



Department of
**Primary Industries and
Regional Development**

Fisheries Management Paper No. 287

**Western Australian
Sea Cucumber Resource
Harvest Strategy 2018 – 2023**

Version 1.0

May 2018

Important disclaimer

The Chief Executive Officer of the Department of Primary Industries and Regional Development and the State of Western Australia accept no liability whatsoever by reason of negligence or otherwise arising from the use or release of this information or any part of it.

Department of Primary Industries and Regional Development
Gordon Stephenson House
140 William Street
PERTH WA 6000
Telephone: (08) 6551 4444
Website: dpird.wa.gov.au
ABN: 18 951 343 745

ISSN: 0819-4327

Copyright © Department of Primary Industries and Regional Development, 2018.

TABLE OF CONTENTS

INTRODUCTION	1
1.1 Review Process	1
2 SCOPE	1
2.1 Environmental Context	3
2.2 Target Species – Sandfish and Redfish	3
2.3 Fishing Activities	4
2.3.1 Governance	4
2.3.2 Commercial Fishing	4
2.3.3 Recreational Fishing	5
2.3.4 Customary Fishing	5
3 HARVEST STRATEGY	6
3.1 Long-Term Objectives	6
3.1.1 Ecological Sustainability	6
3.2 Operational Objectives	7
3.3 Overview of Management Approach	7
3.4 Overview of Harvest Strategy Procedures	7
3.5 Resource Status – Performance Indicators, Reference Levels & Control Rules	9
3.5.1 Identifying Performance Indicators & Reference Levels	9
3.5.1.1 Retained species	9
3.5.1.1.1 Sandfish (Kimberley)	9
3.5.1.1.2 Sandfish (Pilbara)	10
3.5.1.1.3 Redfish (Pilbara)	10
3.5.1.2 Risk Assessments	12
3.5.1.3 Economic & Social Benefits	12
3.5.2 Application of Harvest Control Rules	12
3.6 Annual Fishery Performance & Tolerance Levels	18
3.7 Monitoring and Assessment Procedures	18
3.7.1 Information and Monitoring	18
3.7.1.1 Fishery-Dependent Information	18
3.7.1.2 Fishery-Independent Information	18
3.7.2 Assessment Procedure	19

3.7.2.1	Target species	19
3.7.2.2	Risk Assessments.....	19
4	MANAGEMENT MEASURES AND IMPLEMENTATION.....	20
4.1	Management Measures	20
4.2	Implementing Changes to the Management Arrangements.....	21
4.2.1	Consultation.....	22
4.2.1.1	Commercial Sector Consultation.....	22
4.2.1.2	Consultation with Other Groups.....	22
4.3	Compliance and Enforcement.....	23
4.3.1	Operational Compliance Plan.....	23
4.3.1.1	Compliance Strategies	23
5	. PUBLIC CONSULTATION - DRAFT HARVEST STRATEGY.....	24
6	REFERENCES	25

INTRODUCTION

Harvest strategies for aquatic resources managed by the Western Australian (WA) Department of Primary Industries and Regional Development (the Department) are formal documents that are prepared based on a policy (Department of Fisheries 2015) to support the decision-making processes and ensure these processes are consistent with the principles of Ecologically Sustainable Development (ESD Steering Committee 1992; Fletcher 2002) and Ecosystem Based Fisheries Management (EBFM; Fletcher et al. 2012). The objectives of ESD are reflected in the objects of the *Fish Resources Management Act 1994* (FRMA) and the *Aquatic Resources Management Act 2016* (ARMA), which will replace the FRMA once enacted.

The publication of harvest strategies is intended to make the decision-making considerations and processes for the management of specified aquatic resources publicly transparent and provide a basis for informed dialogue on management actions with resource users and other stakeholders (Department of Fisheries 2015).

These strategies provide guidance for decision-makers, but do not derogate from or limit the exercise of discretion required for independent decision-making under the FRMA by either the Minister for Fisheries, the Department's Chief Executive Officer or other delegated decision-makers in order to meet the objects of the FRMA.

Harvest strategies make explicit the objectives, performance indicators, reference levels, and harvest control rules for each defined ecological asset, which are taken into consideration by the Department when preparing advice for the Minister for Fisheries (Department of Fisheries 2015). They also indicate the scope of management actions required in relation to the status of each resource in order to meet the specific long and short-term management objectives and the broader goals of ESD and EBFM. Finally, they specifically outline the expected performance of the fisheries that access each resource.

1.1 Review Process

The Western Australian harvest strategy policy (Department of Fisheries 2015) recognises that fisheries change over time and that a review period should be built into each harvest strategy to ensure that it remains relevant. This harvest strategy will remain in place for a period of five (5) years, after which time it will be fully reviewed. As this is the first harvest strategy for this resource, this document may be subject to review and amended as appropriate within this five year period.

2 SCOPE

This harvest strategy relates to the sea cucumber resource (also commonly referred to as beche-de-mer or trepang) of Western Australian (WA) and the fishing activities that impact this resource. Two key species, sandfish (*Holothuria scabra*) and redfish (*Actinopyga*

echinites), are targeted by the commercial WA Sea Cucumber Fishery (WASCF) through hand collection by diving and wading primarily in shallow waters from Exmouth Gulf to the Northern Territory border (Figure 1).

Small quantities of sea cucumber (different species to those targeted by the WASCF) are also collected by the Marine Aquarium Managed Fishery (MAF) for aquarium display purposes, and some are caught and discarded in trawl fisheries. Recreational and customary fishing for sea cucumbers is permitted, although catches are considered to be negligible. Thus the focus of this current harvest strategy is on the commercial WASCF for sandfish and redfish.

This harvest strategy has been developed in line with the Department’s overarching *Harvest Strategy Policy for Aquatic Resources* (Department of Fisheries 2015) which is consistent with relevant national policies / strategies (ESD Steering Committee 1992), guidelines (e.g. Sloan et al. 2014) and international best practice (Fletcher et al. 2016). It also sets out and summarises matters relevant to independent third-party certification assessment of the WASCF against the Marine Stewardship Council (MSC) standard for sustainable fishing and should be read in conjunction with other documentation relevant to this assessment.

This document has been developed via a consultative process with commercial and recreational fishing peak bodies and has been approved by the Minister for Fisheries.

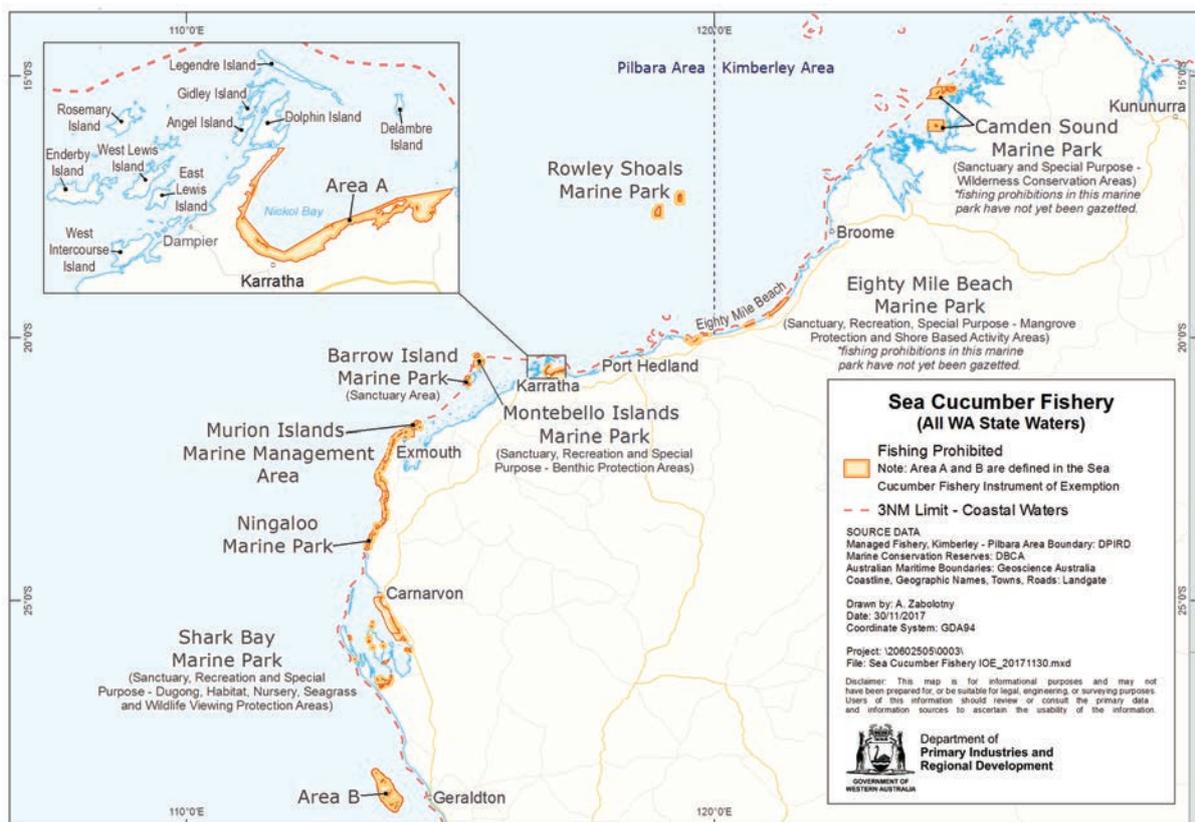


Figure 1. Fishing area (out to 3 nm) with closures (shaded areas) for the WASCF.

2.1 Environmental Context

Sea cucumbers are widely dispersed within tropical WA waters and are commercially targeted mainly in shallow waters of the Kimberley and Pilbara regions of the North Coast Bioregion (NCB, Figure 1). The NCB has a unique combination of features that distinguish it from other marine regions around Australia, including a wide continental shelf, very high tidal regimes, high cyclone frequency, unique current systems, warm oligotrophic surface waters and unique geomorphological features (Brewer et al. 2007). Coastal waters are generally low-energy in terms of wave action, but are seasonally influenced by intense, tropical cyclones, storm surges and associated rainfall run-off. These cyclone events generate the bulk of the annual rainfall, although the Kimberley coast does receive limited monsoonal thunderstorm rainfall over summer.

The Kimberley coast is highly indented, with bays and estuaries backed by a hinterland of high relief. Broad tidal mudflats and soft sediments with fringing mangroves are typical of this area. The eastern Pilbara coast is more exposed than the Kimberley, with few islands and extensive intertidal sand flats. Western Pilbara is characterised by a series of significant, but low-relief islands, including the Dampier Archipelago, Barrow Island and the Montebello Islands. Nearshore coastal waters include rocky and coral reef systems, as well as areas of soft sediments, salt-marshes and mangrove communities. In addition to a diversity of corals, fish, molluscs and other invertebrates, the nearshore waters of the NCB also has a number of Endangered, Threatened and Protected (ETP) species, including cetaceans, dugong, marine turtles, sea snakes, crocodiles, syngnathids (seahorses and pipefish), sharks, rays and birds (sea and shore).

2.2 Target Species – Sandfish and Redfish

Sea cucumbers are soft-bodied, elongated animals of the Phylum Echinodermata (Class Holothuroidea) that grow to around 400 mm in length. The two main commercially retained species in WA, sandfish (*H. scabra*) and redfish (*A. echinites*), are widely distributed on soft sediments throughout shallow waters of the Indo-Pacific region. In tropical WA, sandfish and redfish occur primarily within low energy environments behind fringing reefs or within protected bays.

The stock structures of the sandfish and redfish in WA have not yet been established, however, genetic studies of sandfish populations in the Northern Territory and Queensland waters have indicated genetically distinct stocks occur within these regions (Uthicke and Benzie 2001; Gardner and Fitch 2012). This suggests there may be genetic differences in stocks along the WA coast, and particularly between the fished stocks of the Kimberley and the Pilbara. Consequently, the harvest strategy recognises the need to manage these species by each regional area.

Sandfish spawning can occur year round, although the main spawning season occurs during September to November. In populations outside of WA, sexual maturity of sandfish occurs at approximately 140 mm in length or two years of age. The size at maturity of redfish is approximately 120 mm or two years of age.

2.3 Fishing Activities

2.3.1 Governance

Sea cucumbers in WA are currently targeted primarily by the commercial fishing sector, with the recreational and customary harvest considered to be negligible. These fishing sectors are managed by the Department under the following legislation:

- *Fish Resources Management Act 1994* (will be replaced by the *Aquatic Resources Management Act 2016* once enacted);
- *Fish Resources Management Regulations 1995* (FRMR);
- FRMA Section 43 Order No. 3 of 1999 – Prohibition on Fishing (Diving) Order;
- Notice No. 366 – Prohibition for commercial fishers to take fish of the classes *Gastropoda*, *Lamellibranchiata*, *Echinoidea*, *Asteroidea* and *Holothuroidea* unless the person has a licence authorising them to do so;
- FRMA Section 7 Exemption; and
- Regulation Licences, Commercial Fishing Licences and Fishing Boat Licences (and associated conditions).

Licence holders and fishers must also comply with the requirements of the:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC);
- *Western Australian Marine Act 1982*;
- *Western Australian Wildlife Conservation Act 1950*;
- *Western Australian Conservation and Land Management Act 1984*;
- *Western Australian Environmental Protection Act 1986*; and
- Any other legislation governing the use of the marine environment in which activities occur.

2.3.2 Commercial Fishing

Commercial fishing for sea cucumbers in WA began in 1995, and until 2007, it was primarily a single species fishery with 99% of the catch being sandfish. Deepwater redfish has since also been targeted.

The WASCf is a hand-harvest fishery, with animals caught principally by diving, and a smaller amount (< 5%) by wading. While the fishery is permitted to operate throughout WA waters, with the exception of several permanently-closed areas, fishing to date has only occurred in the NCB, from Exmouth Gulf to the Northern Territory border. This fishery is primarily a “pulse” fishing operation, whereby extremely remote areas of the Kimberley with sandfish occurring in commercial densities are generally accessed two or three times a year

for approximately two to three weeks per fishing trip. Other areas are targeted less frequently. Redfish stocks have typically been fished in the Pilbara only for a period of two months every third year.

The total annual catch of sea cucumbers in the WASCf has ranged between 0 (due to the rotational harvesting approach) and 252 tonnes live weight in the last 10 years. The fishery is managed through a range of input controls including limited entry, a maximum number of divers, spatial closures and gear restrictions (that includes permission of only hand-harvest methods). In addition to sandfish and redfish, six other species are permitted to be retained and records show minimal catches. Sea cucumbers are harvested and processed by gutting, blanching for 10-30 minutes and snap freezing. They are subsequently dried and packaged before being exported as “beche-de-mer” to Asian markets. Industry imposes a price penalty on sea cucumbers below the minimum target sizes to minimise collection of immature individuals.

The selective nature of the fishing method (hand collection by divers) ensures discards are minimal and minimises the risk of interactions with ETP species. There have been no interactions with any ETP species reported in the WASCf. For the most part, fishers dive directly from dinghies, which are fitted with a hookah system, to access very shallow bays and lagoons and return the catch to the mother boat. The divers collect the sea cucumbers as they drift over the bottom. There is minimal impact on the habitat as divers are highly selective in their fishing effort and no fishing gear/lines contact the seabed.

The MAF is permitted to collect sea cucumber species other than those targeted in the WASCf for marine aquarium display purposes only. The total annual catch of sea cucumbers by this fishery is capped at 3000 individuals, although the actual annual catch is much lower. Sea cucumbers are also caught as bycatch in very low numbers in WA’s inshore trawl fisheries and are typically species that are not retained by the WASCf. It is thought that mortality of sea cucumbers caught as bycatch is low as they are discarded back into the water within 10-30 minutes of capture.

In 2011 the FRMA was amended to allow for the issuing of non-transferable Regulation Licences to Aboriginal Bodies Corporate for commercial fishing for mud crabs, trochus and sea cucumbers. A Ministerial Policy Guideline is under development to guide the assessment and issuing of these Regulation Licences. To date one of these licences has been issued, but no harvest has been recorded against it.

2.3.3 Recreational Fishing

The recreational take of sea cucumbers is considered to be negligible.

2.3.4 Customary Fishing

The customary take of sea cucumbers is considered to be negligible.

3 HARVEST STRATEGY

This harvest strategy is structured to describe, hierarchically:

- 1) the high-level, long-term objectives of management (Section 3.1);
- 2) the short-term, operational objectives (Section 3.2); and
- 3) how these translate into the management approach used for this fishery (Section 3.3).

This is followed by a more detailed description of:

- 4) the harvest strategy procedures (Section 3.4);
- 5) the processes for managing stock status (Section 3.5);
- 6) fishery performance (Section 3.6); and
- 7) the specific monitoring and assessment procedures used to ascertain if objectives are being met (Section 3.7).

3.1 Long-Term Objectives

In addition to ensuring the biological sustainability of all captured aquatic resources, this harvest strategy includes broader ecological objectives for each ecosystem component or asset. Social and economic objectives for the resource have not been developed given the very small and remote harvest and value of the fishery.

3.1.1 Ecological Sustainability

- 1) To maintain spawning stock biomass of each retained species above B_{MSY} to maintain high productivity and ensure the main factor affecting recruitment is the environment;
- 2) To ensure fishing impacts do not result in serious or irreversible harm¹ to bycatch species' populations;
- 3) To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected species' populations;
- 4) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function; and
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to ecosystem structure and function.

¹ Serious or irreversible harm relates to a change caused by the fishery that fundamentally alters the capacity of the component to maintain its function or to recover from the impact.

3.2 Operational Objectives

Long-term management objectives are typically operationalised as short-term (e.g. annual), fishery-specific objectives, through one or more performance indicators, that can be measured and assessed against pre-defined reference levels so as to ascertain actual performance. Thus, within the context of the long-term objectives provided above, the harvest strategy has operational objectives to maintain each resource/component above the threshold level (and, where relevant, close to the target level), or rebuild the resource if it has fallen below the threshold or limit levels.

3.3 Overview of Management Approach

The harvest strategy for the sea cucumber resource of WA is a constant exploitation approach where the catch varies in proportion to variation in stock abundance. The sandfish fishery in the Kimberley is based on a large number of smaller populations that have been harvested over a longer time period, whereas the sandfish and redfish fisheries in the Pilbara primarily target dense but localised populations found in the Montebello Islands and the Dampier Archipelago. Consequently it is possible to conduct cost-effective fishery-independent biomass surveys of the sandfish and redfish stocks in the Pilbara region. Whether these approaches or a modified version of them, are applicable to the Kimberley area requires further investigation.

The WASCFC is managed through a range of input controls including limited entry, a maximum number of divers, spatial closures and gear restrictions (that includes permission of only hand-harvest methods). The key considerations informing the harvest strategy for the sea cucumber resource in WA are its geographical isolation, the spatially discrete nature of the resource, and the intrinsic vulnerability of sea cucumber stocks. Although there is no evidence of overexploitation in Australia, a recent review suggests that >50% of sea cucumber fisheries globally were overexploited, compared to <30% for finfish stocks (Purcell et al. 2013). In acknowledgement of the likelihood that separate genetic stocks of sandfish exist in the NCB, two stock units, the Kimberley and Pilbara, have been identified for management.

3.4 Overview of Harvest Strategy Procedures

The procedures used within this harvest strategy involve two interrelated decision-making processes. The first is the formal, resource-level review process that assesses the current status of the relevant stocks against defined (target, threshold and limit) reference levels to determine the risks associated with each operational objective. If the status falls outside the target reference level/range, Harvest Control Rules (HCRs) are triggered and management adjustments/measures implemented to return the resource status back to the target range.

The second process involves an annual, fishery-level review. This determines whether the current catch/effort by each of the relevant sectors is consistent with the levels defined (or expected) by the current HCRs and the status of the resource (i.e. the resource-level review process). If the annual catch, effort and/or catch rate for one or more species/sectors falls

outside of an annual tolerance range and cannot be adequately explained the performance is termed 'Unacceptable'. This result would generate a review that may lead to management adjustments, or the need for a re-assessment of the resource status and determine whether the current HCRs and their associated management arrangements are still appropriate. These are described in detail in the following sections.

3.5 Resource Status – Performance Indicators, Reference Levels & Control Rules

To determine the resource status for the WASCFC, suitable indicators have been selected to describe performance in relation to each management objective, with a set of reference levels established to separate acceptable from unacceptable performance. Where relevant, these levels include a:

- target level or range (i.e. where you want the indicator to be);
- threshold level at B_{MSY} (i.e. where you review your position); and
- limit level (i.e. where you do not want the indicator to be and below which there is a significantly increased risk of recruitment impairment).

Based on where the indicators sit in relation to each of their performance levels, HCRs define what specific management actions should occur.

3.5.1 Identifying Performance Indicators & Reference Levels

3.5.1.1 Retained species

Various fishery-dependent and fishery-independent information and monitoring data have been used to establish performance indicators and reference levels for the assessment of the three main sea cucumber stocks considered in this harvest strategy; Kimberley and Pilbara sandfish, and Pilbara redfish. The reference levels against which these indicators are compared are based on a defined reference period or point to determine the current status of each stock (Table 1).

3.5.1.1.1 Sandfish (Kimberley)

In the absence of fishery-independent survey data required to estimate biomass for sandfish in the Kimberley, the principal performance indicator for this stock uses standardised annual catch rates (catch per unit effort, SCPUE) as an index/proxy for biomass (Figure 3). The index accounts for spatial variability in catch and effort across the Kimberley, and changes in fishing efficiency over the history of the fishery.

Catch rate-based (target, threshold and limit) reference points for Kimberley sandfish have been calculated based on a reference period (2004-2017, see Table 1) during which the stock has been operating at a sustainable level (i.e. recruitment was not impaired; Figure 3). Consequently the threshold reference level for this stock has been set as the lowest catch rate observed during that period. For the purposes of this harvest strategy, the threshold is assumed to be at the level of B_{MSY} (Department of Fisheries 2015). Associated target and limit reference levels were then determined as 1.33 and 0.67 times the threshold value, respectively, as summarised in Table 2.

3.5.1.1.2 Sandfish (Pilbara)

The principal performance indicator for the Pilbara sandfish resource is a biomass estimate derived from a biomass dynamics model (Figure 4). The model incorporates catch data from the beginning of the fishery (1996 to 2017), catch rate data from the inception of the daily logbook program, and a fishery-independent survey biomass estimate from 2017. Associated reference levels set using the estimate of unfished biomass (B_0) in 1996 have been defined as: target (40% B_0), threshold (30% B_0) and limit (20% B_0) (Table 1). The rationale underpinning the selection of these levels, and modelling approach used to estimate unfished biomass, are described in Hart et al. (2018).

3.5.1.1.3 Redfish (Pilbara)

The principal performance indicator for the Pilbara redfish resource is a biomass estimate derived from a biomass dynamics model (Figure 5). The model incorporates catch data from the beginning of the fishery (2006 to 2017), catch rate data from the inception of the daily logbook program, and a fishery-independent survey biomass estimate from 2015. Associated reference points set using the estimate of unfished biomass (B_0) in 2006 have been defined as: target (40% B_0), threshold (30% B_0) and limit (20% B_0) (Table 1). The rationale underpinning the selection of these levels, and modelling approach used to estimate unfished and annual biomass, are described in Hart et al. (2018).

Table 1. Performance indicators (PIs) and, where applicable, reference periods used for setting reference levels for each PI

Species (Area)	Performance indicator (PI)	Reference Period	Justification
Sandfish (Kimberley)	Catch rate	2004 – 2017	Includes all available years of data which the fine-scale catch and effort data has been available. Reference levels define on year of lowest SCPUE, which is 2015. This set as the threshold level (30% virgin biomass).
Sandfish (Pilbara)	Biomass	1996	Unfished biomass (B_0) estimated for 1996. Reference levels defined as: Target (40% B_0), threshold (30% B_0) and limit (20% B_0) in relation to this.
Redfish (Pilbara)	Biomass	2006	Unfished biomass (B_0) estimated for 2006. Reference levels defined as: Target (40% B_0), threshold (30% B_0) and limit (20% B_0) in relation to this

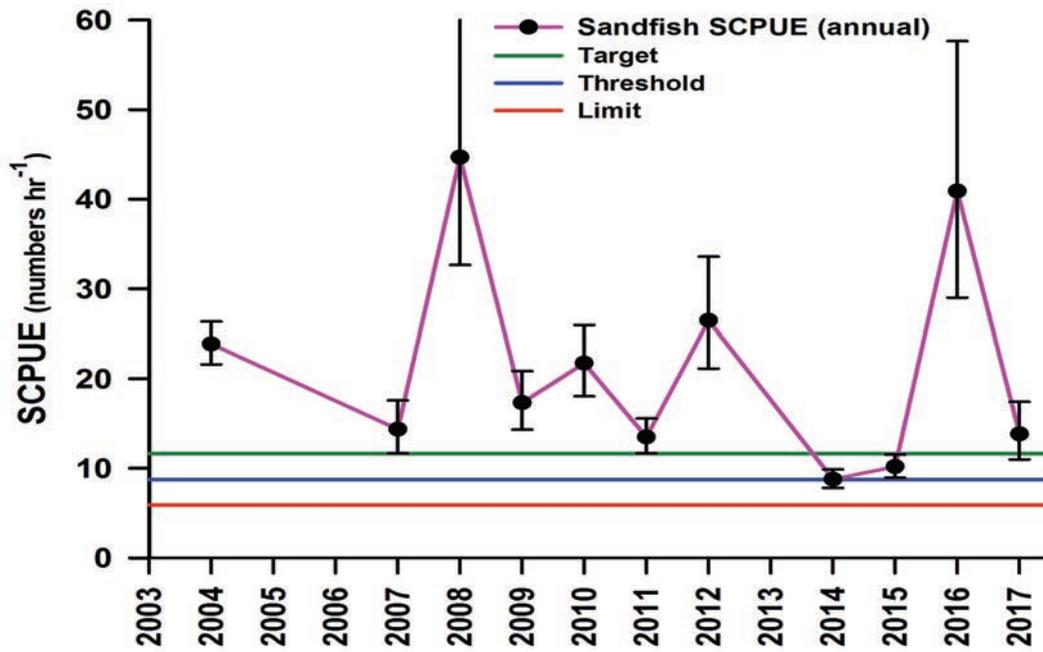


Figure 3. Kimberley sandfish stock (*Holothuria scabra*) SCPUE and reference points based on the lowest SCPUE observed during the 2004-2017 reference period. Error bars are 60% CL.

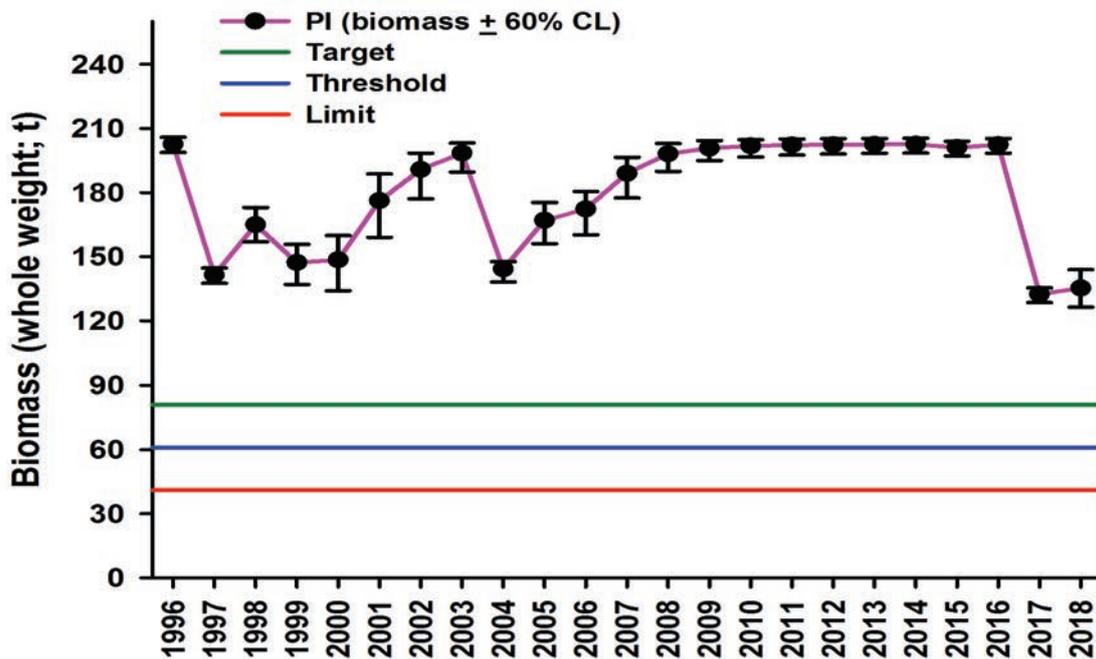


Figure 4. Pilbara sandfish stock (*Holothuria scabra*) biomass estimates with biomass reference points. Error bars are 60% CL. Reference points as follows: Target = 40 % of unfished biomass (B_0), Threshold = 30% B_0 , Limit = 20% B_0 .

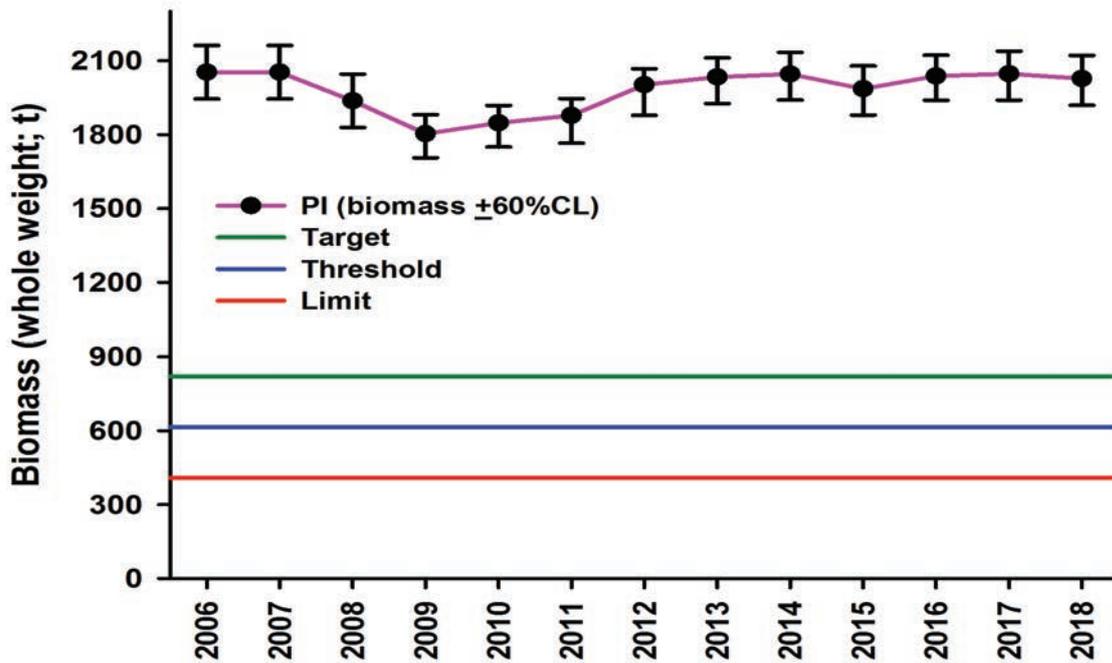


Figure 5. Pilbara redfish stock (*Actinopyga echinites*) biomass estimates with biomass reference points. Error bars are 60% CL. Reference points as follows: Target = 40 % of unfished biomass (B_0), Threshold = 30% B_0 , Limit = 20% B_0

3.5.1.2 Risk Assessments

Other ecological assets incorporated in this harvest strategy include bycatch, ETP species, habitats and ecosystem structure and function. Reference levels used to monitor performance against management objectives relating to these assets have been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher et al. (2012) and Fletcher (2015).

3.5.1.3 Economic & Social Benefits

The Department's Harvest Strategy Policy (2015) and the principles of ESD refer to the provision of social and economic objectives for some fisheries. In the case of the sea cucumber resource, social and economic objectives have not been developed at this time as there are no sectoral allocations and the commercial fishery is operated by one company which is primarily a pulse fishing operation.

Sea cucumber has been identified as a potential target species for commercial fishing by Aboriginal Bodies Corporate in order to provide for economic development opportunities for Aboriginal Corporations and communities in the future.

3.5.2 Application of Harvest Control Rules

For each performance indicator and associated reference level there needs to be accompanying guidance that leads to management decisions and actions. HCRs are the key part of the harvest strategy for directing what management decisions need to be made to meet sustainability objectives.

The HCRs in place for sandfish and redfish have been designed to reduce fishing effort as the performance indicators breach the reference points. It does this by implementing spatial closures in the affected management areas of the fishery, with the duration of these closures (2-3 years) increasing as the indicator approaches the limit reference point. To ensure the harvest strategy for the retained stocks are sufficiently precautionary, the HCRs for the threshold and limit reference levels are triggered when there is less than 80% probability that the performance indicator (P1) is still above this level (i.e. the lower 60% CL around the estimated catch rate or biomass breaches the reference point).

Table 2. Harvest strategy objectives, performance indicators (PIs), reference levels and control rules for the WA sea cucumber resource and associated assets that may be impacted by fishing activities. Note the reference levels prescribe the operational objective which is to maintain each resource above the threshold level and near the target level.

Component	Management Objectives	Resource / Asset	Performance Indicators (PI)	Reference Levels	Control Rules
Retained species	To maintain spawning stock biomass of each retained species above B_{MSY} to maintain high productivity and ensure the main factor affecting recruitment is the environment	Sandfish (Kimberley stock)	Annual standardised catch rate (numbers per hour)	<p>Target: 11.67</p> <p>Threshold: 8.75</p> <p>Limit: 5.84</p>	<p>1. If the PI is \geq Target, no specific management action required.</p> <p>2. If the PI is $<$ Target and \geq Threshold, review all available information to decide if further management action is required.</p> <p>If there is $<80\%$ probability that the PI is $>$ Threshold, implement a 2 year spatial closure for the stock.</p> <p>If there is $<80\%$ probability that the PI is $>$ Limit, implement a 3 year spatial closure for the stock.</p>
		Sandfish (Pilbara stock)	Annual biomass estimate (tonnes whole weight)	<p>Target: 81</p> <p>Threshold: 61</p> <p>Limit: 41</p>	<p>1. If the PI is \geq Target, no specific management action required.</p> <p>2. If the PI is $<$ Target and \geq Threshold, review all available information to decide if further management action is required.</p> <p>If there is $<80\%$ probability that the PI is $>$ Threshold, implement a 2 year spatial closure for the stock.</p> <p>If there is $<80\%$ probability that the PI is $>$ Limit, implement a 3 year spatial closure for the stock.</p>

<p>Retained species cont.</p>	<p>Redfish (Pilbara stock)</p> <p>Annual biomass estimate (tonnes whole weight)</p>	<p>Target: 821</p> <p>Threshold: 615</p> <p>Limit: 410</p>	<p>1. If the PI is \geq the Target, no specific management action required.</p> <p>2. If the PI is $<$ Target and \geq Threshold, review all available information to decide if further management action is required.</p> <p>If there is $<80\%$ probability that the PI is $>$ Threshold, implement a 2 year spatial closure for the stock.</p> <p>If there is $<80\%$ probability that the PI is $>$ Limit, implement a 3 year spatial closure for the stock.</p>
<p>Bycatch (non-Endangered, Threatened and Protected species)</p> <p>To ensure fishing impacts do not result in serious or irreversible harm to bycatch species' populations.</p>	<p>All bycatch species²</p> <p>Periodic risk assessments incorporating current management arrangements, catch levels, species information and available research.</p>	<p>Target: Fishing impacts expected to generate an acceptable level of risk to all bycatch species' populations, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any bycatch species' populations, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any bycatch species' populations, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>

² Bycatch when harvesting sea cucumbers is minimal due to the highly selected fishing method, however, it may include any "piggy back" species (which is unlikely but possible) and discarded catch of non-target species or small individuals

<p>Endangered, Threatened and Protected (ETP) species</p>	<p>To ensure fishing impacts do not result in serious or irreversible harm to ETP species' populations.</p>	<p>All ETP species</p>	<p>Periodic risk assessments incorporating current management arrangements, number of reported interactions, species information and available research.</p>	<p>Target: Fishing impacts expected to generate an acceptable level of risk to ETP species populations and stocks, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any ETP species' populations and stocks, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ETP species' populations and stocks, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>
<p>Habitats</p>	<p>To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.</p>	<p>Benthic habitats</p>	<p>Periodic risk assessments incorporating current management arrangements, extent of fishing activities, habitat distribution and available research.</p>	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to habitat structure and function, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to habitat structure and function, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to habitat structure and function, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>

<p>Ecosystem To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.</p>	<p>Trophic interactions Community structure</p>	<p>Periodic risk assessments incorporating current management arrangements, extent of fishing activities, ecosystem information and available research.</p>	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to ecosystem structure and function, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to ecosystem structure and function, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to ecosystem structure and function, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>
---	---	---	---	---

3.6 Annual Fishery Performance & Tolerance Levels

Defining annual tolerance levels provides a formal but efficient basis to annually evaluate the effectiveness of current management arrangements in delivering the levels of catch (or effort for quota-managed fisheries), specified by HCRs and where relevant, any sectoral allocation decisions (Fletcher et al. 2016). If the annual catch/effort remains within the ‘tolerance range’ (based on historical variations in recruitment and/or fishing operations) the fishery is considered to be operating ‘acceptably’ with no need to review the management settings. Where the annual catch or effort falls outside of this range and this cannot be adequately explained (e.g. documented evidence of, for example, environmental or market induced impacts), this will result in a review of the cause which may lead to a re-assessment of the resource status. This would necessitate reassessing the status against the PIs and HCRs which could potentially lead to a change in management settings and therefore a revision of the tolerance levels.

The annual catch tolerance ranges for the WASCf are based on historic catch levels, recognising that the rotational harvesting approach will frequently lead to zero catches. The catch tolerance levels are reviewed annually and published in the State of the Fisheries and Aquatic Resource Report and in the Department’s Annual report to the WA Parliament.

Table 3. Annual catch tolerance ranges (in tonnes, t) for the sandfish and redfish stocks

Species	Annual Catch Tolerance Range
Sandfish (Kimberley)	0 – 50 t
Sandfish (Pilbara)	0 – 50 t
Redfish (Pilbara)	0 – 150 t

3.7 Monitoring and Assessment Procedures

3.7.1 Information and Monitoring

3.7.1.1 Fishery-Dependent Information

Monitoring of the fishery has occurred since the inception of the fishery in 1995, initially from mandatory monthly catch and effort returns, followed by daily reporting of catch and effort in fishers’ “daily logbooks” since 2007 (but first trialled in 2004). The logbooks contain species-specific, fine-scale data on GPS location, catch (number and weight) and effort (number of dives, duration or waded distance) and appropriate environmental information, such as depth fished and any ETP species interactions. Commercial catch rates based on these daily logbook data are used in the assessment of sea cucumber stocks.

3.7.1.2 Fishery-Independent Information

Population surveys have been undertaken on a periodic basis over the history of the WASCf. An experimental trial involving commercial fishers to evaluate abundance in two different

areas was undertaken in 2004. It was found that the densities of sandfish recorded in Nickol Bay of the Pilbara region were five times greater than in the key fishing areas in the Kimberley region.

In addition, fishery-independent population surveys of Pilbara redfish and sandfish populations have been undertaken in 2015 and 2017, respectively. These will be repeated every five years to inform the biomass based harvest strategy. The survey design is a stratified systematic survey design using fine-scale GPS spatial information derived from the fishery logbooks.

Where appropriate, and resources permitting, it is expected that fishery-independent population surveys will occur when previously unexploited stocks are discovered and the resultant biomass estimates updated used to inform the harvest strategy for the relevant stocks.

3.7.2 Assessment Procedure

3.7.2.1 Target species

The stock status of the WA sea cucumber resource is assessed using a weight-of-evidence approach that considers all of the available (fishery-dependent and fishery-independent) information for this resource (Hart et al. 2018). This annual assessment is primarily based on the monitoring of catch, effort, catch distribution, trends in size-structure, standardised fishery-dependent catch rates for Kimberley sandfish and biomass surveys for Pilbara sandfish and redfish. Each line of evidence is considered independently of, and in conjunction with, all other lines of evidence to arrive at a risk assessment for each species in each area.

3.7.2.2 Risk Assessments

The Department uses a risk-based EBFM framework to assess the impacts of fishing on all parts of the marine environment, including target species, bycatch, ETP species, habitats and the ecosystem. In line with this framework, periodic risk assessments are conducted for the WASCf. These assessments are used to prioritise research, data collection and monitoring needs, as well as management actions for the WASCf to ensure that fishing activities are managed both sustainably and efficiently.

In 2016, an ecological risk assessment workshop was held to assess the impacts of the WASCf (Webster & Hart 2018). The outcomes of the workshop were sent to stakeholders for comment and review which included representatives from the (then) Department of Parks and Wildlife, WASCf industry, the Western Australian Fishing Industry Council (WAFIC) and environmental groups and then published in a report.

The risk assessment framework applied during the workshop was based on the global standard for risk assessment and risk management (AS/NZS ISO 31000), which has been adopted for use in a fisheries context (Fletcher et al. 2002; Fletcher 2015).

Four aspects were considered for the assessment: ecological sustainability, community well-being, external factors and governance (note only ecological sustainability is currently considered as part of this harvest strategy). Fourteen ecological components were identified as being potentially impacted by the WASCF operations, with 31 possible associated issues.

Risk assessments will be undertaken periodically (every 3 – 5 years) to reassess any current or new issues that may arise in the WASCF. A risk assessment can also be triggered if there are significant changes identified in fishing operations, management activities or controls that may change the current risk levels.

4 MANAGEMENT MEASURES AND IMPLEMENTATION

4.1 Management Measures

The FRMA provides the overarching legislative framework to implement the management arrangements for the commercial and recreational catch of sea cucumbers. There are a number of management measures in place for the sea cucumber resource (Table 4) that are used to help achieve the management objectives.

Table 4. Management measures and instrument of implementation for the Sea Cucumber Resource

Measure/ Control	Description	Instrument
Limited Entry	Only six Fishing Boat Licence holders are permitted to take commercial species of sea cucumbers for a commercial purpose (with each licenced fishing boat permitted to have no more than 4 dinghies).	<i>Section 7 Exemption from Notice 366 and Order No. 3 of 1999</i>
	Twelve Marine Aquarium Managed Fishery (MAF) Licence holders are permitted to take no more than 3000 individuals of other species not retained in the WASCF for marine aquarium display purposes.	<i>Section 7 Exemption from Notice 366 and Order No. 3 of 1999</i>
	Applications for new entrants to the Aboriginal Bodies Corporate Regulation Licence sector will be considered in line with the Aboriginal Body Corporate Licence Policy (Department of Primary Industries and Regional Development, in prep).	<i>Regulation Licence</i>
Species Restrictions	The WASCF is limited to the collection of eight sea cucumber species.	<i>Section 7 Exemption</i>
	The MAF may collect any species except for six of the eight permitted commercial species in the WASCF.	

Size Restrictions ³	There are species dependent minimum target sizes in place. 160 mm for sandfish (<i>Holothuria scabra</i>); 120 mm for deep water redfish (<i>Actinopyga echinitis</i>); 320 mm for white teat fish (<i>Holothuria fuscogilva</i>); 260 mm for black teat fish (<i>Holothuria whitmaei</i>); 300 mm for prickly red fish (<i>Thelenota aranas</i>); 150 mm for lolly fish (<i>Holothuria atra</i>); 280 mm for brown curry fish (<i>Stichopus vastus</i>); and 280 mm for curry fish (<i>Stichopus hermanni</i>).	<i>Voluntary since March 2017</i>
Method Restrictions	Sea cucumbers can only be taken by means of diving and/or by hand.	<i>Section 7 Exemption</i>
Diver Restrictions	In the WASCf, no more than 10 crew members are permitted to operate on each Licensed Fishing Boat named on the Fishing Boat Licence. No more than 4 crew are permitted to dive for sea cucumbers at any one time on each Licensed Fishing Boat named on the Fishing Boat Licence. In the MAF, no more than three divers are permitted to take sea cucumbers at any one time.	<i>Section 7 Exemption</i>
Licence Requirements	Operators in the WASCf and MAF must hold a Commercial Fishing Licence and Fishing Boat Licence.	<i>FRMR</i>
Spatial Restrictions	There are several closed areas within the Dampier region. Fishing is also prohibited within a 5 nm radius of Cape Keraudren, 2 nm radius of the Rowley Shoals and within the waters of the Abrolhos Islands Fish Habitat Protection Area. Fishing is not permitted in some zones of marine parks.	<i>Section 7 Exemption</i>
Notification prior to fishing	Fishers in the WASCf are required to advise the Department at least 6 hours prior to commencing fishing of details including the proposed place and time of landing fish ⁴	<i>Section 7 Exemption</i>
Recreational bag limit	The daily bag limit for recreational catch is 10 sea cucumbers	<i>FRMR (Schedule 3, Part 6)</i>

4.2 Implementing Changes to the Management Arrangements

Decision-making processes can be triggered following the identification of new or potential issues as part of an ecological risk assessment (generally reviewed every 3 – 5 years), results of research, management or compliance projects or investigations, monitoring or assessment outcomes (including those assessed as part of the harvest strategy) and /or expert workshops and peer review of aspects of research and management.

³ Based on Northern Territory estimates of size at sexual maturity.

⁴ Note: This notification requirement will be replaced by the Vessel Monitoring System notification once the management plan is in force.

There are two main processes for making decisions about the implementation of management measures and strategies in the WASCF:

- Annual decision-making processes that may result in measures to meet the operational objectives (driven by the harvest strategy); and
- Longer-term decision-making processes that result in new measures and / or strategies to achieve the long-term objectives (i.e. changes to the management system).

If there is an urgent issue, stakeholder meetings may be called on an as-needed basis to determine appropriate management action.

4.2.1 Consultation

Management changes are generally given effect through amendments to the Instrument of Exemption and subsidiary legislation such as Orders. These changes generally require the approval of the Minister for Fisheries and/or the CEO of the Department (or appropriate delegates). In making decisions relevant to fisheries, the Minister for Fisheries may choose to receive advice from any source, but has indicated that:

1. The Department is the primary source of management advice; and
2. Peak Bodies (WAFIC and Recfishwest) are the primary source of industry advice and representation.

The peak bodies are funded by Government under Service Level Agreements (SLA) to undertake their representation/advisory and consultation roles.

4.2.1.1 Commercial Sector Consultation

Under its SLA with the Department, WAFIC has been funded to undertake statutory consultation functions related to fisheries management and the facilitation of Annual Management Meetings (AMM) for licensed fisheries.

AMMs between the Department, WAFIC and licence holders are used as the main forum to consult with stakeholders and licence holders on the management of the WASCF. During these meetings, current and future management issues that may have arisen during the previous fishing season, and any proposed changes to the management structure, are discussed. Follow-up meetings may be held as required.

4.2.1.2 Consultation with Other Groups

Consultation with non-fisher stakeholders including Government agencies, conservation sector Non-Government Organisations, customary fishers, statutory advisory committees and other affected / interested parties is undertaken in accordance with the Department's Stakeholder Engagement Guideline (Department of Fisheries 2016). The Department's approach to stakeholder engagement is based on a framework designed to assist with selecting the appropriate level of engagement for different stakeholder groups and includes collaborating with, and involving, key stakeholders. Input from interested parties is sought

through a public consultation process and keeping all parties fully informed through the provision of balanced, objective and accurate information. Key fishery-specific documents, such as harvest strategies, recovery plans and bycatch action plans, are subject to both formal key stakeholder consultation and public consultation processes.

4.3 Compliance and Enforcement

A primary objective of the Department regarding compliance is to encourage voluntary compliance through education, awareness and consultation activities.

4.3.1 Operational Compliance Plan

Enforcement of management arrangements (Table 3) is planned by using an Operational Compliance Plan (OCP), with a specific plan developed for the WASCf. An OCP is informed and underpinned by a compliance risk assessment conducted for each fishery and reviewed every 1 – 2 years. The WASCf OCP has the following objectives:

- To provide clear and un-ambiguous direction and guidance to Fisheries and Marine Officers for the delivery of compliance in the WASCf;
- To protect the fisheries' environmental values, whilst providing fair and sustainable access to the fisheries' commercial and social values;
- To encourage voluntary compliance through education, awareness and consultation activities; and
- To provide processes which ensure that the fisheries are commercially viable in the international market yet environmentally sustainable in the local context.

4.3.1.1 Compliance Strategies

Compliance strategies that are used in the SCF include:

- catch unload inspections in port;
- at sea fishing boat inspections;
- education strategies; and
- Vessel Monitoring Systems.

Inspections may involve:

- inspection and verification of Automatic Location Communicators;
- inspection of all authorisations;
- observations of fishing processes and crew activity; and
- inspection of holding tanks, freezers and fish on-board the vessels.

5 . PUBLIC CONSULTATION - DRAFT HARVEST STRATEGY

The draft Harvest Strategy was released for one month's public consultation from 16 May to 13 June 2018. The consultation was notified on the Department's Public comment and consultation webpage, and email notification of the consultation was sent to 33 stakeholders identified by the Department.

No comment or submissions were received.

6 REFERENCES

- Brewer, D.T., Lyne, V., Skewes, T. and Rothlisberg, P. (2007). Trophic Systems of the North West Marine Region Prepared for the Department of the Environment, Water, Heritage and the Arts by CSIRO Marine and Atmospheric Research, Cleveland, Queensland.
- Department of Fisheries (2015). Harvest Strategy Policy for the Aquatic Resources of Western Australia. Fisheries Management Paper No. 271. Department of Fisheries, Western Australia.
- Department of Fisheries (2016). Guidelines for stakeholder engagement on aquatic resource management-related processes. Fisheries Occasional Publication No. 131. Department of Fisheries, Western Australia.
- Department of Primary Industries and Regional Development (in prep). Matters related to issuing of Aboriginal Body Corporate Licences for commercial fishing. Ministerial Policy Guideline No. x. Department of Primary Industries and Regional Development, Western Australia.
- ESD Steering Committee (1992). National Strategy for Ecologically Sustainable Development. Endorsed by the Council of Australian Governments, December 1992. ISBN0 644 27253 8.
- Fletcher ,W.J. (2002). Policy for the implementation of ecologically sustainable development for fisheries and aquaculture within Western Australia. Fisheries Management Paper No. 157. Department of Fisheries, WA.
- Fletcher, W.J. (2015). Review and refinement of an existing qualitative risk assessment method for application within an ecosystem-based fisheries management framework. *ICES Journal of Marine Science* 72: 1043-1056.
- Fletcher, W., Chesson, J., Sainsbury, K., Fisher, M., Hundloe, T., & Whitworth, B. (2002). Reporting on Ecologically Sustainable Development: A “how to guide” for fisheries in Australia. Canberra, Australia. 120 pp.
- Fletcher, W.J., Gaughan, D.J., Metcalf, S.J., & Shaw, J. (2012). Using a regional level, risk based framework to cost effectively implement Ecosystem Based Fisheries Management (EBFM). In: *Global progress on Ecosystem-Based Fisheries Management* (G.H. Kruse, H.I. Browman, K.L. Cochrane, D. Evans, G.S. Jamieson, P.A. Livingston, D. Woodby, C. Ik Zhang eds.). Fairbanks: Alaska Sea Grant College Programme 129-46.
- Fletcher, W.J., Wise, B.S., Joll, L.M., Hall, N.G., Fisher, E.A., Harry, A.V., Fairclough, D.V., Gaughan, D.J., Travaille, K., Molony, B.W., & Kangas, M. (2016). Refinements to harvest strategies to enable effective implementation of Ecosystem Based Fisheries Management for the multi-sector, multi-species fisheries of Western Australia. *Fisheries Research* 183: 594-608.

- Gardner, M.G., & Fitch, A.J. (2012). Population genetic structure of sea cucumbers (beche-de-mer) in northern Australia. Seafood CRC Project No. 2008/733.
- Hart, A.M., Murphy, D.M., Caputi, N., Hesp, S.A., & Fisher, E.A. (2018, in review). Resource Assessment Report: Western Australian Sea Cucumber Resource. Fisheries Research Report No. XXX, MSC Report Series No. XX. Department of Primary Industries and Regional Development, Western Australia.
- Purcell, S.W., Mercier, A., Conand, C., Hamel, J., Toral-Granda, M.V., Lovatelli, A., & Uthicke, S. (2013). Sea cucumber fisheries: global analysis of stocks, management measures and drivers of overfishing. *Fish and Fisheries* 14: 34-59.
- Sloan, S.R., Smith, A.D.M., Gardner, C., Crosthwaite, K., Triantafillos, L., Jeffries, B., & Kimber, N. (2014). National Guidelines to Develop Fishery Harvest Strategies. Final report to the FRDC on Project No. 2010/061. Primary Industries and Regions, South Australia, Adelaide.
- Uthicke, S., & Benzie, J.A.H. (2001). Restricted gene flow between *Holothuria scabra* (Echinodermata: Holothuroidea) populations along the north-east coast of Australia and the Solomon Islands. *Marine Ecology Progress Series* 216: 109-117.
- Webster, F., Hart, A. (2018, in review). Ecosystem Based Fisheries Management (EBFM) Risk Assessment of the Western Australian Sea Cucumber Fishery. Fisheries Research Report No. XXX, MSC Report Series No. XX. Department of Primary Industries and Regional Development, Western Australia.