation from extended beach patrols using jet skis are already evident with jet skis spotting sharks at a number of beaches, raising the alarm and assisting in water evacuations and beach closure procedures.

Construction of a watch tower at Cottesloe beach (metropolitan region)
In January 2012 the Western Australian Premier announced a $300,000 contribution to Cottesloe Surf Life Saving Club for the construction of a watchtower at Cottesloe Beach, one of the most popular beaches in the metropolitan region of Western Australia, and site of two shark fatalities in recent years. The watchtower is due to be completed by the end of 2014.

Shark Response Unit
The Shark Response Unit at DoF was created in early 2012 and has received $3.75m over five years to 2015/16. The Unit conducts research into shark populations and movements, improves response plans and procedures, and provides advice and information to members of the public to assist them in making informed decisions when using the aquatic environment. The DoF patrol vessel *Hamelin* has also been commissioned to the Unit to improve the management of shark hazards and carry out important shark research and tagging activities along the Western Australian coast.

The Unit promotes the importance of reporting shark sightings to the Western Australian Water Police and assists in the development and coordination of the communication and response processes that follow. Information from sightings and tagged shark detections is made available to the public on websites and Twitter, and by SMS to response agencies allowing beaches to be closed where possible. The Unit assists with coordination and response to incidents, heightened alerts, certain types of shark attacks and sharks considered an imminent threat.

Several legislative amendments have been made to prohibit activities that may change the behaviour of sharks and attract sharks to major tourist or population areas. Dedicated shark tourism, such as commercial cage diving is now banned under the *Fish Resources Management Regulations 1995* (FRMR) (R.128OA). A ban on the use of mammal and bird offal and blood for berley for the purposes of attracting sharks has also been put in place under the FRMR.

The Unit has commenced a four year community engagement strategy to explore the use of community-based programs to contribute to public safety along the Western Australian coast. An extensive survey of community views on sharks, and preferred means of communicating about shark hazard, has been completed. Two major outcomes include a

shark specific website, and a mobile phone app. to provide up to date information on the latest sightings.

The recently launched SharkSmart website www.sharksmart.com.au is designed to give detailed, accurate information for those interested in, or concerned about, sharks near beaches. Information on the site includes:

- advice on what to do if a person spots a shark;
- how to reduce the chance of encountering a shark;
- details of the Western Australian Government's shark research and hazard mitigation initiatives;
- latest research outcomes, including long term shark monitoring data and videos that reveal the travel patterns of 29 tagged sharks in Western Australian waters;
- the latest research on shark behaviour; and
- information on the biology of sharks found in local waters.

The BeachSafe mobile app. is a quick ready reference for beachgoers. The Western Australian Government partnered with Surf Life Saving WA and provided $50,000 to deliver a shark module as part of an overall beach safety app. The app. provides information relevant to any shark sightings, beach closures as a result of shark sightings and other beach safety information in real time from the Surf Life Saving WA communications centre.

DoF Research

The State Government is supporting research to reduce the risk of shark attack through DoF research and a funding program for external researchers also seeking solutions to the problem.

Four major research projects have either been completed, or are underway at DoF to better understand white sharks in Western Australia and the likely effectiveness of any community safety interventions. These are:

- Expansion of the Western Australian Government's shark monitoring network. This ongoing program uses acoustic monitoring and tagging to collect information on the occurrence and movements of white sharks (and some other species) in Western Australian waters. The information collected will be used to assess any factors associated with shark hazard risk, and provide safety agencies with near real-time alerts of the presence of tagged sharks at key locations, enabling beaches to be closed.
- A correlation study exploring possible links between shark sightings, interactions or attacks and locations, weather conditions, water temperatures and the activity of other marine mammals that might attract sharks (FOP 109 2012).
- An examination of white shark population numbers which is due out in 2014.
- A beach netting study to look at the effectiveness of shark meshing, and shark exclusion barriers. This study formed the basis for the trial of a beach enclosure at Old Dunsborough.

Applied research programs

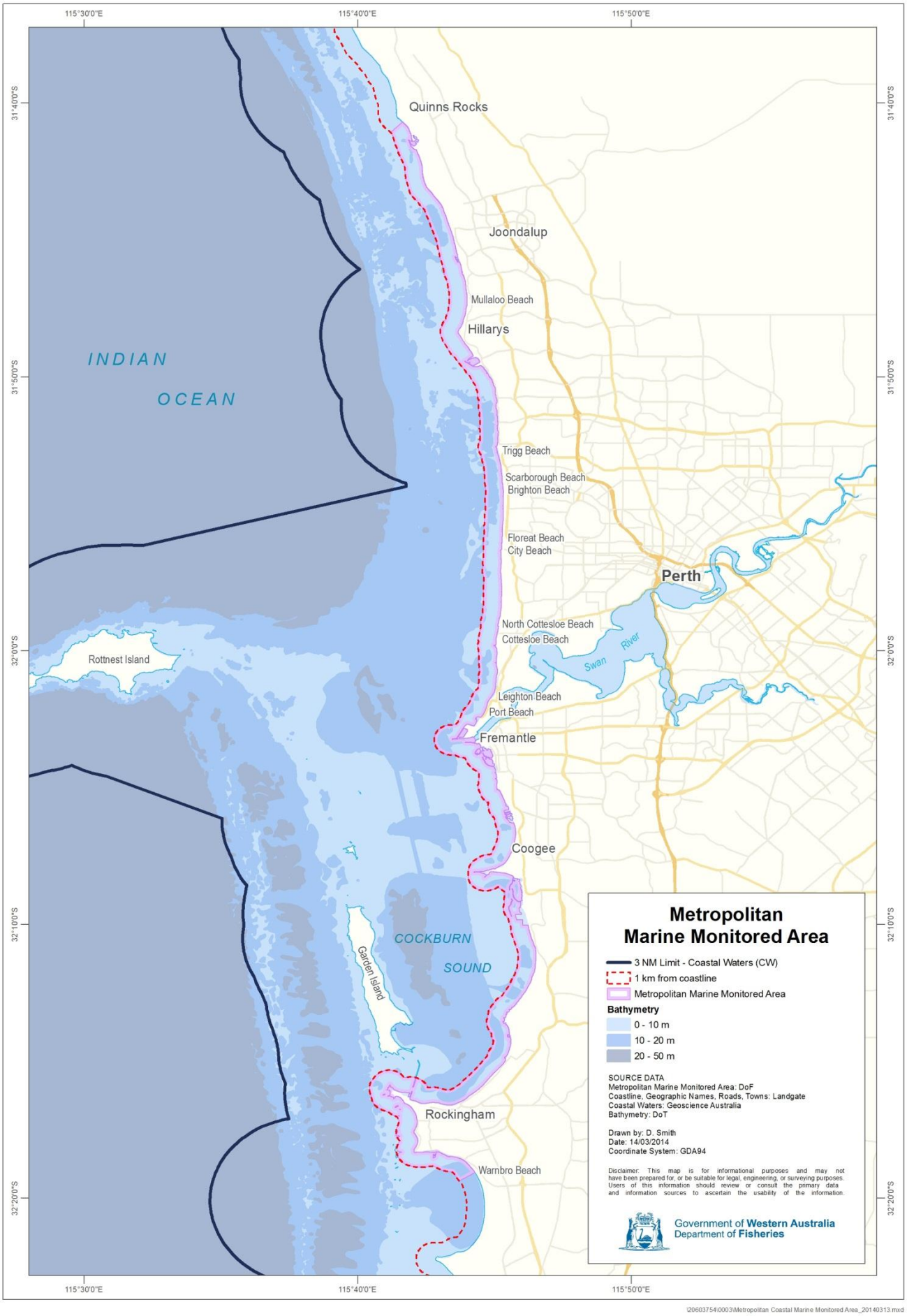
The Western Australian Government has committed grants of up to $300,000 over a period of up to three years to universities, research institutes and industry to focus on non-

lethal shark hazard detection and deterrent systems, including bubble curtains, chemical repellents, the development of the SharkShield device designed for mounting on surfboards and acoustic signature masking.

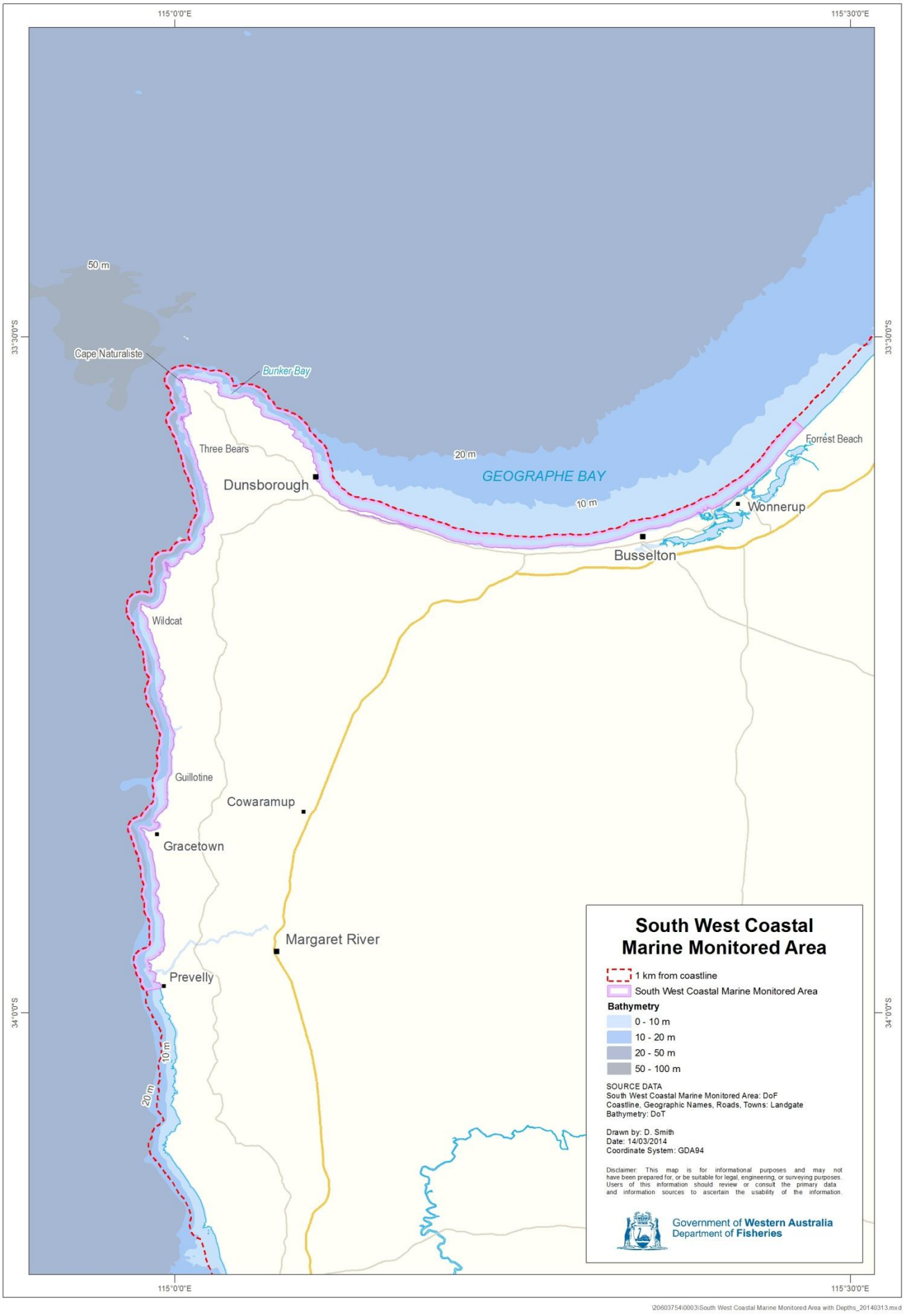
A summary of research grants awarded by the Western Australian Government to examine shark detection and shark deterrent technologies.

Shark Detection			
Project	**Researcher**	**Funding**	**Description**
Sonar Imaging and detection of sharks	Curtin University Centre for Marine Science and Technology (Dr Miles Parsons)	$273,468	Evaluate the effectiveness of imaging sonar for underwater detection of sharks, identify the most likely detection method and create a framework for producing commercially viable shark detection.
Advanced vision system for automatic shark detection and tracking	University of Western Australia School of Computer Science and Software Engineering (Professor Mohammed Bennamoun)	$203,234	Develop an advanced vision system for real-time automatic shark detection and tracking, by developing a novel set of advanced image processing algorithms.
Development and testing of a low impact acoustic-based shark detection system.	University of Western Australia School of Physics (Dr Shane Chambers)	$252,417	Develop and test a low impact acoustic-based shark detection system.
Shark Deterrents			
Project	**Researcher**	**Funding**	**Description**
Development and testing of novel shark deterrents	University of Western Australia Oceans Institute (Assoc Professor Nathan Hart)	$222,221	Develop and test novel shark deterrents including bubble curtains, underwater sounds and strobe lights.
Testing and enhancement of existing shark deterrents	University of Western Australia Oceans Institute (Professor Shaun Collin)	$220,573	Independently test and possibly enhance existing shark deterrents including electric devices, acoustic repellents and chemical repellents.
Integrated surfboard electronic shark deterrent to protect surfers.	Shark Shield Pty Ltd (Lindsay Lyon CEO)	$300,000	Develop and test an integrated surfboard electronic shark deterrent to protect surfers.
Characterisation and masking of acoustic signatures of beach-goers that may attract sharks.	Curtin University Centre for Marine Science and Technology (Professor Christine Erbe)	$130,124	Characterise and mask acoustic signatures of beach-goers that may attract sharks.
A case of a mistaken identity? Discovering the sensory cues that trigger shark attacks	University of Western Australia Oceans Institute (Assoc Professor Nathan Hart)	$284,620	Discover the visual, electrical and hydrodynamic cues that trigger shark attack and develop specific design criteria for shark repellent or masking devices.

4. Map of the Metropolitan Marine Monitored Area



5. Map of the south west Marine Monitored Area



6. Criteria for drum line placement

Beach use
Surf Life Saving WA Beach Attendance Statistics for the 2012-13 season were used to guide the beaches at which drum lines were to be set. Beaches with seven day a week patrols were prioritised for drum line placement.

Surfing WA and local recreational water users were consulted to identify popular surfing spots between Cape Naturaliste and Prevelly.

Distance offshore and water depth
Advice was sought from Surf Life Saving WA and Surfing WA as to the maximum distance offshore of water based activities. At approximately 1km distance from shore, interactions with surfers, swimmers and other water users should be mostly avoided. One kilometre offshore also correlates with distance extent patrolled by Surf Life Saving WA.

Shark control equipment in Queensland, including nets and drum lines, is set approximately 350m from shore and sits approximately along the 10m depth contour.

At 1km offshore, in the metropolitan region water depth was found to be between nine and 13 m and between five and 30 m in the south west region.

Benthic habitat
Sea bed habitat was considered to ensure no drum lines were placed over reef structures or other fragile benthic habitat.

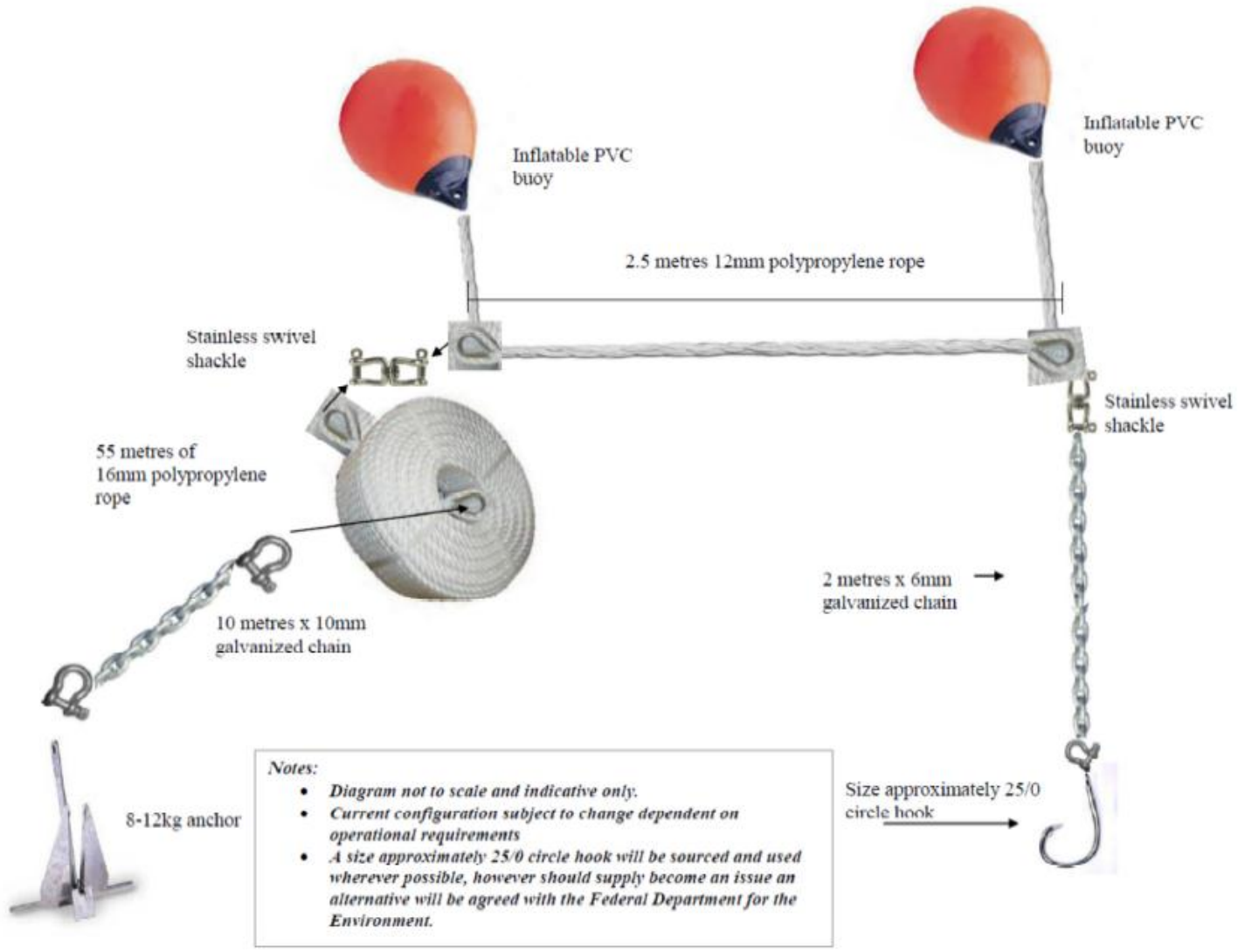
Marine Protected Areas
The following Department of Parks and Wildlife and Department of Fisheries Marine Protected Areas were identified:

- Cottesloe Reef Fish Habitat Protection Area (FHPA)
- Waterman's Reef Observation Area
- Marmion Marine Park
- The Ngari Capes Marine Park

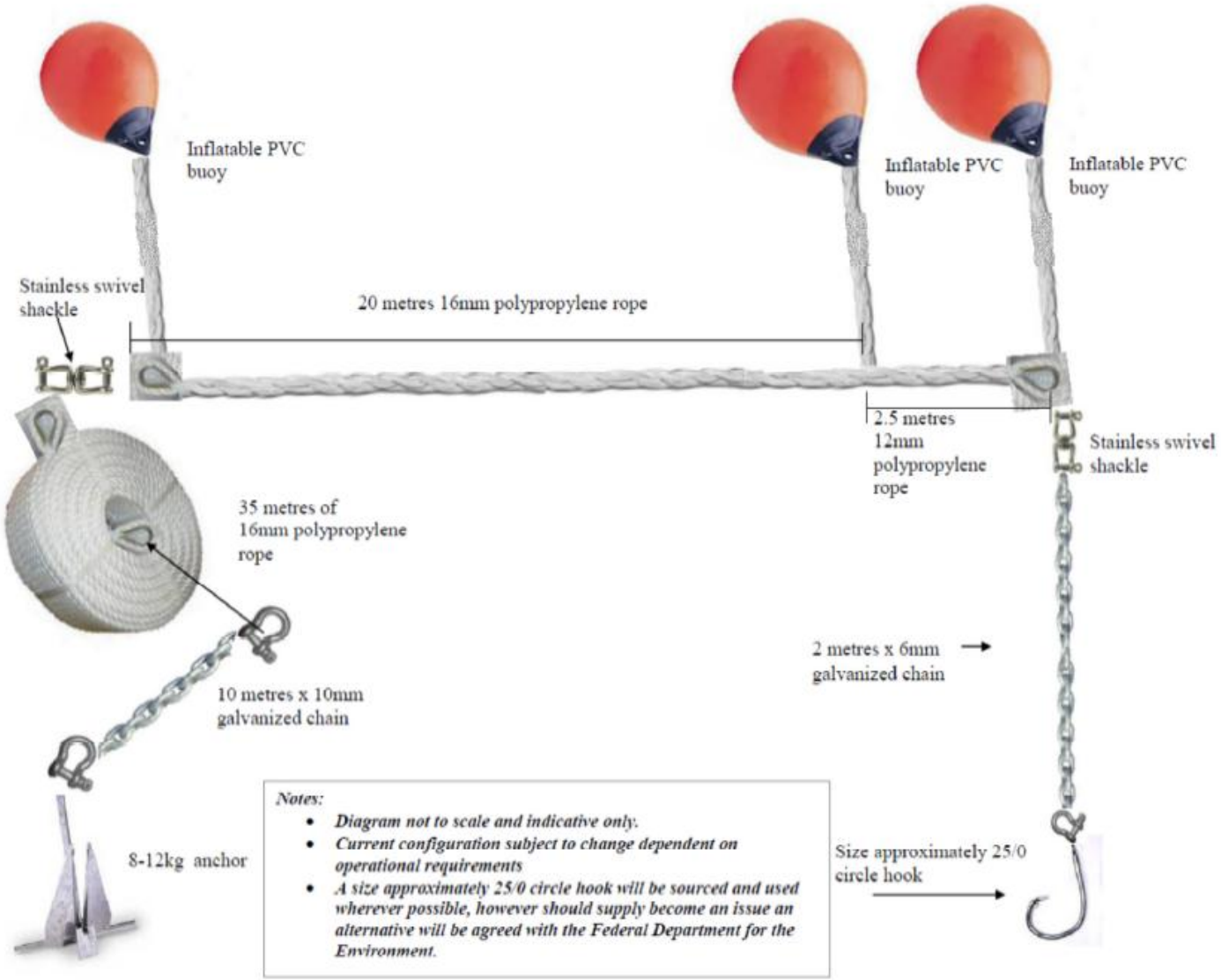
The Cottesloe FHPA, Waterman's Reef Observation Area and all sanctuary and recreation zones within the Marmion Marine Park were excluded for permanent drum line placement. All proposed and gazetted sanctuary and recreation zones within the Ngari Capes Marine Park were excluded for permanent drum line placement.

Shark activity
Data on shark activity from the Department of Fisheries and the Surf Life Saving WA Twitter feed were used to identify areas of high densities of shark sightings.

7. Primary drum line configuration



8. Drum line configuration with optional third float



9. Photo of a conventional fin tag

10. Photo of a kangaroo tag

11. Example data log sheet for species capture

Shark Drum Line Deployment, Management and Associated Services Inspection Log

INSPECTION, RESEARCH AND CATCH RECORD											
DRUM LINE GPS	TIME INSPECTED	SPECIES	*SPECIES HEALTH	**ACTION	SIZE (cm)	SEX	***RESEARCH ANIMAL	RESEARCH TAG NO.	DISPOSAL TAG NO.	PHOTO NUMBER	NOTES
ML2	13:43	Tiger	A	D	373 total	F	N	N	1921	IMG 6912	
					326 fork					IMG 6918	
					148 interd					IMG 6909	

*
A = Alive
N = Near Dead
D = Dead

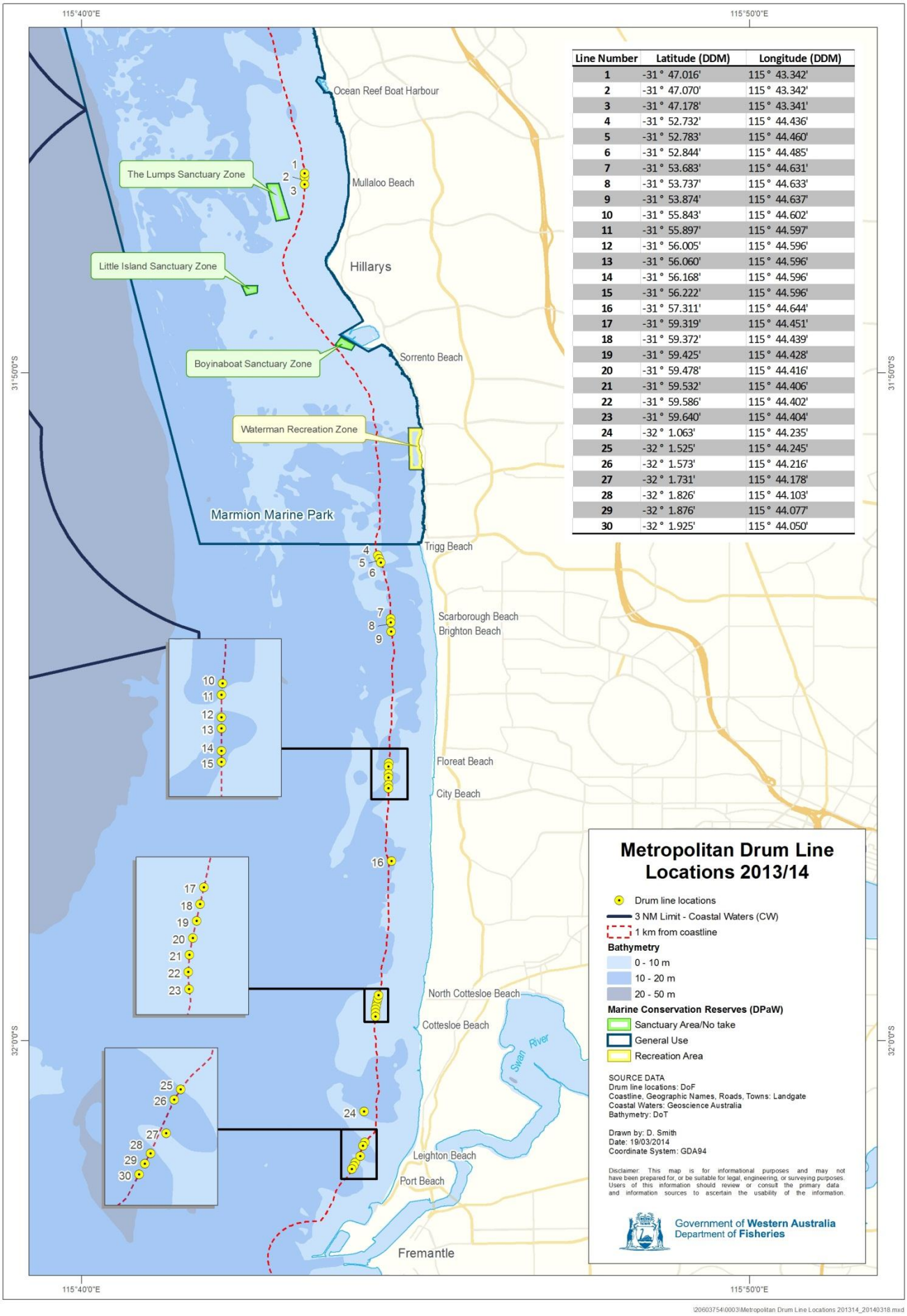
**
R = Retained
D = Disposed
RL = Released

***
Y = Yes
N = No

12. Observer trips undertaken between 25 January and 30 April 2014

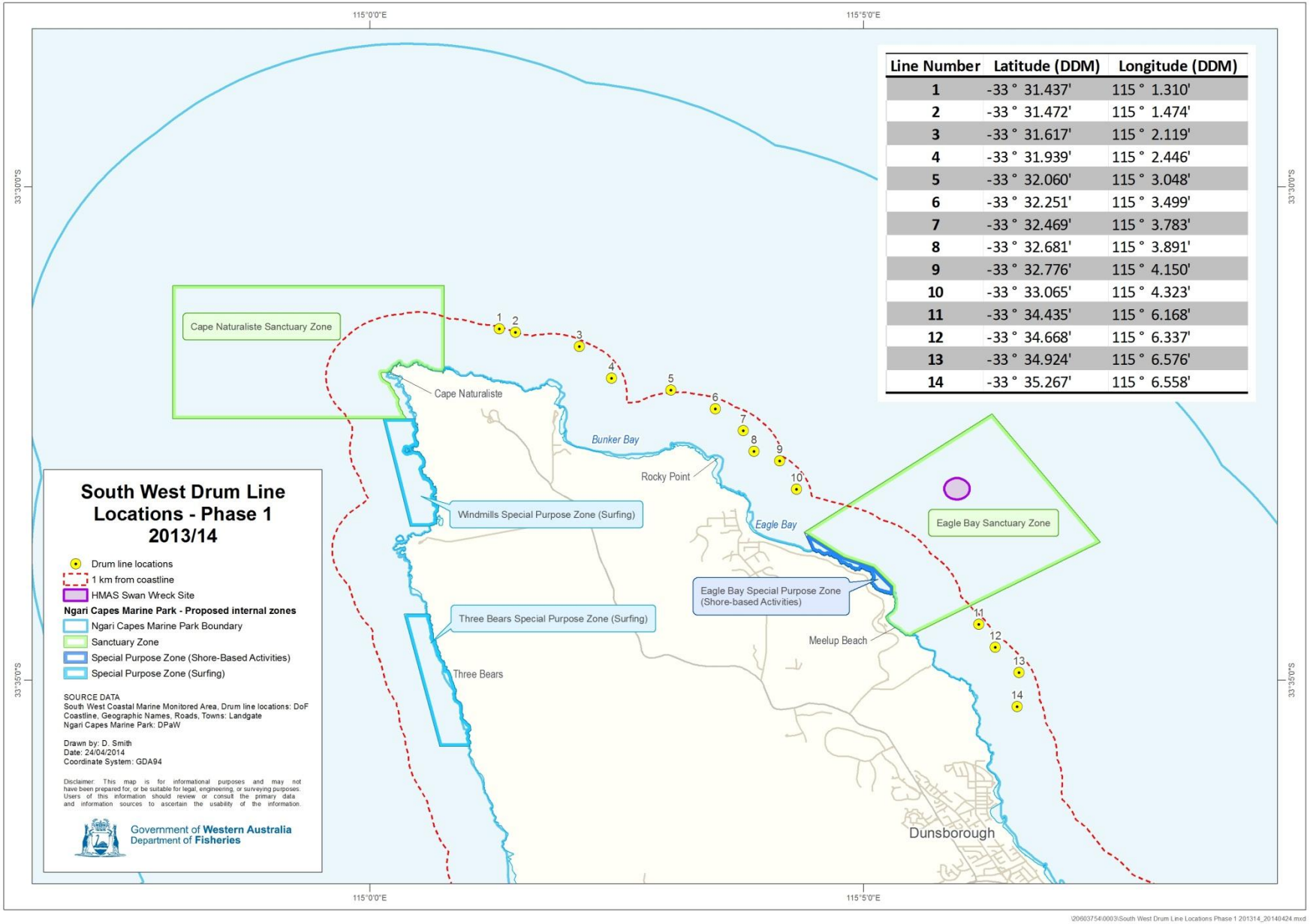
Date	Location
29-01-2014	Quindalup (South West)
31-01-2014	Quindalup (South West)
04-02-2014	Quindalup (South West)
06-02-2014	Quindalup (South West)
13-02-2014	Gracetown (South West)
18-02-2014	Fremantle (Metropolitan)
20-02-2014	Canal Rocks (South West)
21-02-2014	Canal Rocks (South West)
08-03-2014	Fremantle (Metropolitan)
18-03-2014	Fremantle (Metropolitan)
20-03-2014	Fremantle (Metropolitan)
16-04-2014	Canal Rocks (South west)

13. Metropolitan drum line locations 2013/14



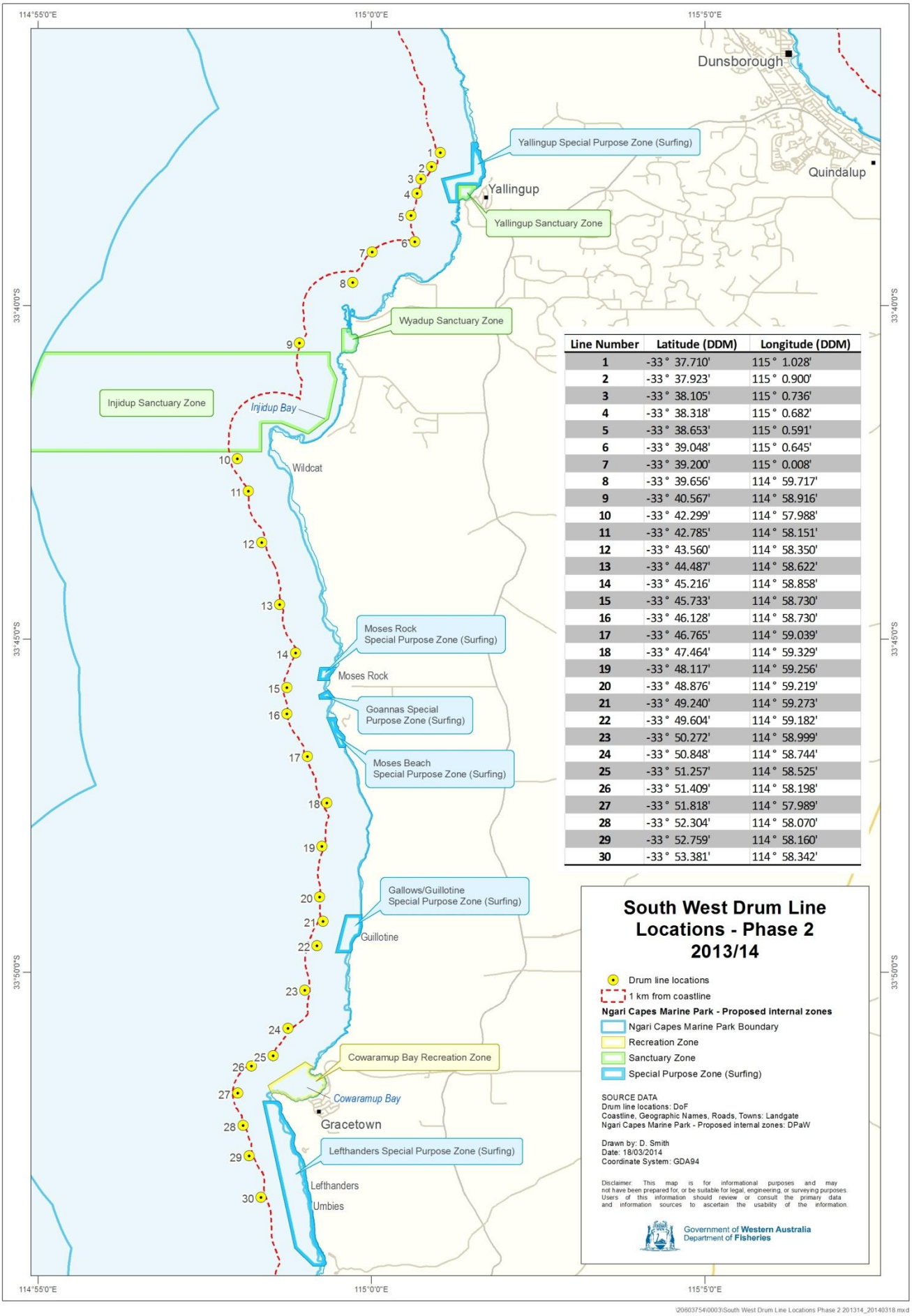
Line Number	Latitude (DDM)	Longitude (DDM)
1	-31 ° 47.016'	115 ° 43.342'
2	-31 ° 47.070'	115 ° 43.342'
3	-31 ° 47.178'	115 ° 43.341'
4	-31 ° 52.732'	115 ° 44.436'
5	-31 ° 52.783'	115 ° 44.460'
6	-31 ° 52.844'	115 ° 44.485'
7	-31 ° 53.683'	115 ° 44.631'
8	-31 ° 53.737'	115 ° 44.633'
9	-31 ° 53.874'	115 ° 44.637'
10	-31 ° 55.843'	115 ° 44.602'
11	-31 ° 55.897'	115 ° 44.597'
12	-31 ° 56.005'	115 ° 44.596'
13	-31 ° 56.060'	115 ° 44.596'
14	-31 ° 56.168'	115 ° 44.596'
15	-31 ° 56.222'	115 ° 44.596'
16	-31 ° 57.311'	115 ° 44.644'
17	-31 ° 59.319'	115 ° 44.451'
18	-31 ° 59.372'	115 ° 44.439'
19	-31 ° 59.425'	115 ° 44.428'
20	-31 ° 59.478'	115 ° 44.416'
21	-31 ° 59.532'	115 ° 44.406'
22	-31 ° 59.586'	115 ° 44.402'
23	-31 ° 59.640'	115 ° 44.404'
24	-32 ° 1.063'	115 ° 44.235'
25	-32 ° 1.525'	115 ° 44.245'
26	-32 ° 1.573'	115 ° 44.216'
27	-32 ° 1.731'	115 ° 44.178'
28	-32 ° 1.826'	115 ° 44.103'
29	-32 ° 1.876'	115 ° 44.077'
30	-32 ° 1.925'	115 ° 44.050'

14. South west drum line locations 2013/14: Phase 1



Line Number	Latitude (DDM)	Longitude (DDM)
1	-33 ° 31.437'	115 ° 1.310'
2	-33 ° 31.472'	115 ° 1.474'
3	-33 ° 31.617'	115 ° 2.119'
4	-33 ° 31.939'	115 ° 2.446'
5	-33 ° 32.060'	115 ° 3.048'
6	-33 ° 32.251'	115 ° 3.499'
7	-33 ° 32.469'	115 ° 3.783'
8	-33 ° 32.681'	115 ° 3.891'
9	-33 ° 32.776'	115 ° 4.150'
10	-33 ° 33.065'	115 ° 4.323'
11	-33 ° 34.435'	115 ° 6.168'
12	-33 ° 34.668'	115 ° 6.337'
13	-33 ° 34.924'	115 ° 6.576'
14	-33 ° 35.267'	115 ° 6.558'

15. South west drum line locations 2013/14: Phase 2



Line Number	Latitude (DDM)	Longitude (DDM)
1	-33 ° 37.710'	115 ° 1.028'
2	-33 ° 37.923'	115 ° 0.900'
3	-33 ° 38.105'	115 ° 0.736'
4	-33 ° 38.318'	115 ° 0.682'
5	-33 ° 38.653'	115 ° 0.591'
6	-33 ° 39.048'	115 ° 0.645'
7	-33 ° 39.200'	115 ° 0.008'
8	-33 ° 39.656'	114 ° 59.717'
9	-33 ° 40.567'	114 ° 58.916'
10	-33 ° 42.299'	114 ° 57.988'
11	-33 ° 42.785'	114 ° 58.151'
12	-33 ° 43.560'	114 ° 58.350'
13	-33 ° 44.487'	114 ° 58.622'
14	-33 ° 45.216'	114 ° 58.858'
15	-33 ° 45.733'	114 ° 58.730'
16	-33 ° 46.128'	114 ° 58.730'
17	-33 ° 46.765'	114 ° 59.039'
18	-33 ° 47.464'	114 ° 59.329'
19	-33 ° 48.117'	114 ° 59.256'
20	-33 ° 48.876'	114 ° 59.219'
21	-33 ° 49.240'	114 ° 59.273'
22	-33 ° 49.604'	114 ° 59.182'
23	-33 ° 50.272'	114 ° 58.999'
24	-33 ° 50.848'	114 ° 58.744'
25	-33 ° 51.257'	114 ° 58.525'
26	-33 ° 51.409'	114 ° 58.198'
27	-33 ° 51.818'	114 ° 57.989'
28	-33 ° 52.304'	114 ° 58.070'
29	-33 ° 52.759'	114 ° 58.160'
30	-33 ° 53.381'	114 ° 58.342'

South West Drum Line Locations - Phase 2 2013/14

Drum line locations
1 km from coastline

Ngari Capes Marine Park - Proposed internal zones

Ngari Capes Marine Park Boundary
Recreation Zone
Sanctuary Zone
Special Purpose Zone (Surfing)

SOURCE DATA
Drum line locations: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Ngari Capes Marine Park - Proposed internal zones: DPaW

Drawn by: D. Smith
Date: 18/03/2014
Coordinate System: GDA94

Disclaimer: This map is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Government of Western Australia
Department of Fisheries

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16. Shark threat or incident: response criteria

The following must be confirmed before initiating a response:

1. Report made within one hour of sighting and response able to be in place within one hour of report being made.
2. Location is clear (e.g. land or ocean marker or GPS waypoint).
3. The sighting is credible. This assessment can take into account the source of the report (Surf Life Saving WA, commercial fisher, Government Agency vessel) or be confirmed by contacting the individual reporting the sighting.
4. The shark is believed to have a length of three metres or greater and be within 1km of the shore.
5. Where possible the shark species is identified as a target species under the Western Australian shark hazard mitigation policy.
6. The Operations Manager is satisfied that public safety is of concern (beach is occupied, shark remains in the vicinity, shark is close to shore etc.).
7. The Land Manager (or delegated authority) must agree to, and have capacity to give effect to, beach closure for the period of deployment and removal of shark hazard.
8. In the event that the Land Manager will not agree to beach closures the deployed vessel will still attend and place drum lines 1km off shore.

Clarification on the following will assist in the confirmation and initiation of a response:

- Person reporting the sighting can explain how they determined the length of the shark and the detail is plausible.
- Length can be gauged in comparison to an object e.g. the reporter's water vessel or other visual marker.
- Person can explain how they determined distance from beach and the detail is plausible.
- Person can describe any patterns or particular features of the shark's body, assisting in species identification.
- Environmental conditions are favourable to water visibility.
- Sighting can be verified by another person.

Procedure to be followed to initiate a response

1. Identify resources to support deployment operation (e.g. vessel availability, beach closures, aerial support).
2. Obtain verification that beaches have been cleared as appropriate
3. The deployed vessel attends the site and sets up to five baited drum lines.
4. In responding to a sighting, the drum lines must be moved back out to approximately 1km offshore within one hour of arrival at the site, and/or removed from the water no more than one hour after arrival at site.
5. In responding to an attack, up to five drum lines may be set in the vicinity of the attack zone. Drum lines will be moved out to no further than 1km offshore and maintained and monitored for a maximum of seven days.

A decision on the deployment of resources in the event of a shark threat or attack will be made by the Operations Manager at the Department of Fisheries.