



Environmental Protection Authority

Referral of a Proposal by A Third Party to the Environmental Protection Authority under Section 38(1) of the *Environmental Protection Act 1986*.

EPA REFERRAL
FORM
THIRD PARTY

PURPOSE OF THIS FORM

Section 38(1) of the *Environmental Protection Act 1986* (EP Act) provides that any person may refer a significant proposal (one that is likely to have a significant effect on the environment) to the Environmental Protection Authority (EPA) for a decision on whether or not it requires assessment under the EP Act. This form sets out the information requirements for the referral of a proposal by a third party.

Referrers are encouraged to familiarise themselves with the EPA's *General Guide on Referral of Proposals* [see Environmental Impact Assessment/Referral of Proposals and Schemes] before completing this form.

A referral under section 38(1) by a third party to the EPA must be made on this form. This form will be treated as a referral even though a third party may not be able to provide sufficient information on the proposal to enable the EPA to make a decision on whether or not to assess the proposal. Generally, the EPA will obtain additional project information from the proponent. The referral form and proponent information will be made available for public comment for a period of 7 days, prior to the EPA making its decision on whether or not to assess the proposal.

CHECKLIST

Before you submit this form, have you

	Yes	No
Completed all applicable questions in the form	Y	
Completed the Referror's Declaration	Y	

Following a review of the information presented in this form, please consider the following question. (A response is Optional)

DO YOU CONSIDER THE PROPOSAL REQUIRES FORMAL ENVIRONMENTAL IMPACT ASSESSMENT?		
☒ YES	☐ NO	☐ NOT SURE
IF YES, WHAT LEVEL OF ASSESSMENT?		
☐ ASSESSMENT ON PROPONENT INFORMATION		
☒ PUBLIC ENVIRONMENTAL REVIEW		

THIRD PARTY REFERROR DECLARATION (To be completed by the Referror)

I, **Redacted**, (*full name*) submit this referral to the Environmental Protection Authority for consideration of the environmental significance of its impacts.

Signature Redacted	Name (print) Redacted
Address	Redacted
Date	14.1.14

1. PROPONENT, PROPOSAL AND LOCATION INFORMATION

1.1 PROPONENT

Name	Redacted
Joint Venture parties (if applicable)	
Postal Address	Redacted
Key proponent contact for the proposal • Name • Address • Phone • Email	Hon Ken Baston Minister for Agriculture and Food; Fisheries Electorate Office Unit 8 20 Hamersley Street BROOME WA 6725 PO Box 1452 BROOME WA 6725 Ph: (08) 9193 7044 Fax: (08) 9193 7055 Ministerial Office 4th Floor, London House 216 St Georges Terrace PERTH WA 6000 Ph: (08) 6552 5400 Fax: (08) 6552 5401 Email: Minister.Baston@dpc.wa.gov.au

1.2 PROPOSAL

Title	Shark Drum Line Deployment, Management and Associated Services
Description	On 10 December 2013 the Premier and the Minister for Fisheries announced new measures to deal with the threat of sharks off the Western Australian coast. Through this Request, the Department of the Premier and Cabinet (DPC) is seeking the services of an experienced licenced commercial fishing organisation to deploy, manage and maintain drum lines off the Western Australian (WA) coast in specific locations in

the Metropolitan and South West areas. The services will also involve responding to shark threats including deployment of additional drum lines.

The successful Respondent will be required to deploy, manage and maintain drum lines off the Western Australian (WA) coast in Marine Monitored Areas (MMAs) in the Metropolitan and South West areas. The services include the management, release of by catch, retention or disposal of the targeted catch and 12 hour patrols of the drum line areas. The services will also involve responding to shark threats within MMAs including deployment of additional drum lines.

DRUM LINE OPERATIONS

The successful Respondent shall provide the following services:

- a) Deploy a series of baited drum lines, configuration similar to the diagram at Attachment 1. The exact drum line deployment is to be finalised, however they will broadly be located as described in Section 2.3.1 (Metropolitan) and Section 2.3.2 (South West). Drum lines will not be within any marine conservation areas;
- b) Bait (supplied by successful Respondent – preferably sourced from shark), maintain and patrol the drum lines for 12 hours each day, between 6am and 6pm (Patrol Hours), 7 days per week;
- c) Bait drum lines at both the commencement of, and prior to the end of each patrol day. All used baits shall be disposed of on-shore;
- d) Carry additional sets of drum lines on board for deployment in the event of a rapid response requirement, or for replacement of damaged gear;
- e) Undertake rapid response on an as required basis. Further details described in Section 2.4;
- f) Humanely destroy any **white shark (*Carcharodon carcharias*)**, tiger shark (*Galeocerdo cuvier*) or bull shark (*Carcharhinus leucas*) that is greater than 3m total length caught on the drum lines. Current direction on the humane destruction of large sharks involves the use of a firearm. Total length is defined as the distance from the snout to a point on the horizontal axis intersecting a perpendicular line extending downward from the tip of the upper caudal lobe to form a right angle;
- g) Tag (to be supplied by DoF) and remove any sharks that are dead, or destroyed. Tagged sharks are

	to be taken offshore (distance to be confirmed) and discarded. In the initial stages of the program, the Customer Representative may direct a number of sharks to be brought to shore; h) Retain and return any existing tagging or tracking research equipment found on animals that are caught on the drum lines and are either dead or form part of the identified species and size; i) Release alive where possible all other animals taken on the drum lines. Any animals which are dead, or considered not in a condition to survive, are to be humanely destroyed, tagged and taken offshore for disposal; j) Maintain a data log sheet which includes details of the vessel patrol times and location; baiting times; times drum lines are checked; species caught; condition (dead, near dead or alive); and for the species listed as dangerous, measurements and sex are to be recorded; and k) Permit a fisheries or other officer as determined by the Customer's Representative, to observe the performance of contract requirements. Appendix 1 of the Supporting Documentation provides greater detail on the activities proposed.
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1.3 LOCATION

Name of the Shire in which the proposal is located	The proposal will occur in multiple areas as outlined below
For urban areas – • street address • lot number • suburb • nearest intersection road	Metropolitan Coastal area The Metropolitan MMA extends from Quinns Rock Beach (31.678°S, 115.694°E) to Warnbro Beach (32.318°S, 115.739°E) inclusive of all waters up to 1km offshore. The successful Respondent shall deploy, manage and maintain up to 36 drum lines from Mullaloo Beach (31.787°S, 115.733°E) to Port Beach (32.035°S, 115.745°E) at locations specified by the Customer's Representative. South West Coastal Area The South West MMA extends from Forrest Beach (33.568°S, 115.464°E) to Prevelly (33.982°S, 114.992°E) inclusive of all waters up to 1km offshore.

	The successful Respondent shall, in accordance with Section 2.1(a), deploy, manage and maintain up to 36 drum lines as follows: Phase 1: 10 January 2014 – 10 February 2014 Quindalup Beach (33.550°S, 115.000°E) to Cape Naturaliste (33.530°S, 115.003°E). Phase 2: 11 February 2014 – 30 April 2014 Cape Naturaliste (33.530°S, 115.003°E) to Left Handers Beach (33.953°S, 115.073°E).
For remote localities – • nearest town • distance and direction from that town to the proposal site	

2. POTENTIAL ENVIRONMENTAL IMPACTS

Use the following list of environmental elements to set out your concerns in relation to the potential impacts of the proposal and in explanation of your judgement that the proposal is significant in terms of the *Environmental Protection Act 1986*:

Element of the environment	Potentially significant impact
Flora and vegetation • Clearing of native vegetation • Rare or priority flora • Threatened Ecological Communities • Bush Forever	
Fauna • Fauna or fauna habitat • Specially Protected (Threatened) fauna	The program will target and result in the destruction of multiple individuals of the great white shark (<i>Carcharodon carcharias</i>) which is listed as Vulnerable on the Environmental Protection and Biodiversity Conservation Act 1999 and Schedule 1 of the Wildlife Conservation Act 1950. The program may also result in destruction of the grey nurse shark <i>Carcharodon carcharias</i> which is also listed under both the EPBC and WC Acts. The program will also target other dominant predators including the tiger shark (<i>Galeocerdo cuvier</i>) and bull shark (<i>Carcharhinus leucas</i>). There are multiple examples in the scientific literature demonstrating the

	concomitant effects of removal of top level predators on downstream ecosystems e.g. Estes et al. Science 15 July 2011: Vol. 333 no. 6040 pp. 301-306). The program proposed by the state government has provided no impact assessment to the contrary and is working against the objects of the precautionary principle. The project should not be initiated without a thorough scientific understanding of the role of the top-level predators in maintaining ecosystem processes. Appendix 2 of the Supporting Documentation presents a report commissioned by the Department of Fisheries into various shark mitigation strategies. The report provides a recommendation that drum-lining should not be instigated due to impacts on the environment (p.4).
Rivers, creeks, wetlands and estuaries Proximity of development to waterways	
Significant areas and/or land features - National Park or Nature Reserve - Environmentally sensitive areas - Significant natural land features (caves, ranges, etc)	
Coastal zone areas - Proximity of proposed development to coastal area - Significant landforms, eg beach ridge plain - Mangroves	
Marine areas and biota - Sensitive benthic communities, eg seagrasses, coral reefs, mangroves - Marine conservation reserves - Recreation or commercial fishing areas	Impacts are present in fauna section however the following species may also be impacted inadvertently as by-catch - Grey nurse shark (vulnerable, west coast population); - Green sawfish (vulnerable); - Freshwater sawfish (vulnerable); - Loggerhead turtle (endangered); - Leatherback turtle (endangered); - Green turtle (vulnerable) - Humpback whale (vulnerable); - Southern right whale (endangered) and, - Australian sea lion (vulnerable)
Water supply and drainage catchments	

• Proclaimed groundwater or surface water protection area • Underground Water Supply and Pollution Control area • Public Drinking Water Supply Area	
Pollution – discharge of • Noise • Vibration • Gaseous emissions • Dust • Liquid effluent • Solid waste	
Greenhouse gas emissions	
Contamination	
Social surroundings • Aboriginal ethnographic or archaeological significance • Site of high public interest, eg recreation, scenic • Goods transport affecting amenity	The proposal will operate in areas of significant social and public interest where a significant proportion of the Perth community visit. This has been demonstrated by recent protests in Cottesloe that resulted in a turn-out of greater than 4000 individuals. There is significant concern that the proposed drum-lining may in fact increase shark attacks by changing the behaviour of the target species and drawing greater numbers of individuals into areas that may not have previously been occupied.

Supporting Documentation

Appendix 1 – Tender Document; Shark Drum Line Deployment,
Management and Associated Services

Appendix 2 – Report to WA Fisheries on Effectiveness of Control
Strategies

Appendix 1 – Tender Document; Shark Drum Line Deployment,
Management and Associated Services

Appendix 2 – Report to WA Fisheries on Effectiveness of Control Strategies



Request

REQUEST TITLE:

Shark Drum Line Deployment, Management and Associated Services

REQUEST NUMBER:

DPC1596

CLOSING TIME:

2:30 PM 3 January 2014 Perth, Western Australia

ISSUED BY:

The Department of the Premier and Cabinet

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PART A – REQUEST NO DPC1596

1. INTRODUCTION

1.1 BACKGROUND

On 10 December 2013 the Premier and the Minister for Fisheries announced new measures to deal with the threat of sharks off the Western Australian coast. These measures complement the considerable investment the State Government has made into shark mitigation and is a direct response to the unprecedented shark fatalities that have occurred in Western Australia over the last three years.

Through this Request, the Department of the Premier and Cabinet (DPC) is seeking the services of an experienced licenced commercial fishing organisation to deploy, manage and maintain drum lines off the Western Australian (WA) coast in specific locations in the Metropolitan and South West areas. The services will also involve responding to shark threats including deployment of additional drum lines.

1.2 SUBMISSION OF OFFER

- 1.2.1 The Respondent may submit the Offer by hand at:

**Tendering Services
Optima Centre
16 Parkland Road
OSBORNE PARK WA 6017**

- 1.2.2 The Respondent may submit the Offer by post at:

**Tendering Services
Locked Bag 11
OSBORNE PARK BC WA 6916**

If the Respondent submits the Offer by hand or post, the Respondent must provide four (4) copies, with one copy marked "original" and three (3) copies marked "copy".

- 1.2.3 Offers may not be submitted by facsimile.

- 1.2.4 The Respondent may submit the Offer electronically by uploading at: www.tenders.wa.gov.au.

The Offer can only be submitted to: www.tenders.wa.gov.au if the size of the Offer is equal to or less than 20 megabytes. The Respondent must be registered to submit an offer electronically.

- 1.2.5 Conditions regarding the submission of Offers (including late lodgement and mishandling) are contained in the Request Conditions.

1.3 OFFER VALIDITY PERIOD

The Offer Validity Period is for a period of three (3) months.

1.4 CONTACT PERSONS

Different enquiries can be best dealt with by the most appropriate contact, shown below

The Respondent must not contact any other person within Government or any consultant engaged in relation to this Request to discuss this Request.

CONTRACTUAL AND ROUTINE ENQUIRIES:

Name: Sue Davies / Tessa Bettenay
Title: Procurement Manager / Procurement Officer
Telephone: 6552 5722 / 6552 6488
E-mail: Susan.Davies@dpc.wa.gov.au / Tessa.Bettenay@dpc.wa.gov.au

TECHNICAL / CUSTOMER ENQUIRIES:

Name: Richard May
Title: Executive Director, Strategic Projects
Telephone: 65525235
E-mail: Richard.May@dpc.wa.gov.au

ADVICE ON DELIVERING OFFERS:

Name: Tendering Services
Telephone: (08) 6551 2345
Facsimile: (08) 6551 2333

1.5 REQUEST CONDITIONS

The "Request Conditions" are contained in the Part A of the *Request Conditions and General Conditions of Contract* [August 2012] located at www.finance.wa.gov.au (select Government Procurement, then select "Goods and Services Templates, Guides and Conditions of Contract" from the Quick Links menu) and contain important provisions regarding the nature of this Request and the consequences of the Respondent submitting an Offer. The Respondent is deemed to have read and considered the Request Conditions prior to submitting an Offer.

2. SELECTION PROCESS

2.1 SELECTION PROCESS

Value for Money is a key State Supply Commission policy objective to ensure that when purchasing products and/or services, Public Authorities achieve the best possible outcome, for every dollar spent, by assessing the costs and benefits of, and the risks inherent in, an Offer, rather than simply selecting the lowest Offered Price.

In determining Value for Money, the Contract Authority or Customer will:

- a). apply relevant State Supply Commission and Government policies to the assessment of Offers;
- b). assess Offers against the Compliance and Disclosure Requirements in Section 3 in Part B;
- c). assess Offers against the Qualitative Requirements in Section 5 in Part B;
- d). assess Offers against the Insurance Requirements in Section 6 in Part B, and
- e). assess the Offered Prices, which includes assessing the Offered Price and Pricing Requirements in Schedule 3.

The determination of Value for Money will require a consideration of all of the above factors and any other matters that the Contract Authority or Customer considers relevant.

2.2 STATE SUPPLY COMMISSION AND GOVERNMENT POLICIES

The following State Supply Commission policies apply to this Request:

- a). Value for Money;
- b). Probity and Accountability;
- c). Open and Effective Competition;
- d). Sustainable Procurement.

The following Government policies apply to this Request:

- a). Buy Local Policy; including the December 2009 Addendum

These policies can be viewed and downloaded at www.ssc.wa.gov.au or copies of these policies are available from the State Supply Commission (telephone (08) 6551 1500).

PART B – CONTENT REQUIREMENT AND RESPONDENT'S OFFER

PART B SHOULD BE COMPLETED BY THE RESPONDENT AND RETURNED TO THE CONTRACT AUTHORITY OR CUSTOMER (REFER 'SUBMISSION OF OFFER' REQUIREMENTS OF CLAUSE 2.1 IN THE REQUEST CONDITIONS).

1. NOTE TO RESPONDENT

In preparing its Offer, the Respondent must:

- a). address each requirement in the form set out in this Part B;
- b). take into account the Customer Contract requirements, as explained in the Customer Contract Details. The Respondent must read these in conjunction with the General Conditions.
- c). in respect of the Qualitative Requirements in Section 5 in this Part B, provide full details of any claims, statements or examples;
- d). assume that the Contract Authority or Customer has no knowledge of the Respondent, its activities, experience or any previous work undertaken by the Respondent for the Contract Authority, Customer or any other Public Authority; and
- e). nominate any Offer Information that the Respondent wishes to expressly and reasonably nominate as confidential for the purposes of the Request Conditions.

2. IDENTITY OF RESPONDENT

The Respondent must provide the following details:

RESPONDENT TO COMPLETE:

- (a) Name of Legal Entity:
- (b) ACN (if a company)
- (c) Registered address or address of principal place of business:
- (d) Business Name:
- (e) ABN
- (f) Contact Person:
- (g) Contact Person Position Title:
- (h) Email:
- (i) Telephone:
- (j) Facsimile:
- (k) Address and facsimile number for service of contractual notices

NB: The Offer does not require the Respondent's signature.

3. COMPLIANCE AND DISCLOSURE REQUIREMENTS

The Contract Authority or Customer will, in its Value for Money assessment, consider the extent to which the Offer satisfies the following Compliance and Disclosure Requirements. The Contract Authority or Customer reserves the right to reject any Offer that does not properly address any of the Compliance and Disclosure Requirements, and/or which contains material departures from the Customer Contract Details and/or General Conditions.

a) COMPLIANCE

(i) Customer Contract

The Respondent must confirm whether it will comply with the Customer Contract (excluding the General Conditions and Schedules). If the Respondent will not comply with any clause of the Customer Contract, the Respondent must set out:

- (A) the clause it will not comply with;
- (B) the extent of non-compliance – including the alternative clause, if any, or a description of any changes it requires to the Customer Contract; and
- (C) the reason for non-compliance.

RESPONDENT TO COMPLETE:

Does the Respondent agree to the Customer Contract?

(Yes / No)

If no, provide details

(ii) General Conditions / Schedules

The Respondent must confirm whether it will comply with the General Conditions and Schedules. If the Respondent will not comply with any of the General Conditions and Schedules, the Respondent must set out:

- (A) the General Conditions / Schedules it will not comply with;
- (B) the extent of non-compliance – including the alternative clause, if any, or a description of any changes it requires to the General Conditions / Schedules; and
- (C) the reason for non-compliance.

RESPONDENT TO COMPLETE:

Does the Respondent agree to the General Conditions / Schedules?

(Yes / No)

If no, provide details.

b) DISCLOSURES**(i) Participants (including subcontractors)****RESPONDENT TO COMPLETE:**

Is the Respondent acting as an agent or trustee for another person or persons?

(Yes / No)

If yes, provide details.

AND

Is the Respondent acting jointly or in association with another person or persons?

(Yes / No)

If yes, provide details.

AND

Has the Respondent engaged, or does the Respondent intend to engage, another person or persons as a subcontractor in connection with the supply of the Products and/or Services.

(Yes / No)

If yes, provide details.

(ii) Criminal Convictions

The Respondent must confirm that neither the Respondent nor any person included in the Specified Personnel has been convicted of a criminal offence that is punishable by imprisonment or detention.

RESPONDENT TO COMPLETE:

Has the Respondent or any person included in the Specified Personnel been convicted of a criminal offence that is punishable by imprisonment or detention?

(Yes / No)

If yes, provide details.

(iii) Conflict of Interest

The Respondent must declare and provide details of any actual, potential or perceived conflict of interest.

RESPONDENT TO COMPLETE:

Does the Respondent have any actual, potential or perceived conflict of interest in relation to the performance of the Customer Contract (if awarded) by the Respondent?

(Yes / No)

If yes, the reasons why.

(v) **Small Business**

The Respondent is required to disclose whether it is a small business that employs less than twenty (20) people.

The Respondent should note that its response to this Compliance and Disclosure Requirement:

- (A) will be used by the Department of Finance for statistical purposes only; and
- (B) will not be used by the Contract Authority or Customer in its evaluation of the Offer.

RESPONDENT TO COMPLETE:

Is the Respondent a small business that employs less than twenty (20) people?

(Yes / No)

4. QUALITATIVE REQUIREMENTS

The Contract Authority or Customer will, in its Value for Money assessment, consider the extent to which the Offer satisfies the following Qualitative Requirements. The Contract Authority or Customer reserves the right to reject any Offer that does not properly address and satisfy any of the Qualitative Requirements.

The Qualitative Requirements are not weighted equally. Refer to the % weighting (xx% weighting) for each Requirement listed below.

Respondents must clearly state which Option/s they are offering. Respondents can nominate both options. If both options are nominated the qualitative criteria for both options must be provided.

(Tick appropriate box/boxes)

☐ **OPTION 1- METROPOLITAN COASTAL AREA**

☐ **OPTION 2 – SOUTH WEST COASTAL AREA**

a). **SUITABILITY OF VESSEL(S) AND EQUIPMENT (40% WEIGHTING)[50%]**

The Respondent must:

- (i) Demonstrate the proposed licenced fishing vessel(s) and equipment are suitable for the delivery of the required Services as set out in Schedule 2 - Specification / Statement of Requirements; and
- (ii) Provide details of the vessel identification, condition, age, licensing, performance and maintenance arrangements. Photographs should be included.

The Respondent should also provide a list of other equipment relevant to the Services and complete the table below:

Vessel Description & Capability	Details
Length	
Draft	
Winch capability	
Minimum cruising speed	
Maximum cruising speed	
Automatic Location Communicator	
Ability to store retained catch on board the vessel	
Firearm (or power head), secure storage and relevant licences	
Ability to enclose rear of vessel with tarpaulin or similar cover	

RESPONDENT TO COMPLETE:

Respondent to demonstrate suitability of vessel(s) and equipment.

b). DEMONSTRATED CAPACITY, SKILLS AND EXPERIENCE OF THE ORGANISATION TO UNDERTAKE PROJECTS OF A SIMILAR NATURE (40% WEIGHTING) [50%]

The Respondent must provide information regarding:

- (i) The organisational capacity to perform the Customer Contract including relevant skills and experience within the organisation in performing similar requirements;
- (ii) Previous experience in supplying similar services, with particular reference to the handling of large marine animals;
- (iii) Firearms licence and associated provisions;
- (iv) Contingency planning and capability including potential for deployment of an alternative vessel of similar specifications in the event of mechanical breakdown or unserviceability; and
- (v) The ability to undertake and record basic research such as species identification, sexing and size measurement.

RESPONDENT TO COMPLETE:

Respondent to demonstrate capacity, skills and experience of the organisation to undertake projects of a similar nature.

c). LOCAL CONTENT (20 % WEIGHTING) [0%]

When a bid is received from:

- A business that is located in another state or territory of Australia, or in New Zealand under the Australia New Zealand – Government Purchase Agreement (ANZGPA); or
- A business that is located in the United States (when the purchase is a “covered procurement” under the Australia United States Free Trade Agreement (AUSFTA)); or
- A business that is located in Chile (when the purchase is a “covered procurement” under the Australia Chile Free Trade Agreement (ACI-FTA)),

the local content weighted selection criteria will not be evaluated during the qualitative assessment. Should the local content criterion not be applicable, the 20% weighting will be divided proportionately across the remaining criteria (see [xx%] for revised weightings).

The Respondent must address the following:

- (i) the Respondent must specify the location where the following activities will be performed:
 - (A) where fuel, bait, repairs and maintenance will be sourced and provided; and
 - (B) where contract management will be undertaken;
- (ii) the Respondent must provide details of how the Respondent supports other Western Australian businesses through subcontracting or material supply arrangements;
- (iii) The Respondent must estimate the percentage of the total Offered Price as to the amount which represents Contract activities performed in Western Australia, in other Australian States or Territories, New Zealand, the United States and overseas, in accordance with the following table:

	Western Australian Content	Other Australian States, New Zealand, United States and Chile	Imported Overseas Content	TOTAL
%	%	%	%	100%

- (iv) the Respondent must estimate the employment creation and retention and industry and skills development initiatives which may arise if a contract is awarded to the Respondent; and
- (v) the Respondent must provide details of any other economic, social or environmental benefits to Western Australia.

RESPONDENT TO COMPLETE:

Respondent to provide the local content information required under this clause.

5. CUSTOMER CONTRACT INSURANCE REQUIREMENTS

RESPONDENT TO COMPLETE

Does the Respondent have the insurance requirements set out in Schedule 1 - Customer Contract Details?

(Yes / No)

If yes, the Respondent must complete the following table:

	Insurer	ABN	Policy No	Insured Amount	Expiry Date	Exclusions, if any
1. Public Liability Insurance						
2. Workers' Compensation including common law liability of \$50 million						

OR

If no, does the Respondent confirm that if it is awarded a contract, then it will obtain the insurance policies set out in Schedule 1 - Customer Contract Details prior to the Commencement Date?

(Yes / No)

If no, the reasons why.

SCHEDULE 1 - CUSTOMER CONTRACT DETAILS

1. Customer	The Customer is the Director General, Department of the Premier and Cabinet.
2. The Term of the Customer Contract	The Term of the Customer Contract is from the Commencement Date until 30 April 2014.
3. Commencement Date	The Customer will notify the Contractor of the Commencement Date in the Letter.
4. Price Variation	The Price is fixed for the Term.
5. Public Liability	Public liability insurance covering the legal liability of the Contractor and the Contractor's Personnel arising out of the Services for an amount of not less than \$5 million for any one occurrence and unlimited in the aggregate;
6. Workers' Compensation	Workers' compensation insurance in accordance with the provisions of the <i>Workers' Compensation and Injury Management Act 1981</i> (WA), including cover for common law liability for an amount of not less than \$50 million for any one occurrence in respect of workers of the Contractor. The insurance policy must be extended to cover any claims and liability that may arise with an indemnity under section 175(2) of the <i>Workers' Compensation and Injury Management Act 1981</i> .
7. Contract Management Requirements	Customer's Representative Richard May Executive Director, Strategic Projects Telephone: 6552 5235 Email: Richard.May@dpc.wa.gov.au Customer's address Level 5, Dumas House 2 Havelock Street, West Perth WA 6005 Meetings A post - contract commencement meeting will be held with the successful Respondent to determine applicable reporting lines and provide an overview and agreement on deliverables. The successful Respondent will attend other meetings as required by the Customer's Representative.
8. Confidential Information	For the purposes of paragraph (b) of the definition of "Confidential Information" in clause 2.1 of the General Conditions, all information is specified by the Customer as confidential.
9. Police Clearance	Clause 18.4 of the General Conditions does not apply
10. Confidential Declaration Prevention of Paedophilia	Clause 18.5 of the General Conditions does not apply.
11. Warranties	For the purposes of clause 19.5 of the General Conditions, no warranties are specified.
12. Intellectual Property Owner	Clause 23.1 of the General Conditions applies.
13. Working Papers	Clause 23.7 of the General Conditions applies.
14. Publicity	For the purposes of clause 25.4 of the General Conditions, no other Public Authority is specified
15. Government Policies	For the purposes of clause 33 of the General Conditions, no obligations relating to Government procurement policies are specified.

SCHEDULE 2 - SPECIFICATION / STATEMENT OF REQUIREMENTS

1. STATEMENT OF REQUIREMENTS

The successful Respondent will be required to deploy, manage and maintain drum lines off the Western Australian (WA) coast in Marine Monitored Areas (MMAs) in the Metropolitan and South West areas. The services include the management, release of by catch, retention or disposal of the targeted catch and 12 hour patrols of the drum line areas. The services will also involve responding to shark threats within MMAs including deployment of additional drum lines.

Respondents may submit pricing for delivery of the required services in the Metropolitan MMA and/or the South West MMA. A contract may be awarded to one Respondent for both MMAs, or to separate Respondents for each MMA.

The Successful Respondent shall provide these services as described below

2. SPECIFICATION

2.1 DRUM LINE OPERATIONS

The successful Respondent shall provide the following services:

- a) Deploy a series of baited drum lines, configuration similar to the diagram at Attachment 1. The exact drum line deployment is to be finalised, however they will broadly be located as described in Section 2.3.1 (Metropolitan) and Section 2.3.2 (South West). Drum lines will not be within any marine conservation areas;
- b) Bait (supplied by successful Respondent – preferably sourced from shark), maintain and patrol the drum lines for 12 hours each day, between 6am and 6pm (Patrol Hours), 7 days per week;
- c) Bait drum lines at both the commencement of, and prior to the end of each patrol day. All used baits shall be disposed of on-shore;
- d) Carry additional sets of drum lines on board for deployment in the event of a rapid response requirement, or for replacement of damaged gear;
- e) Undertake rapid response on an as required basis. Further details described in Section 2.4;
- f) Humanely destroy any white shark (*Carcharodon carcharias*), tiger shark (*Galeocerdo cuvier*) or bull shark (*Carcharhinus leucas*) that is greater than 3m total length caught on the drum lines. Current direction on the humane destruction of large sharks involves the use of a firearm. Total length is defined as the distance from the snout to a point on the horizontal axis intersecting a perpendicular line extending downward from the tip of the upper caudal lobe to form a right angle;
- g) Tag (to be supplied by DoF) and remove any sharks that are dead, or destroyed. Tagged sharks are to be taken offshore (distance to be confirmed)

SCHEDULE 2 - SPECIFICATION/STATEMENT OF REQUIREMENTS – RESPONDENT TO READ AND KEEP THIS PART

- and discarded. In the initial stages of the program, the Customer Representative may direct a number of sharks to be brought to shore;
- h) Retain and return any existing tagging or tracking research equipment found on animals that are caught on the drum lines and are either dead or form part of the identified species and size;
 - i) Release alive where possible all other animals taken on the drum lines. Any animals which are dead, or considered not in a condition to survive, are to be humanely destroyed, tagged and taken offshore for disposal;
 - j) Maintain a data log sheet which includes details of the vessel patrol times and location; baiting times; times drum lines are checked; species caught; condition (dead, near dead or alive); and for the species listed as dangerous, measurements and sex are to be recorded; and
 - k) Permit a fisheries or other officer as determined by the Customer's Representative, to observe the performance of contract requirements.

2.2 VESSEL AND ASSOCIATED REQUIREMENTS

The successful Respondent's vessel will be under appropriate commercial survey and licensing requirements and have the following capabilities and or equipment:

- a) Approximate Draft - 1.5m or less;
- b) Approximate Length - 12m or greater;
- c) Automatic Location Communicator capabilities, or at a minimum, maintain a GPS Track log;
- a) Winch capable of minimum 1.5 tonnes lifting capacity;
- b) Approximate cruising speed of 20 knots;
- c) Ability to store retained catch on board the vessel;
- d) Firearm (or power head), secure storage and relevant licences;
- e) Ability to enclose rear of vessel with tarpaulin or similar cover.

Please note:

Multiple vessel configurations may be considered for the service requirements in the South West MMA.

2.3 SERVICE DETAIL AND LOCATIONS

2.3.1 Metropolitan Coastal area

The Metropolitan MMA extends from Quinns Rock Beach (31.678°S, 115.694°E) to Warnbro Beach (32.318°S, 115.739°E) inclusive of all waters up to 1km offshore.

The successful Respondent shall, in accordance with Section 2.1(a), deploy, manage and maintain up to 36 drum lines from Mullaloo Beach (31.787°S, 115.733°E) to Port Beach (32.035°S, 115.745°E) at locations specified by the Customer's Representative.

2.3.2 South West Coastal Area

The South West MMA extends from Forrest Beach (33.568°S, 115.464°E) to Prevelly (33.982°S, 114.992°E) inclusive of all waters up to 1km offshore.

SCHEDULE 2 - SPECIFICATION/STATEMENT OF REQUIREMENTS – RESPONDENT TO READ AND KEEP THIS PART

The successful Respondent shall, in accordance with Section 2.1(a), deploy, manage and maintain up to 36 drum lines as follows:

Phase 1: 10 January 2014 – 10 February 2014

Quindalup Beach (33.550°S, 115.000°E) to Cape Naturaliste (33.530°S, 115.003°E).

Phase 2: 11 February 2014 – 30 April 2014

Cape Naturaliste (33.530°S, 115.003°E) to Left Handers Beach (33.953°S, 115.073°E).

2.4 RAPID RESPONSE OPERATIONS

Upon identification of a shark threat during Patrol Hours within the relevant MMA, and as advised by the Department of Fisheries (DoF), the successful Respondent shall respond to the identified area within approximately 30 minutes (with some variance allowable with due respect to location of vessel and area being responded to) and deploy baited drum lines.

The successful Respondent shall continue to patrol the area until advised by DoF and/or until such time as another vessel can take over monitoring the situation. When this occurs, patrols and management of the 'fixed' drum lines shall recommence.

Should the deployment result in the capture of an animal, the successful Respondent shall follow the handling protocols described in Section 2.1.

2.5 LOST OR DAMAGED DRUM LINES

In the event the successful Respondent is unable to locate or believes that any drum lines are missing, a report shall be made immediately to the DoF for replacement of equipment.

2.6 REPORTING

On a monthly basis, the successful Respondent shall provide a written report that includes all information obtained and collected under the requirements of Section 2.1(i) and downloaded information from the GPS track log (or similar).

3. NOTIFICATIONS

The following notifications apply:

- 3.1 The DoF will supply the drum lines to the successful Respondent.
- 3.2 Exemptions from various state legislation which prohibit the take, or attempted take, of totally / specifically protected species of shark will be provided to the successful Respondent, to allow the services to be undertaken in state waters under the supervision of the Department of Fisheries.
- 3.3 It is likely a 50m exclusion zone will be implemented by Department of Transport around each drum line. Vessels operated by the successful Respondent, the Department of Transport and the DoF will be excluded from the restrictions of the exclusion zone.

SCHEDULE 3 – PRICING

The Customer will, in its Value for Money assessment, consider the extent to which the Offer satisfies the following Offered Price and Pricing Requirements. The Customer reserves the right to reject any Offer that does not properly address and satisfy any of the Offered Price and Pricing Requirements.

a) OFFERED PRICE AND PRICE SCHEDULE

- (i) The Respondent must include in the Offer this completed Schedule 3 - Pricing.
- (ii) The Respondent must state the basis of its Offered Price in Australian Dollars.
- (iii) The Offered Price will be deemed to include the cost of complying with this Request (including the Customer Contract Details) and the General Conditions and the cost of complying with all matters and things necessary or relevant for the due and proper performance of the Customer Contract. Any charge not stated as being additional to the Offered Price will not be payable by the Customer.
- (iv) If the Offered Price is consideration for a taxable supply under the GST Act, the Offered Price will be deemed to be inclusive of all GST applicable to the taxable supply at the rate in force for the time being.

RESPONDENT TO COMPLETE

PLEASE NOTE:

- The Respondent must include all costs associated with the services in the pricing below (Inc. GST).
- If the Respondent is responding to both options, both pricing tables must be completed.
- If a secondary vessel is proposed as a contingency measure (in the case of mechanical failure, unserviceability, etc) please indicate whether or not the below rates apply. If the below rates do not apply, please provide rates under the specified headings.
- Respondents should also provide details of their charging methods when adverse weather and sea conditions prevent patrol and response for any day or part day.

A). Option 1 - Metropolitan Coastal Area

Description	Price (Inc. GST)
The Respondent must provide the daily rate for the provision of the Services: • DAILY RATE	\$
The Respondent must provide the hourly rate for additional hours over the specified patrol hours: • HOURLY RATE ADDITIONAL HOURS	\$
The Respondent must provide an hourly rate applicable to attending a rapid response area (this recognises that additional fuel costs may be associated with higher vessel speeds): • HOURLY RATE RAPID RESPONSE	\$

B). Option 2 - South West Coastal Area

Description	Price (Inc. GST)
The Respondent must provide the daily rate for the provision of the Services: • DAILY RATE	\$
The Respondent must provide the hourly rate for additional hours over the specified patrol hours: • HOURLY RATE ADDITIONAL HOURS	\$
The Respondent must provide an hourly rate applicable to attending a rapid response area (this recognises that additional fuel costs may be associated with higher vessel speeds): • HOURLY RATE RAPID RESPONSE	\$

b) REGIONAL PRICE PREFERENCES (ONLY APPLICABLE TO SOUTH WEST MMA)

The Western Australian Government provides price preferences to Western Australian businesses when they are in competition with other Western Australian businesses for government contracts where the purchase or contract delivery point is in regional Western Australia.

The two types of regional price preferences are Regional Business Preference and Regional Content Preference.

Details regarding the regional price preferences and how they are applied are documented in the Western Australian Government's "Buy Local" Policy. This policy can be viewed and downloaded at www.ssc.wa.gov.au or copies of this policy are available from the State Supply Commission (telephone (08) 6551 1500).

When a bid is received from:

- A business that is located in another state or territory of Australia, or in New Zealand under the ANZGPA; or
- A business that is located in the United States (when the purchase is a "covered procurement" under the AUSFTA); or
- A business that is located in Chile (when the purchase is a "covered procurement" under the ACF-FTA),

the regional business preference and the regional content preference will not be applied.

(i) Regional Business Preference

Bona fide regional businesses located within a prescribed distance from the purchase or contract delivery point that bid, manage or deliver the majority of the contract outcomes from their regional business location are eligible to claim the regional business preference.

The contract delivery point for this contract is: South West MMA

The prescribed distance is 200 km.

Government agencies, when comparing bids received from regional businesses located within the prescribed distance, with bids received from Western Australian businesses located outside the prescribed distance, including the Perth region, will reduce the price of bids received from regional businesses located within the prescribed distance, for evaluation purposes only, by 10% of the total Offered Price calculated to a maximum of \$250,000.

To receive the regional business preference and to ensure that the preference is applied correctly where appropriate, regional businesses must be able to answer 'Yes' to the first five questions below:

RESPONDENT TO COMPLETE

- | | | |
|--|---------------------------------|--------------------------------|
| 1. Is your business located within the prescribed distance from the South West MMA (excluding zone one, the Perth region)? | Yes
☐ | No
☐ |
| 2. Does your business maintain a permanent operational office within the prescribed distance? | Yes
☐ | No
☐ |

SCHEDULE 3 - PRICING - RESPONDENT TO COMPLETE AND RETURN THIS PART

3. Has your business maintained and conducted business from this office for the past six (6) months or more prior to the date this Request was called?	Yes ☐	No ☐
4. Will your business manage / deliver the majority of the contract outcomes from the business location described above?	Yes ☐	No ☐
5. The regional business preference is only available to eligible regional businesses that submit their offer submission from their regional business location. Have you bid from your business location described above?	Yes ☐	No ☐
6. What is your total Offered Price?	\$	

(ii) Regional Content Preference

A regional content preference is available to Western Australian businesses located outside the prescribed distance, including businesses located in the Perth region, that use products, materials or services in regional contracts that are purchased from businesses located within the prescribed distance. The preference applies to the cost of products, materials or services purchased and used in the delivery of the contract outcomes.

Respondents should note that costs not eligible for the regional content preference include all travel, accommodation and meal costs associated with sending people from outside a prescribed distance to work on a regional contract and all ongoing travel, accommodation and meal costs associated with the delivery of the contract outcome.

The cost of the declared regional content will be reduced, for evaluation purposes, by 10% calculated to a maximum of \$250,000.

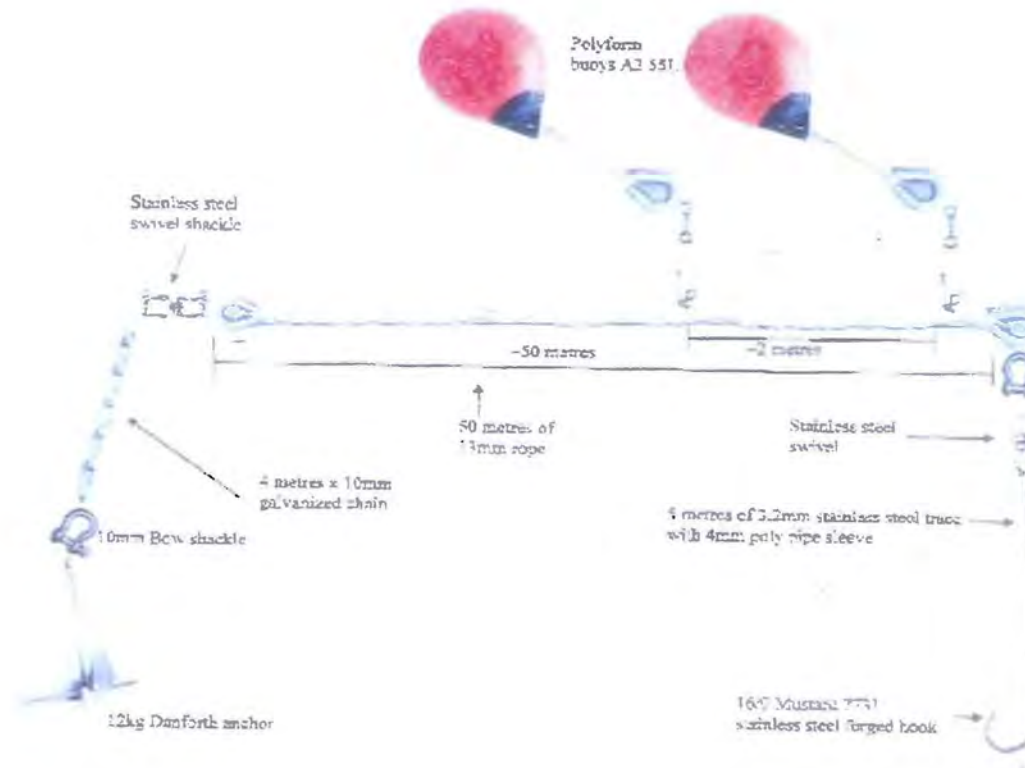
To claim the regional content preference and to ensure that the preference is applied correctly where appropriate, businesses must be able to answer the questions set out below:

RESPONDENT TO COMPLETE		
Does your business intend purchasing products or services for use in the Customer Contract from regional businesses, which are located within the prescribed distance from the contract delivery point [excluding zone one, the Perth region]?	Yes ☐	No ☐
If yes, Respondent's must show the actual cost of their regional content in the table below (attach additional list if required):		
1	Description of the Supplier's Name & Location Products or Services	Cost \$
2	Total Cost of Regional Content:	\$

ATTACHMENT 1

Confidential in Confidence, Dept. of Fisheries Internal Request for Quote – Commercial Fishing for Sharks Considered an Inherent Threat.

Attachment 1



Likely effectiveness of netting or other capture programs as a shark hazard mitigation strategy in Western Australia

Associate Professor Daryl McPhee

**A report prepared for Department of Fisheries,
Western Australia**



**BOND
UNIVERSITY**

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Executive Summary

- There are three main locations where ongoing Shark Control Programs have been implemented – Queensland, NSW and KwaZulu-Natal (South Africa). There have also been a number of locations where programs have been undertaken for shorter time periods (e.g. Brazil, New Zealand, Hawaii)
- Shark Control Programs do not, as many people perceive, provide a continuous barrier that prevents access to beaches by sharks. Instead they aim to reduce the number of sharks that can potentially cause harm to humans through the use of shark meshing nets and/or drum-lines.
- A Shark Control Program is not a fishery as it does not capture fisheries resources for commerce or trade. Rather, a shark control program is specifically designed and implemented with the objective of improving public safety.
- Shark Control Programs result in the capture of a wide range of by-catch species including marine mammals, marine turtles, and sharks and rays not implicated in unprovoked attacks on humans.
- Information obtained from other shark control programs has documented that by-catch rates are often very high in the early years of a program. These rates subsequently decline which is likely due in part to the effect of shark control programs "fishing down" local populations of animals vulnerable to the gear.
- There is a high likelihood that the additional anthropogenic source of mortality that a shark control program in WA would generate has potential implications for the populations of any currently threatened marine species or where conservation concerns are emerging that would be vulnerable to this gear.
- Shark control activities would pose a risk to dolphins which can be an important tourist drawcard in a number of locations including in Western Australia (e.g. Bunbury).
- Any new shark control activities in WA would likely require Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*. The most likely approval pathways that the Commonwealth would require would cost the proponent (WA Department of Fisheries or other) an estimated \$800,000 and \$1,000,000 and take in the order of 18 months to two years. There would be no guarantee that the Commonwealth would approve the activity.
- As a Shark Control Program is not a fishery, it could not be assessed by the Commonwealth against the Commonwealth Guidelines for the Ecologically Sustainable Management of Fisheries.

- There would need to be significant investment by the WA Department of Fisheries in procedures, protocols and infrastructure to commence shark control activities. Once established and based upon estimates in NSW and Queensland, the likely annual cost of running a Shark Control Program is in excess of \$1 million.
- Due to the environmental impacts of shark control activities, it is not recommended that either shark nets or drum-lines be introduced into Western Australia.
- Further consideration could be given to the feasibility of using shark enclosures for bather protection.
- Shark enclosures have the advantage of providing a complete physical barrier that prevents sharks from accessing an area and do not target the reduction in shark numbers or result in any bycatch of other large species like shark nets do. Such enclosures are better suited to calmer areas although new materials that are available potentially increase their scope of use.
- Shark enclosures are suitable for bathers only. They are unlikely to be desirable at locations for other watersport activities such as surfing or diving.

Introduction

Shark attack is an infrequent, but highly disturbing risk for bathing and water sport participants (e.g. surfing, scuba diving, and snorkelling) in coastal areas. Responses to mitigate shark attack involve public policies that contend with the needs of public safety as well as the responsibility to protect threatened species (Neff, 2012). In Western Australia, a recent series of shark attacks has catalysed an analysis of how shark attack risk to the public in Western Australia can potentially be mitigated. Shark attacks are low probability-high consequence events, but their vivid nature ensures a high degree of media reporting and public concern (Neff, 2012).

Of the eleven species of sharks that have been implicated in fatal attacks on humans, three species are considered responsible for 86% of recorded human fatalities: the white shark (*Carcharodon carcharias*), the tiger shark (*Galeocerdo cuvier*) and the bull shark (*Carcharhinus leucas*, also called the river whaler) (ISAF, 2011). The number of shark attacks overall in many parts of the world is increasing, but this is a product of more people in the water, and not a per capita increase in the number of shark attacks (Cliff, 2006, West, 2011). In addition to changing human demographics, as there is little information on population trends for potentially dangerous shark species in WA, understanding whether the risk of shark attacks might be changing due to changes in the species' abundance (e.g. due to the protection that has been afforded to white sharks in Australia) is very complicated. Nevertheless, the Commonwealth Recovery Plan for the white shark aims to increase the population level of the species¹ under the assumption that this population actually has the ecological capacity to increase in abundance.

One shark mitigation strategy employed in some jurisdictions is the use of shark control programs. The objective of shark-control programs is to provide the public with protection against shark attack at popular beaches by a local reduction in large shark numbers. This is achieved by fishing for sharks directly off the beaches, using large-mesh gill-nets or baited drum-lines or both, thereby reducing the likelihood of a dangerous shark coming into contact with humans. Notable shark control programs are in operation in NSW and Queensland, and KwaZulu-Natal (South Africa). Shark-control programs are dedicated programs and do not represent specific fisheries for shark products for human consumption (e.g. flesh or fins), although some catch from the KwaZulu-Natal program is sold. Unlike small-mesh shark-exclusion nets that are deployed in waters sheltered from currents and wave action, shark-control gear on exposed beaches does not form an impenetrable barrier and hence does not eliminate the risk of shark attack. Shark control programs are used in tandem with education material that alerts water users to the potential dangers and how these dangers can be mitigated by avoiding being in the water at times of higher risk.

The use of various methods to potentially reduce the risk from shark attacks can potentially result in impacts on non-target species of conservation significance. Further, a number of shark species that pose a risk to humans are themselves of conservation significance, including one species that is listed as a Vulnerable species in Australia (i.e. the white shark). Globally, sharks are the focus of significant emerging conservation interest and there are a number of dedicated environmental campaigns in Australia that strongly advocate for the removal of shark nets in particular². Methods that protect humans from sharks can represent an anthropogenic source of mortality that negatively impacts the populations of these species of conservation significance. With the exception of shark enclosures, the

¹ <http://www.environment.gov.au/coasts/publications/gwshark-plan/pubs/greatwhiteshark.pdf>

² For example: <http://www.removesharknets.com/>

use of other destructive methods such as baited drum-lines and shark nets do not guarantee that beaches are free of sharks of a size or species that pose a risk to humans.

The objectives of this study are as follows:

1. A literature review of studies and reports undertaken on shark meshing and the use of shark exclusion areas in other national and international jurisdictions.
2. An objective assessment of the pros and cons of shark meshing and shark exclusion areas with a specific focus on the Western Australian circumstances.
3. A summary of the equipment used and reported catches of sharks and by-catch species, including mortality/survival of the latter.
4. An overview of the administration and costs involved in the installation and ongoing maintenance of these systems.
5. An assessment of the effectiveness, logistical constraints and cost estimates of shark netting/meshing programs and shark exclusion areas at Western Australian beaches given the unique environmental and topographical conditions.

Shark Control and Exclusion Methods in Australia and Overseas

This section provides an overview of shark control and exclusion methods used in Australia and overseas. There are three locations where shark control has a long history – two in Australia (Queensland and NSW) and one in South Africa (KwaZulu-Natal). A number of smaller scale programs have been undertaken in New Zealand, Brazil and Hawaii and are included here for completeness. There are also a number of locations, including in Australia where shark exclusion methods have been used.

Queensland

In Queensland, Australia the Queensland Shark Control Program (QSCP) uses a combination of baited drum-lines and mesh nets to catch large sharks in near-shore coastal waters. The QSCP was established in 1962 following a number of fatal attacks. The QSCP deploys approximately 6.5 kilometres of nets (each 186 metres in length, and 6 metres deep with a mesh size of 50 cm). Baited drum lines have continually been in place at popular swimming beaches along the Queensland coastline since 1962 with the traditional bait of fish and elasmobranchs being replaced in the early 1990s with predominantly a mono-specific bait of whole mullet (*Mugil cephalus*). Shark control measures are undertaken by contractors. The QSCP is unique in being the only such program around the world that has a long history of using baited drum lines to catch large sharks to mitigate the risk of shark attack on bathing beaches. Overall, a combination of shark nets and drum-lines in Queensland is considered to be the best mix of apparatus to meet the objectives of public safety while reducing by-catch. The QSCP deploys gear at 37 beaches adjacent to population centres and tourist areas all year round (Table 1).

Table 1 Deployment of QSCP shark control gear along the Queensland east coast (From Gribble et al. 1998)

Area	Nets	Drumlines
Cairns	5	24
Townsville	2	42
Mackay	5	24
Rockhampton	0	54
Tannum Sands	0	12
Rainbow Beach	3	12
Sunshine Coast	10	48
Point Lookout	0	24
Gold Coast	11	32

The cost of the program was:

- \$1.39 million in 2002/03;
- \$1.79 million in 2003/04; and,
- \$1.70 million in 2004/05.

The most significant component of the cost was payments to contractors (Anonymous, 2006).

It is not considered that the use of baited hooks attracts sharks into an area as the distance at which sharks are sensitive to olfactory stimuli (smell) is measured in hundreds of metres (Dudley et al., 1998). As such, the shark must already be in the general area to be attracted to the baited hook.

New South Wales

The NSW Department of Primary Industries manages the Shark Meshing (Bather Protection) Program in NSW, hereinafter referred to as the SMP. A total of 51 ocean beaches from Wollongong to Newcastle are currently netted between 1 September and 30 April each year using bottom-set mesh nets. The shark mesh nets do not act as a complete barrier to sharks reaching beaches as they are not permanently set in the water, do not cover the whole length of the beach, and do not extend from the water surface to the seabed.

Since it was introduced in Sydney in 1937, the SMP has been effective in reducing incidences of fatal shark attack at major metropolitan beaches, with only one fatal shark attack on a netted beach since the SMP began. However, a number of shark attacks that have resulted in injury have occurred at beaches where the SMP is in operation. Shark meshing was chosen as the bather protection method after other approaches such as complete exclusion of beaches were considered. Shark control measures are undertaken by contractors. Funding for the program is provided by the NSW Treasury and in 2007/08 the cost was in excess of \$800,000 and was estimated to be \$990,000 in 2009/10 (Green et al., 2009). The costs include contract prices, salary for shark meshing observers and shark technicians, shark meshing equipment (including acoustic deterrents) and an allocation for undertaking compliance audits.

The configuration of nets currently used in the SMP was standardised in 1972, including a change from surface-set to bottom-set nets. The nets are set parallel to the beach and anchored in approximately ten metres of water. The nets are multifilament flat braid polyethylene with a cork line and leadline, with 160 kg breaking strength, 150 m long, 6 m high, 50 - 60 cm mesh size when measured between knots

when stretched taut, 12 to 14 meshes deep, 0.67 hanging coefficient for the net on the corkline and leadline (i.e. 33% slack hung in) and 0.74 coefficient for the sidelines at the end of each net. The hanging coefficient determines the looseness of the net, and a coefficient of 29.3% would mean that the nets hang squarely. Beach meshing contractors are required to check their nets every 72 hours (weather permitting).

In NSW, a small number of shark enclosures are deployed, but only in calm waters such as Sydney Harbour and Pittwater. In the early days of the SCP, some shark enclosures were trialled at exposed beaches, but Green et al. (2009) reports they were severely damaged by storm events.

KwaZulu-Natal (South Africa)

The KwaZulu-Natal Shark Control program is described in Cliff and Dudley (2011). The KwaZulu-Natal shark-control program on the eastern coast of South Africa commenced in 1952 when shark nets were introduced at Durban, following a spate of attacks on the city's beaches. While the primary tool remains shark nets, drum-lines have also been trialled. Between 1952 and 1961, Durban was the only net installation. There was a steep rise in the number of protected beaches and the length of netting in the 1960s. After 1970, few new installations were added, although the length of netting continued to increase, peaking at 45 km in 1992, when there were 44 protected beaches. In 1996/97, the cost of the program was estimated to be \$3.6 million (Dudley and Gribble, 1999). Drum-lines have complemented or replaced shark nets at a number of locations and have reduced the level of by-catch (Cliff and Dudley, 2011).

Hawaii (United States)

Weatherbee et al (1994) documents the series of shark control methods implemented at a number of popular tourist locations in Hawaii between 1959 and 1976. The approach adopted by the various programs has focussed on longline fishing for sharks, and also the use of standard game fishing gear. Following another series of shark attacks in 1991 and 1992, renewed targeted shark fishing took place and approximately 100 tiger sharks were caught (Dudley, 2006).

Dunedin (New Zealand)

Dudley (2006) reports that three beaches are protected by two shark nets each set permanently between December and February. Each net has a length of 100 metres and a drop of 5.5 metres with a relatively small mesh size of 30 cm. The nets were first installed in 1969 after four shark attacks (three fatal) between 1964 and 1968. The nets caught 14 great white sharks between 1973-74 and 1975-76, but Dudley (2006) reports that no great white sharks have been captured since, and questions the usefulness of the nets, but notes they remain in place because of public opinion. In 2011, the Dunedin City Council cancelled the netting program for a saving of NZ\$ 38,000.

Recife (Brazil)

Between 1992 and 2006 approximately 47 shark attacks resulting in 17 fatalities occurred at Recife (State of Pernambuco) (Henzin et al. 2008). Dudley (2006) summarises shark control activities in Brazil. In 2004, 20 drum-lines and two longlines with 100 hooks each were deployed. Each week, all lines are set at dusk and retrieved at dawn for a four day period that encompasses the weekend. The longlines are set about 1 km from the shore and parallel to the coast, and the drum-lines are set about 200 metres from the shore.

The Use of Shark Exclusion Methods

Methods to completely exclude sharks from an area have been employed in a number of locations. Shark exclusion nets are the principal methods of bather protection in Hong Kong since the early 1990s when a series of shark attacks resulted in six fatalities. The nets are in place nine months of the year at all gazetted beaches and there have been no fatalities since their installation. The Hong Kong nets are designed and engineered to withstand 10 metre waves. Beaches in the Hong Kong area are very short stretches of sand interspersed between large rocky headlands meaning that beach activities are restricted to a relatively small part of the coastline. An example of shark exclusion nets in Hong Kong are shown in Figure 1 and the relatively short length of beaches are also illustrated. An average net enclosure would be 500 m long and either semi-circular or rectangular in shape. They are diver-inspected a minimum of twice a week, and independent verification is required. They also exclude floating refuse, and clearly define the swimming area.



Figure 1 An example of shark exclusion nets in the Repulse Bay area of Hong Kong.

There is also a proposal to deploy a shark exclusion net in Fish Hoek Bay (Cape Town) following a shark attack in that location.³ The proposed exclusion net is 350 metres long.

Swimming enclosures are employed in the calm waters of the Gold coast region, Pittwater (NSW) and these are paid for and maintained by local councils. A small swimming enclosure is installed at Wallaroo (South Australia) and is used mostly for swimming lessons⁴. In Western Australia, a feasibility study of a proposed shark exclusion net at Coogee Beach (Cockburn Sound) was undertaken by the local council⁵. However, it was recommended that the installation of a net not proceed. Among the concerns raised that led to the recommendation included cost, potential liability, and uncertain

³ <http://www.scenicssouth.co.za/2012/03/shark-net-barrier-for-fish-hoek-letter-from-lifesavers/>

⁴ <http://www.wallaroocommunity.org/Beaches.html>

⁵ http://www.cockburn.wa.gov.au/Meetings_and_Minutes/Minutes_and_Agendas/2012/May/ITEM_16_1.pdf

community attitude which could result in the area being avoided or alternatively over-utilised. The initial capital cost for the enclosure was estimated to be \$150,000 with operating and depreciation costs of \$72,500 per year.

Performance and Impacts of Shark Control Programs

There have been a number of studies and reports that have considered and addressed various aspects of bather protection from sharks. Overall, the literature can be divided into studies and reports that: 1) detail the effectiveness of the various programs, 2) document catch composition including by-catch captured in the various apparatus, and 3) trial and assess methods to reduce by-catch and improve the survival rates of by-catch when captured.

Effectiveness of Methods for Shark Hazard Mitigation

Shark control programs are generally considered to have improved the safety of people in the water. The main lines of evidence that support this assertion are comparison of shark attacks before and after implementation of shark control measures, and comparisons at locations with and without such measures. Shark mesh nets do not create a physical barrier to sharks; rather, they affect the local and potentially overall abundance of shark species responsible for attacks on humans. In effect, the logic is the less large sharks that are present, all things being equal, the less chance of an attack occurring. Approximately 40% of shark entanglements occur on the beach side of the nets, because sharks are able to swim over and around the nets. Shark attacks are however, recorded from beaches where shark nets are deployed (Green et al., 2009; Cliff and Dudley, 2011). Prior to their installation, there were 37 shark attacks (18 fatal) at NSW beaches and following installation there were 23 (1 fatal) (Green et al., 2009). The rate of fatalities is highly unlikely to be a result of meshing activities, but is likely to be a function of improved beach front response time and first aid procedures.

In Hawaii, Weatherbee et al. (1994) concluded that the effectiveness of shark control program in that location at removing large sharks in coastal waters is likely to have been previously overstated. They also concluded that the shark control program had no measurable effect on shark attacks. This was due in part to the methods employed and the sporadic nature of the program.

As well as the obvious human cost that results from shark attacks, there can be a perceived economic cost to the coastal tourism industry adjacent to where shark attacks or "scares" occur and also a belief that "unprotected beaches" may pose a relatively greater risk to humans than those that are protected, and thus may be avoided. While statements have been made regarding the economic benefits to coastal tourism from shark control (e.g. Gribble and Dudley, 1999), this review has not identified any published empirical information that supports or refutes claims of specific economic costs to coastal tourism from shark attacks in Australia. Dudley (2006) does report a third party estimate of a \$US20 million tourism loss in the Brazilian state of Pernambuco after a series of shark attacks. However, this reported figure was from an unpublished source, and the method to obtain the estimate and its accuracy, and whether other confounding factors (e.g. macro-economic considerations) were significant in determining a change in economic activity cannot be determined. Further, this review has not identified any published information which documents that the level of protection from shark attack is a determinant of choosing a location for beach based water activities in Australia. Anecdotal historical information does strongly suggest though that the avoidance of beaches where "spates" of shark attacks occurred did result at KwaZulu-Natal and around Sydney, both of which gave the initial impetus to the shark control programs in those areas.

Following a shark attack, short term measures may be taken to attempt to capture the shark responsible for an attack to prevent it from attacking again. When such approaches have been taken, they have typically failed to capture the shark and this is in part at least due to the movement patterns of the animals which can be considerable (Holland et al., 1999).

Catch Composition - By-catch and its Mitigation

Shark control programs can pose significant risk to a number of non-target species, and this has been long established (e.g. Patterson, 1979). The risk posed is related to the gear deployed and the spatial overlap between the gear and individuals of the species concerned. When an animal is captured, in many instances it can be released alive. There have been a number of studies that have collated information on by-catch in shark control programs and key examples are included in Tables 2 and 3. The by-catch tends to be numerically dominated by elasmobranch species (sharks and rays) that are not implicated in unprovoked attacks on humans. While, early data is not completely reliable in terms of species identification and potential under-reporting, overall the information available on by-catch is considerable. Where data is available, there are clear regional differences in composition of by-catch (e.g. Dudley, 1996; Green et al., 2009), and there can also be significant seasonal differences (Green et al., 2009).

The environmental impacts shark control programs can have on some marine fauna is recognised in legislation. In NSW, it is listed as a Key Threatening Process (KTP) under both the NSW *Fisheries Management Act 1994* (FM Act) and the NSW *Threatened Species Conservation Act* (TSC Act) as it was identified to adversely impact two or more threatened species. It was identified that at the time of assessment, the shark meshing program in NSW had negative impacts on a number of threatened species including:

- Grey nurse shark;
- Loggerhead turtle;
- Dugong;
- Great white shark;
- Green turtle;
- Leatherback turtle;
- Humpback whale; and,
- Australian fur-seals.

Shark Control activities were also nominated as a key threatening process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The nomination however was deemed ineligible for inclusion as a KTP under that legislation as it was only deemed to impact one listed species – the grey nurse shark.

Table 2 Catch Information for the NSW Shark Meshing Program from 1990/91 to 2007/08 (From Green et al. 2009)

Species (Common Name)	Number
ELASMOBRANCHS	
Hammerheads	1292
Stingrays	1269
Whalers	536
Angel sharks	259
Port Jackson sharks	107
Great white shark	100
Sevengill shark	92
Tiger shark	49
Thresher shark	40
Shortfin mako	31
Grey nurse shark	15
OTHER ANIMALS	
Dolphins	52
Turtles	47
Finfish	43
Whales*	6
Seal	4
Penguin	1
Dugong	1

* Green et al (2009) notes that this includes false killer whales which are members of the dolphin family.

Table 3 Catch and Size Distribution of Sharks and Other Animals Caught at the Mzamba Shark Nets (KwaZulu-Natal) between 1995-1998 (Modified from Dudley et al. 1998).

Scientific Name	Common Name	Catch No.	Released	Size Range (cm)
ELASMOBRANCHS				
<i>Carcharhinus obscurus</i>	Dusky shark	185	34	108-275
<i>Carcharhinus brachyurus</i>	Copper shark	73	8	136-220
<i>Carcharias taurus</i>	Grey nurse shark	44	19	95-214
<i>Carcharhinus brevipinna</i>	Spinner shark	39	7	147-212
<i>Sphyrna zygaena</i>	Hammerhead shark	37	3	70-150
<i>Squatina africana</i>	African angelshark	22	4	48-121
<i>Carcharhinus limbatus</i>	Blacktip shark	19	2	151-190
<i>Sphyrna lewini</i>	Scalloped hammerhead	18	1	60-140
<i>Manta birostris</i>	Manta ray	15	10	200-450
<i>Rhynchobatus djiddensis</i>	Shovelnose ray	15	9	130-200
<i>Carcharodon carcharias</i>	Great white shark	13	0	148-231
<i>Galeocerdo cuvier</i>	Tiger shark	12	6	97-211
<i>Myliobatus aquila</i>	Eagle ray	4	1	60-70
<i>Mobula</i> spp.	Devil ray	4	3	132-230
<i>Gymnura natalensis</i>	Butterfly ray	3	2	39-125
<i>Carcharhinus leucas</i>	Bull shark	3	1	146-200
<i>Pteromyiaeus bovinus</i>	Bull ray	3	1	60-150
<i>Carcharhinus plumbeus</i>	Sandbar shark	2	0	126-135
<i>Isurus oxyrinchus</i>	Shortfin mako shark	2	0	214-221
<i>Sphyrna mokarran</i>	Great hammerhead	1	0	192
CETACEANS				
<i>Tursiops truncatus</i>	Bottlenose dolphin	8	0	152-257
<i>Delphinus delphis</i>	Common dolphin	1	0	226
TELEOSTS				
<i>Thunnus albacares</i>	Yellowfin tuna	2	0	101-103
<i>Argyrosomus japonicus</i>	Mulloway	1	0	123
MARINE REPTILES				
<i>Chelonia mydas</i>	Green turtle	3	1	64

Marine Turtles

There is a high capture of marine turtles in the QSCP as a result of the large number of marine turtles that are in Queensland waters, and utilisation of a number of beaches by marine turtles for nesting. In Queensland, the average yearly capture of marine turtles in nets and drum-lines between 1962 and 1995 was 119.4 animals per year (Gribble et al., 1998). Historically turtle by-catch was not recorded to the species level, so long-term records of the capture of individual species are not in existence, however on the basis of interviews with shark contractors, Gribble et al. (1998) concluded that most turtles caught in nets were the vulnerable green turtle (*Chelonia mydas*), while most turtles caught on drum-lines were the endangered loggerhead turtle (*Caretta caretta*). Many turtles captured were released alive (Gribble et al., 1998), and tagging shows that individuals released from drum-lines are frequently recaptured, and this potentially overestimates the number of individual turtles that have been historically captured. However, repeated hooking may cause subsequent mortality if the turtle's injuries are significant. In NSW and KwaZulu-Natal marine turtle capture is much more infrequent, but nonetheless is still recorded (Dudley et al., 1998; Green et al., 2009).

Dolphins

Dolphins are captured in each of the three Shark Control Programs that use mesh nets. They are also recorded scavenging on the baits of drum-lines (Sumpton et al., 2010). In the NSW Shark Control Program, Krogh and Reid (1996) identified a total of 94 dolphins and "porpoises" were recorded in the shark meshing catches between 1950 and 1993, with a disproportionate number captured at Newcastle. Most of these were caught in the 1960s and 1970s and more recent catches average about one or two per year. Paterson (1990) recorded 520 dolphins caught in the Queensland shark meshing program between 1962 and 1988. He identified three species of dolphins in the southern Queensland shark meshing catches: the bottlenose dolphin (*Tursiops truncatus*); the common dolphin (*Delphinus delphinus*); and the Indo-Pacific humpback dolphin (*Sousa chinensis*). Only 13% of captured dolphins were recorded as released alive, although improvements in survival were predicted (Gribble et al., 1998). Cliff and Dudley (2011) also recorded low survival of dolphins captured in shark nets at KwaZulu-Natal.

Whales

Overall, the frequency of whale captures in shark control programs is low (Gribble et al., 1998; Green et al., 2009). For example, between 1962 and 1995, the QSCP captured eight humpback whales (*Megaptera novaengliae*) of which only five were released alive. In Queensland however; there is concern about the obstruction of humpback whale migratory routes from a number of shark control nets (Gribble et al., 1998). When a whale does become entangled in Queensland it frequently attracts media attention⁶.

Pinnipeds

Compared to the other species of conservation interest discussed, the frequency of interaction is relatively low. This is largely due to shark control programs not implemented in areas where pinniped populations are naturally absent, or at the very least low. The capture of seals however is documented in the NSW Shark Control Program (Green et al., 2009).

⁶ Some examples include: <http://www.brisbanetimes.com.au/queensland/baby-whale-freed-from-gold-coast-nets-20100904-14uvi.html> and <http://subtropic.com.au/2010/09/16/heartless-and-inhumane-remove-shark-nets-in-whale-season/>

Dugong

In Queensland Shark Control Program has been a significant source of anthropogenic mortality of dugong. In particular, the dugong capture in a number of nets was very high in early days of the QSCP (Marsh et al. 2001). In effect, the QSCP effectively made a significant contribution to "fishing down" dugong populations at the local level, and the cumulative impacts of these local declines is likely to be significant for the dugong population overall, given the life history of the animal, which is long-lived and has low fecundity.

Other Elasmobranch and Finfish Species

Species of sharks and rays that are not implicated in unprovoked shark attacks are frequently captured and generally make up the numerically dominant component of the bycatch (e.g. Weatherbee et al., 1994; Dudley et al., 1998; Green et al., 2009; Cliff and Dudley, 2011). Some of these species are recognised nationally and internationally as threatened species, while others are also garnering conservation attention. The survival of captured elasmobranchs is highly variable between species. In KwaZulu-Natal, Cliff and Dudley (2011) identify that tiger and raggedtooth (= grey nurse) sharks had the highest survival rates of approximately 40%, while very few hammerhead sharks were found alive.

Minimising Impacts and Alternative Methods

There have been a number of methods which have been trialled and evaluated in an attempt to reduce the impact of shark control methods on non-target species, while still providing a level of protection for beach users. In NSW, shark mesh nets are in place seasonally during the summer months which is the peak period of beach usage. This management approach reduces the overall soak time and hence, the number of non-target species that are caught annually.

The use of acoustic alarms or "pingers" has been trialled in Queensland with the aim of reducing bycatch of marine mammals – cetaceans and dugong. The use of pingers on shark control nets has been assessed in Queensland. The use of pingers was considered to result in an 18–90% reduction in shark catches (Anonymous 2001), which contradicted earlier observations reported in Gribble et al. (1998). The decrease in shark capture in nets fitted with pingers was regarded as a real decrease because drum-line catches at the same locations did not decrease to the same degree. In NSW, prior to the installation of pingers, an average of 3.3 dolphins were caught per year from 1990 - 2000, but since pingers were introduced the average has been reduced to 2 dolphins per year (Green et al., 2009). From the information in Green et al. (2009), it is not possible to determine whether the use of pingers has resulted in a statistically significant decrease in dolphin capture. In KwaZulu-Natal, on several occasions, bottlenose and Indo-Pacific dolphins were caught within ten metres of a dolphin pinger, suggesting that animals may have been attracted to the sound source (Cliff and Dudley, 2011).

There has also been considerable development and trialling of pingers in commercial net fisheries, and this information has relevance for nets used in shark control programs. Focusing on cetaceans, there has been a significant amount of overseas research focussing on the question of whether pingers work or not with considerable debate ensuing (e.g. Barlow and Cameron, 2003; Dawson and Lusseau, 2005; Teilmann, 2006). There are a number of particular challenges for testing the hypothesis in the field that pingers result in reduced cetacean by-catch and these include: pseudo-replication (the same dolphin and its response may be counted more than once), the generally low level of interactions leading to low statistical power, and the potential for habituation by dolphins to the devices (Dawson and Lusseau, 2005; Teilmann et al., 2006).

Sumpton et al. (2010) documented trials of different hook modification and baits on drum-lines that were aimed at reducing by-catch (Figure 2). Double hook lines did not differ significantly in shark catch compared with the standard single hook arrangement, but were more likely to catch green turtles. Plastic hook guards reduced the turtle bycatch by almost 70% but shark catch also declined significantly. Both mesh guards and hook shrouds dramatically reduced scavenging of baits by dolphins in the short-term but they may also increase the turtle catch and their impact on shark catch was inconclusive. None of the baits tested significantly reduced the incidental capture of marine turtles but several baits (particularly frozen shark flesh) reduced scavenging by dolphins.



Figure 2 Hook arrangements trialled by Sumpton et al. (2010) to reduce bycatch. a) Single hook baited with mullet (standard traditional approach), b) Double hook, c) Hook with plastic guard, d) Hook with mesh guard, and e) hook with shroud guard.

Methods have also been employed to attempt to maximise the survival of captured animals. The regular checking of shark nets (weather permitting) is the key aspect.

An approach to reduce the actual incidence of capture of sharks in general is to stimulate an approaching shark's electro-sensory system with the use of powerful permanent magnetic fields. By doing this, sharks can be repelled from the general area of the net. In a preliminary quantitative study, Connell et al. (2011) tested the use of permanent magnets on juvenile lemon sharks (*Negaprion brevirostris*) and found that permanent magnetic fields could exclude sharks from an area. However, Connell et al. (2011) also identified that further work needed to be undertaken on other sharks species including key species implicated in shark attacks, and impacts on other species. Green et al. (2009) reports that based on existing technologies, electrical deterrents were unlikely to be feasible and ongoing costs of the approach would have been prohibitive. While ongoing work on electrical repellents is being undertaken by the Natal Sharks Board, it is recognised that the deployment of electrical devices in surf conditions represents a significant (and as yet to be overcome) engineering challenge (Dudley et al., 2006). Chemical deterrents have also been trialled but their success under natural conditions is highly unlikely.

An Evaluation of the Applicability of Shark Control Methods for Western Australia

The WA coastline is considered to be a potential migratory pathway for great white sharks migrating between South Australia, the Southern and Indian oceans, and South Africa (Bruce et al., 2006). The great white shark is the main species implicated in shark attacks in WA. To date, Shark Attack Response Plans have been operational in WA since 2001 and these consist of conducting aerial surveillance patrols and public education strategies in an attempt to reduce risk of shark attack without the use of direct control measures. Following the recent shark attacks, the WA government is considering a potential range of additional measures and approaches to reduce the risk of shark attack.

As it currently stands, the *Fish Resources Management Act 1994* does not contain objectives related to public safety. In Queensland, the *Fisheries Act 1994* was amended to include the following: "*Despite the main purpose of this Act, a further purpose of this Act is to reduce the possibility of shark attacks on humans in coastal waters of the State adjacent to coastal beaches used for bathing.*" Should the Western Australian Department of Fisheries decide to implement a shark control program, the objectives of the Act may need to be amended to include an objective related to reduce the possibility of shark attack in coastal waters.

Shark control measures in Queensland and NSW are concentrated at specific regions where the number of water users is high. Recent shark attacks in Western Australia have occurred over a relatively large spatial scale. This could in part be due to the migratory nature of the white sharks, which is the species implicated in the recent Western Australian attacks. This relatively large spatial scale means that a prioritisation process would need to be undertaken to identify potential locations for shark control measures to be introduced.

When Shark Control Programs were introduced in Queensland, New South Wales and KwaZulu-Natal, they were done so at a time when the conservation needs of sharks (and other marine animals) were a lower societal priority than they are today. Cliff and Dudley (1992) identify that in the Cape waters of South Africa, despite a number of shark attacks in that region where shark control is absent, the growing conservation ethic among the public is unlikely to allow the installation of shark control nets in those waters. This is a challenge also faced by WA.

A key environmental issue with the use of mesh nets for shark control in both Queensland and NSW, is that catch rates of by-catch species were exceptionally high in the years just after placement of the nets in the water and then declined to relatively constant levels (Green et al., 2009). The most likely explanation for this is that the mesh nets "fished down" the local populations of a number of by-catch species. This is not surprising since the aim of shark nets is to fish down local fauna – specifically larger individuals of key species. It follows that local by-catch species are also likely to be fished down. In the case of dugong in Queensland and grey nurse sharks in NSW, the declines in the local populations are important in the context of the population as a whole. Similarly, in Western Australia the implementation of shark nets is likely to result in very high catch rates of by-catch during the initial few years.

In NSW and Queensland, their Shark Control Programs are long standing. If Western Australia proposed to implement shark control measures using similar apparatus, it is likely that the activity (= action) would need to be referred to the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999* to determine if the action is likely to affect Matters of National Environmental Significance (MNES). The key matter would be potential impacts on nationally threatened species or ecological communities, and listed migratory species.

Potential nationally threatened species of relevance to any proposed shark control activities in Western Australia includes:

- White shark (vulnerable, and a species implicated in shark attacks);
- Grey nurse shark (vulnerable, west coast population);
- Green sawfish (vulnerable);
- Freshwater sawfish (vulnerable);
- Loggerhead turtle (endangered);
- Leatherback turtle (endangered);
- Green turtle (vulnerable)
- Humpback whale (vulnerable);
- Southern right whale (endangered) and,
- Australian sea lion (vulnerable)

In the case of the NSW and Queensland shark control activities, they have little spatial overlap with pinnipeds. However, if shark nets were installed off southern Western Australian beaches, then these mammals, in particular the Australian sea lion (*Neophoca cinerea*) may also be captured. They may also hang around the nets and forage upon captured animals. Marine turtle interactions are likely to be significantly less than Queensland in the Perth and southern Western Australian regions due to latitude, however, loggerhead, green and leatherback turtles do utilise the area and individuals would potentially be at threat of capture. The threat of capture of marine turtles is likely to be higher as you move further north.

Given the numerous potential impacts on MNES, it is highly likely that the WA Government would need to prepare an EPBC Referral for submission by the Commonwealth which would need to outline the proposed activity in detail, the potential impacts on MNES, how potential impacts will be mitigated, and alternative approaches considered instead of the proposed activity. If appropriate "in-house" expertise exists then the WA Department of Fisheries could prepare the Referral themselves or alternatively it could be out-sourced. Upon receiving the EPBC Referral, the Commonwealth Environment Minister will make a decision as to whether the activity is a "controlled action" or not. If it is not a controlled action then no further assessment by the Commonwealth is required. If the Commonwealth Environment Minister deems the activity a controlled action then he or she will decide on the level of environmental assessment. From lowest to highest, the levels of environmental assessment are:

- Preliminary documentation (PD);
- Public Environment Report (PER);
- Environmental Impact Assessment (EIS); and,
- Commission of Inquiry (CI).

While the decision on whether an activity is a controlled action or not, and the level of environmental assessment required if it is deemed to be, rests solely with the Commonwealth Minister, the author will put forward his view, based on extensive experience, of the most likely outcome. It is the author's opinion that the Commonwealth Minister will deem the activity a controlled action if an EPBC Referral was prepared and lodged. Unlike most other activities where impacts on listed threatened species are incidental, shark control programs actually target the removal of one threatened species – the great white shark. Further though as this report has highlighted, they are well known to also impact other threatened species. The Shark Control Programs in both Queensland and New South Wales were in

place prior to the establishment of the *EPBC Act 1999* and were not the subject of environmental assessment by the Commonwealth prior to their introduction.

A shark control program is not a fishery as it does not aim to take fisheries resources for trade or commerce. As such, a strategic assessment of fisheries under Part 10 of the *EPBC Act* would not be an appropriate assessment pathway. It is the author's opinion that the Commonwealth Minister would deem either a PER or an EIS as the appropriate level of environmental assessment, with an EIS the most likely. It is highly likely that the WA Department of Fisheries would need to outsource preparation of the EIS. It is difficult to provide an exact estimate of cost as there are no terms of reference available and no specific proposal that would indicate any desired scale of shark control activities, a rudimentary estimate would be in the vicinity of \$800,000 to \$1,000,000.

The exact species that are likely to be impacted by the implementation of shark control measures will be influenced by the exact location and timing of these measures. However, assuming a focus in the summer months and at beaches in the Perth and beaches where recent shark attacks have occurred, as well as species that are listed as threatened by the Commonwealth, significant components of by-catch are likely to include:

- Sandbar shark (*Carcharhinus plumbeus*);
- Dusky shark (*Carcharhinus obscurus*);
- Whiskery shark (*Furgaleus macki*);
- Bottlenose dolphins (*Tursiops truncatus* and *Tursiops aduncus*); and

Although the capture of penguins is likely to be rare, it may still feasibly occur if a net was sighted near known penguin rookeries and feeding habitat (such as Penguin Island in Warnboro sound, the site of a fatal shark attack in December 2008). There are a number of other whale species that frequent Western Australian waters, including blue whales (*Balaenoptera musculus*) that generally inhabit deeper waters and would therefore be unlikely but not impossible to be caught by shark control equipment. There is historical entanglement of humpback whales with commercial fishing gear as the whales move southwards in Spring when they travel closer to the coast. As such, entanglement of humpback whales in shark nets for bather protection is a clear possibility. Overall, it is not possible to predict the exact number of animals of each species that would be captured in Western Australia should Shark Control Methods be implemented.

Shark control programs have gathered biological information, often in a structured and standardised way; that makes a significant contribution to the knowledge base of sharks, and in some instances has also gathered similar information for the marine animals of conservation significance. This in itself however, is not a specific reason to commence measures to protect humans from shark attack in Western Australian waters.

There is scope to further consider shark enclosures in WA as a method for providing bather protection at selected locations. Enclosures have the advantage of providing a direct physical barrier that prevents sharks from accessing an area and do not target the reduction in shark numbers or have bycatch of other large species like shark nets do. While enclosures are more suitable for calmer waters, new innovations in materials (e.g. marine mesh that is used in offshore aquaculture), may increase the potential scope of their use. Enclosures would provide a shark free area for bathing, however, they are unlikely to be a highly desirable location for other watersports such as diving, surfing and surf-skiing.

Discussion

Shark meshing using fixed nets is the most commonly applied approach for shark control, although drum-lines are also used and are considered a more selective approach (Gribble et al. 1998). This selectivity however also extends to the species of sharks captured. It has been identified that drum-lines are not as effective as nets at catching one of the shark species commonly implicated in shark attack - the bull shark (*Carcharhinus leucas*) (Cliff and Dudley, 2011). They are however identified as being effective for other species implicated in shark attack. Further, drum-lines can still have high by-catch of threatened species including some marine turtles and mammals.

As well as large sharks that pose a potential risk to humans, shark control programs also capture marine mammals, marine turtles, sharks and rays that are not implicated in unprovoked attacks, and some species of finfish. While the survival of captured species is highly variable, the largely indiscriminate nature of shark control nets in particular is cause for conservation concern. In Western Australia, dolphins, are likely to be at significant risk. Shark control measures may have significant implications for current and future dolphin-based tourism activities.

Weighing-up the competing needs for human safety and the conservation of threatened species is not a simple task. The conservation of sharks (including dangerous species) has higher community priority now, than it did when the major shark control programs were introduced in Australia and South Africa. The conservation of marine animals in general is also higher, and societal acceptance of a large number of animals being killed to increase the level of protection of people voluntarily undertaking a water-based recreational pursuit is also less.

Currently, the use of pingers (acoustic alarms) on shark mesh nets is not a panacea for reducing by-catch. Experimental work to unequivocally demonstrate their effectiveness or otherwise is difficult, but certainly not impossible. There would appear to be a clear difference in the effectiveness of pingers based on the by-catch species and biophysical characteristics of the environment. In at least one case reported in Cliff and Dudley (2011) the use of pingers is implicated in attracting dolphins to the area where nets are deployed resulting in a higher chance of interaction between the nets and the animals. The trialling of pingers is likely to continue for the purposes of minimising by-catch in shark meshing and commercial net fishing in general. The use of large scale "electrical shields" has also been trialled, but the results using existing technologies are not encouraging and this method is likely to remain unfeasible and cost prohibitive for a number of years, but is likely to be a source of further research.

An important consideration for Western Australia is whether shark nets will be effective at reducing the populations of great white sharks that are implicated in shark attacks. Great white sharks are migratory, while shark nets aim to reduce the local abundance of sharks. It would be expected that they would be more effective at reducing population of sharks that are more localised (e.g. bull sharks, which are extremely uncommon outside of the Swan-Canning river system). Consistent with this, in Queensland it is documented that great white shark catches in shark nets have not altered, while the catch of whalers have declined (Paterson, 1990). From the available information from existing shark control programs it is not possible, however, to determine the effectiveness of shark control programs at mitigating the risk of shark attack from a particular shark species.

If the Western Australia Department of Fisheries proceeds with the implementation of a Shark Control Program using nets and or drum-lines, it should be recognised that it will have significant upfront costs as well as significant ongoing costs which are likely to be in the vicinity of a \$1 million per year. The upfront costs would include an amount for environmental approvals which could be very significant, as well as the need to develop management protocols, data collection systems etc. If an Environmental

Impact Statement or a Public Environment Report were required by the Commonwealth, the timeframe to complete the environmental assessment and to gain the necessary approvals would most likely be 18 months to two years. There is no guarantee that should a Commonwealth approval be deemed necessary, that it would be granted by the Commonwealth.

There is scope to introduce shark enclosures which do constitute a barrier to sharks accessing a beach. This could be implemented on a seasonal or permanent basis. This approach is best implemented in calmer waters as heavy surf can damage gear, although new materials suggest that the approach can be more effective than has historically proven the case. Shark enclosures are the principal approach to protect swimmers in Hong Kong and since their installation, no fatalities have been recorded. Shark enclosures are only likely to be effective for bathers, but they will however avoid the significant environmental impacts that arise from using shark nets or drum-lines. A range of location specific issues would need to be addressed if shark enclosures were implemented and this includes local topography and the presence of existing structures (e.g. jetties), and any local changes to coastal processes (e.g. sand movement) as a result of the shark enclosures. Ongoing maintenance costs would need to be estimated and budgeted for. Liaison with City of Cape Town on their trial of a shark enclosure would be beneficial and would also assist understanding of whether shark enclosures changed beach usage patterns. Shark enclosures can be constructed and maintained by local authorities.

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