



Department of
**Primary Industries and
Regional Development**

Fisheries Management Paper No. 302

**West Coast Deep Sea Crustacean Resource
Harvest Strategy
2020-2025**

November 2020

Previous Harvest Strategies in this series

Publication Series Title	Change Description	Date
Fisheries Management Paper No. 272	First published harvest strategy for the West Coast Deep Sea Crustacean Fishery	2015
Fisheries Management Paper No. 302	<ul style="list-style-type: none">• Division of B Class units to B and C Class• Removal of secondary indices	November 2020

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, 2020.

TABLE OF CONTENTS

1 INTRODUCTION	1
1.1 Review Process	1
2 SCOPE	2
2.1 Environmental Context	4
2.2 Target Species	4
2.2.1 Crystal Crab	4
2.2.2 Champagne Crab	4
2.2.3 Giant Crab	4
2.3 Fishing Activities	5
2.3.1 Governance	5
2.3.2 Commercial Fishing	5
2.3.3 Recreational Fishing	6
2.3.4 Customary Fishing	6
3 HARVEST STRATEGY	7
3.1 Long-Term Objectives	7
3.1.1 Ecological Sustainability:	7
3.1.2 Social and Economic Objective	8
3.2 Operational Objectives	8
3.3 Harvesting and Management Approaches	8
3.4 Ecological Sustainability	8
3.4.1 Performance Indicators and Reference Levels	9
3.4.2 Application of Harvest Control Rules	10
3.5 Fishery Performance	15
3.6 Monitoring and Assessment Procedures	17
3.6.1 Information and Monitoring	17
3.6.2 Assessment Procedures	18
4 MANAGEMENT MEASURES AND IMPLEMENTATION	19
4.1 Management Measures	19
4.2 Implementing Changes to the Management Arrangements	20
4.2.1 Consultation	20
4.3 Compliance and Enforcement	21

4.3.1 Operational Compliance Plan	21
5 REFERENCES	22

1 INTRODUCTION

Harvest strategies for aquatic resources in Western Australia (WA) that are managed by the Western Australian Department of Primary Industry and Regional Development (DPIRD, the Department) are formal documents that support decision-making processes and ensure these are consistent with the principles of Ecologically Sustainable Development (ESD; 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), Section 3 and the *Aquatic Resources Management Act 2016* (ARMA), Section 9, which will replace the FRMA once enacted.

This harvest strategy has been developed in line with the Department's Harvest Strategy Policy for Aquatic Resources (Department of Fisheries 2015) and is consistent with relevant national harvest strategy policies and guidelines (e.g. Sloan et al. 2014; Department of Agriculture and Water Resources 2018a, b). It makes explicit the performance indicators, reference levels, and harvest control rules designed to achieve the specific long- and short-term management objectives for the resource, and the broader goals of ESD and EBFM.

The publication of this strategy 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). This strategy provides guidance for decision-makers, but do not derogate from or limit the exercise of discretion required for independent decision-making by the Minister for Fisheries, the Chief Executive Officer (CEO) of DPIRD, or other delegated decision-makers in order to meet the objects of the FRMA or ARMA.

Consistent with the Department's Stakeholder Engagement Guideline (Department of Fisheries 2016), this harvest strategy has been subjected to formal stakeholder consultation with industry members and peak commercial and recreational fishing sector bodies, as well as public consultation processes. It has been approved by the Minister for Fisheries.

1.1 Review Process

The WA harvest strategy policy (Department of Fisheries 2015a) 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 is the second version of the harvest strategy for this fishery, which has been updated following a review in 2019. The review of the harvest strategy was necessary due to the separation of the B class units (combined champagne and giant crab) into individual units for champagne (B Class) and giant crabs (C class). This harvest strategy will remain in place for a period of five years, after which time it will again be fully reviewed. If required, however, this document may be subject to review and amended within this five-year period.

2 SCOPE

This harvest strategy has been developed for the West Coast Deep Sea Crustacean Resource, with is primarily accessed by the West Coast Deep Sea Crustacean Managed Fishery (WCDSCMF), with some components of the resource accessed by the West Coast Rock Lobster Managed Fishery (WCRLMF). The resource principally comprises of crystal crab (*Chaceon albus*), champagne crab (*Hypothalassia ascerba*) and giant crab (*Pseudocarcinus gigas*) in offshore waters north of Augusta (34°24' S latitude) through to the Northern Territory border and seaward of the 150 m isobath (Figure 1). The WCDSCMF is the only fishery that targets the three aforementioned deep sea crab species of the resource with the WCRLMF taking champagne crab as a by-product when deep-water fishing as part of the annual “whites” migration of western rock lobster (*Panulirus cygnus*).

In addition to considering fishing impacts on the resources’ main species (i.e. crystal, giant and champagne crab), this harvest strategy also covers impacts on other captured species, bycatch¹, endangered, threatened and protected (ETP) species, habitats and other ecological components to ensure the risks to these elements are managed effectively.

¹ *Bycatch* is described as the part of the catch which is returned to the sea (usually referred to as non-retained or discarded) either because it has no commercial value or because legislative requirements preclude it being retained.

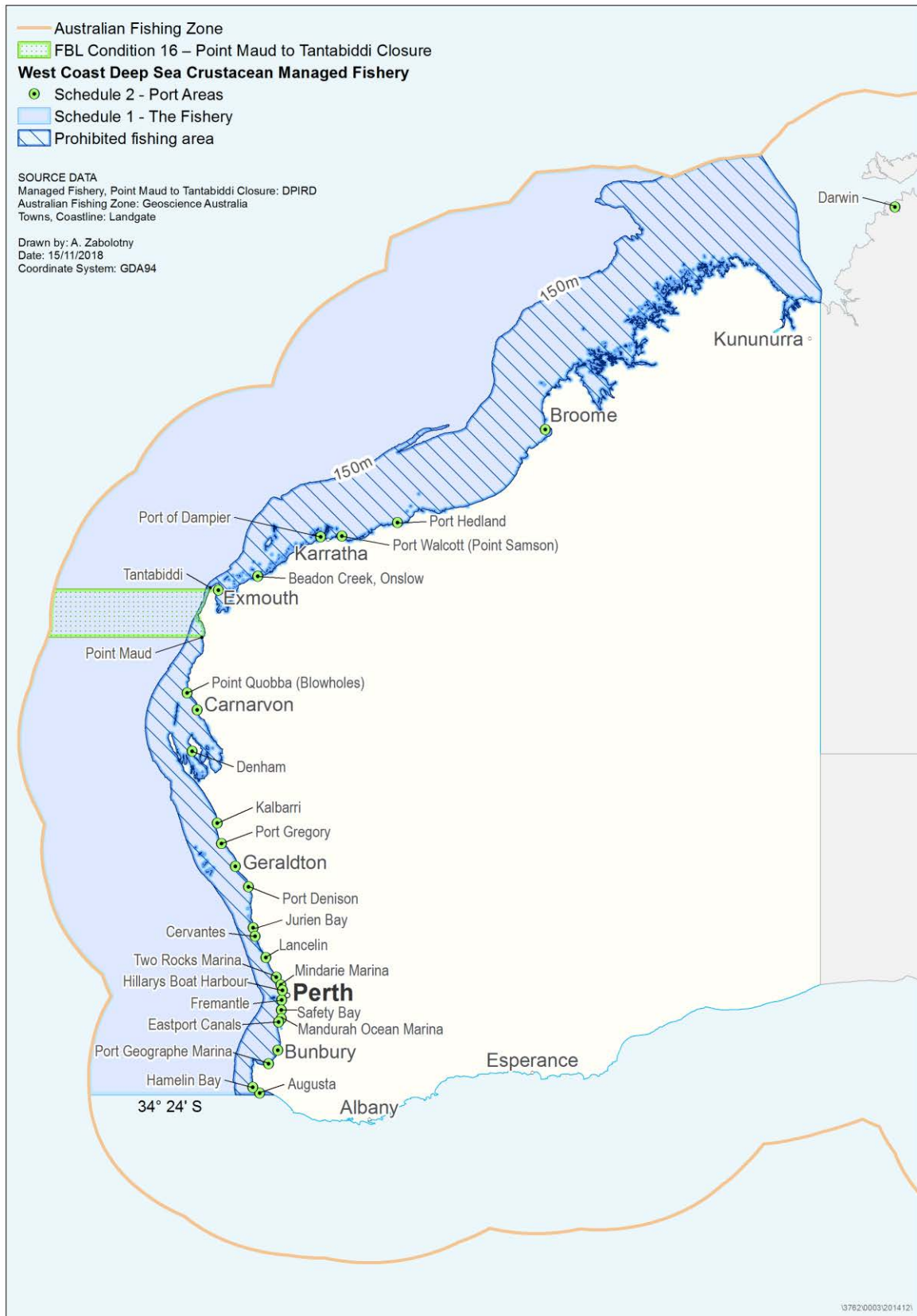


Figure 1. Location and boundaries of the West Coast Deep Sea Crustacean Managed Fishery and specified Port Areas

2.1 Environmental Context

The boundaries of the WCDSMF are all WA waters of the Indian Ocean and the Timor Sea north of 34° 24' south latitude. Fishing in this area is only allowed seaward of the 150 m isobath to the edge of the Australian Exclusive Economic Zone. Most fishing is concentrated on the continental slope between depths of 500 to 800 m (How and Nardi 2014). The continental slope is dominated by sand and mud substrates and is too deep for photosynthetic organisms such as seagrasses and algae due to light limitations (Australian State of the Environment Committee [ASEC] 2001). Sediments at depths greater than 300 m are mostly mud, with macrobenthic fauna decreasing with increasing depth (Levings et al. 2001). The dominant large animals that are likely to live in the sediment and mud are marine worms, crustaceans, echinoderms (e.g. sea urchins) and shellfish. The epifauna include hydroids, sea-pens, small bryozoans and sponges (ASEC 2001). The deep sea environment has relatively stable conditions and factors such as temperature changes and the strength of the Leeuwin Current are not thought to have a major influence on the aquatic resources.

2.2 Target Species

2.2.1 Crystal Crab

The primary target species of the WCDSMF is crystal crab, a large (> 180 mm carapace width [CW]) Geryoniidae crab that is found from 300 to 1450 m depths in sand, mud or broken shell habitats. The species was originally thought to be the Pacific congener, *Chaceon bicolor*, until described as a new species (Davie et al. 2007). It is endemic to WA and distributed from North West Cape to Esperance. Tagging studies indicate crystal crabs are slow-growing and long-lived with a likely maximum age of 25 to 30 years. Preliminary studies indicate that maturity in males is attained at 12 years and legal size at 14 years. There is little evidence of seasonality in the crystal crab reproductive cycle, and spawning occurs year-round (Smith et al. 2004; Melville-Smith et al. 2007).

2.2.2 Champagne Crab

The champagne crab is endemic to WA and occurs from Kalbarri to Eucla. It is a large crab (140 mm CW) and occurs at depths of 90 to 310 m. When in shallower waters it was often captured as by-product of the West Coast Rock Lobster Managed Fishery when they were targeting offshore migratory western rock lobster (*Panulirus cygnus*).

2.2.3 Giant Crab

Giant crab is endemic to southern Australia but is restricted to cooler waters. It is distributed from the Perth Canyon in WA to the central coast of New South Wales and found in a similar depth range to champagne crab (120 – 370 m; Gardner, 1998; Levings et al., 2001).

2.3 Fishing Activities

2.3.1 Governance

Deep sea crustaceans off the west coast of WA are targeted solely by the commercial WCDSMF (although a very small bycatch of champagne crabs is taken by operators in the West Coast Rock Lobster Fishery), which is managed by the Department under the following legislation:

- *Fish Resources Management Act 1994* (FRMA, will be replaced by the ARMA once enacted);
- *Fish Resources Management Regulations 1995* (FRMR); and
- FRMA Part 6 – *West Coast Deep Sea Crustacean Managed Fishery Management Plan 2012*.
- Clause 28 *West Coast Rock Lobster Managed Fishery Management Plan 2012*

Fishers must also comply with the requirements of:

- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Marine Safety (Domestic Commercial Vessel) National Law Act 2012*;
- *Western Australian Marine Act 1982*;
- Western Australian *Biodiversity Conservation Act 2016*;
- Western Australian *Conservation and Land Management Act 1984*; and
- Any other legislation governing the use of the marine environment in which fishing activities occur.

2.3.2 Commercial Fishing

Interest in the harvest of deep sea crustaceans in WA began in the late 1980s and early 1990s, and by the end of 1993, seven fishers were endorsed to fish the offshore waters of the west coast under an Exemption. The fishery became an interim managed fishery in 2003, with effort initially allocated over the fishery using spatial zones. Recognising that the fishery was unlikely to support seven separate fishing operations, a revised interim management plan came into effect in 2008 which introduced a quota system. On 1 January 2013, the 2008 interim management plan was revoked and replaced by the current management plan giving the fishery ‘fully-managed’ fishery status.

There are currently seven licence holders who have equitable spatial access throughout the fishery area and are consolidated under two separate fishing operations. The only allowable method of fishing is with baited traps, set in lines of up to 200 individual traps per line.

The WCDSCMF is a fully-unitised, quota-managed fishery, with individual units of entitlement indicated on each managed fishery licence. The annual total allowable catch (TAC) for crystal crab is currently set at 154 tonnes (2019), well below maximum catches of 200 tonnes that were caught prior to the introduction of quota in 2008. There is also an annual TAC for champagne (20.02 tonnes as of 2019) and giant crabs (980 kg as of 2019). In the previous Harvest Strategy (2015) champagne and giant crab had a combined TAC of 14 tonnes, to allow the retention of non-targeted crabs of up to two tonnes per licence. However, concern that giant crab stocks could not withstand targeted fishing to the full utilisation of this combined TAC (14 tonnes) and the development of new markets for champagne crabs, have resulted in the combined TAC being split.

There are restrictions in the management plan as to what species are allowed to be retained or brought on board a fishing vessel. Species that are captured but cannot be retained must be released within five minutes of being brought on board or before the next trap is pulled, whichever is first. To date, the only retained species reported in the fishery have been crystal, champagne and giant crabs. Other species caught in the traps and subsequently discarded by fishers include other deep sea crabs (e.g. hermit crabs), sea lice (*Bathynomus* sp.), deep water sharks, echinoderms, and octopus. Catches of these species are very rare (< 1 per 1000 pot-lifts).

The fishery has only had one interaction with an ETP species reported since 1990. This interaction involved a humpback whale (*Megaptera novaeangliae*), which was entangled in a trap line, but released unharmed. The use of pots on longlines has reduced the number of vertical lines deployed in the fishery, and the fishery is considered a low risk to ETP species along the west coast.

The fishery operates in depths of 500 to 800 m, though this is likely to change if there is an increased targeting of champagne crabs. Solitary coral and sponges are occasionally brought to the surface after being entangled in the traps, although this is rare. When benthic biota is captured, it is returned immediately to the water. Most (> 90 %) of current fishing effort is focused in waters off Carnarvon and thus the majority of the WCDSCMF area is not fished.

A large proportion of deep sea crustaceans are exported to overseas markets. Fluctuations in the value of the Australian dollar and other macroeconomic factors can have a major influence on the economics of the fishery.

2.3.3 Recreational Fishing

There is currently no known recreational fishery targeting the west coast deep sea crustacean resources.

2.3.4 Customary Fishing

There are no data on the level of customary fishing for the west coast deep sea crustacean resources; however, as these species occurs in offshore waters deeper than 100 m, it is likely to be non-existent.

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 processes for assessing ecological sustainability (Section 3.4);
- 5) the processes for assessing fishery performance (Section 3.5); and
- 6) the specific monitoring and assessment procedures used to ascertain if objectives are being met (Section 3.6).

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, as well as a social and economic objective for the fishery as a whole. It is important to note that the social and economic objective is applied within the context of Ecological Sustainable Development (ESD).

3.1.1 Ecological Sustainability:

- 1) To maintain spawning stock biomass of the target species (i.e. crystal / champagne / giant crabs) above the level recruitment impairment.
- 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 ETP species populations.
- 4) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.

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.

3.1.2 Social and Economic Objective

- 1) To provide flexible opportunities to ensure fishers can maintain or enhance their livelihood, within the constraints of ecological sustainability.

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. Within the context of the long-term objectives provided above, operational objectives aim to maintain each resource above the threshold level (and, where relevant, close to the target level), or rebuild the resource if it has fallen below the threshold or the limit levels.

3.3 Harvesting and Management Approaches

The harvest strategy for crystal, champagne and giant crabs is based on a constant catch approach, which involves harvesting a fixed tonnage from each stock each year. Under this approach, the level of catch remains constant and is not affected by normal levels of recruitment variation. This approach is considered suitable for deep sea crustaceans as they are long-lived, deep-water species with what appears to be relatively stable recruitment.

In line with this harvesting approach, the WCDSMF is managed using both input and output controls. Overall effort in the fishery is constrained by a cap on the number of licences / vessels (limited entry). Spatial closures inshore of the 150 m isobath and in all waters between Point Maud and Tantabiddi (Figure 1) further limit the effective fishing effort. Fishery removals are managed via quota limits on the amount of crystal, champagne and giant crabs that can be retained annually by each licence holder. Units confer an entitlement to take an amount (kilograms) of crystal crab (Class A), champagne (Class B) and giant crab (Class C).

Fishers are not permitted to retain any berried¹ female crabs or crabs smaller than the minimum legal size limits prescribed in the FRMR. Species restrictions are also in place, which limit the retention of other species such as western rock lobster.

3.4 Ecological Sustainability

A formal, resource-level review process is undertaken by the Department to assess the status of relevant target stocks and performance in relation to each other ecological management objective. Suitable indicators have been selected to describe the status of the deep sea crustacean resource, and other ecological assets, against defined reference levels established to

¹ With eggs attached beneath its body.

separate acceptable from unacceptable performance (Section 3.4.1). Where relevant, these levels include:

- a target level (i.e. where you want the indicator to be),
- a threshold level (i.e. where you review your position); and
- a limit level (i.e. where you do not want the indicator to be).

Harvest control rules (HCRs) define the management actions that should occur in relation to the value of each indicator compared to the reference levels (Section 3.4.2). The HCRs aim to maintain each resource at their target level, and return the resource to this level when a threshold or limit level has been breached.

3.4.1 Performance Indicators and Reference Levels

3.4.1.1 Crystal crabs

The performance indicator for crystal crabs is the mean annual catch rate of legally-retainable crabs (kg/trap lift, includes high-graded crabs) across the WCDSMF, standardised for soak time, vessel, month, latitude and depth of fishing.

The reference levels associated with the mean annual standardised commercial catch rate of legally-retainable crystal crabs have been identified based on the reference period (i.e. 2003-2012). The threshold level is the lowest mean standardised catch rate during the reference period and is a proxy for the maximum sustainable yield. The limit reference point is calculated as 80% of the threshold reference point (Table 1) and is assumed as the point below which recruitment impairment may occur. The target region is from the threshold level to the highest mean standardised catch rate (+95%CI) during the reference period.

3.4.1.2 Other ecological components

Other ecological assets incorporated in this harvest strategy include other retained species, bycatch, ETP species, habitats and ecosystem processes that may be affected by the WCDSMF (Table 1).

Where reliable quantitative information is available (e.g. retained species, ETP species and habitat impacts), reference levels have been set based on data from the reference periods defined for each performance indicator. The number of ETP species interactions reported annually in the fishery is used as an indicator of the impacts on ETP species populations. Threshold levels for interactions with ETP species have been set at three individuals per year of any species, noting that only a single interaction with an ETP species has so far been recorded by the fishery (Table 1).

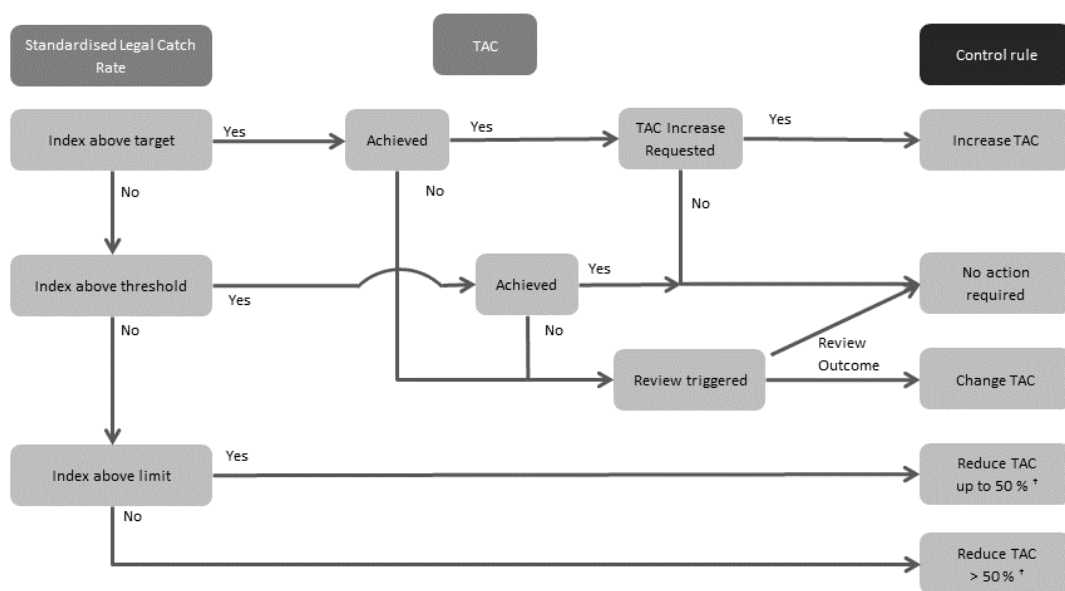
Performance indicators for habitat impacts are the extent of the area fished annually (number of 10 x 10 nm blocks) and annual fishing effort, measured in number of trap lifts. Threshold levels of > 125 blocks and > 169 043 trap lifts / year have been identified based on the highest levels recorded during the reference period (2003-2012). The target range is set to include fishing area or effort below the threshold levels (Table 1).

Where reliable quantitative information is lacking, the reference levels have been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher (2015). Risk assessment outcomes are also used in a weight-of-evidence approach to support each of the assets considered within this harvest strategy.

3.4.2 Application of Harvest Control Rules

For each ecological performance indicator and reference level, an accompanying HCR directs the management needed to meet the sustainability objectives (Table 1 and Figure 2). These HCRs are designed to maintain the resource above the threshold level (i.e. within the target range), or rebuild it where it has fallen below the threshold (undesirable) or the limit (unacceptable) levels.

The extent of management action taken (e.g. to reduce catches) is determined by the extent to which a performance indicator has breached a reference point. The ability to, and timeframe for, implementing these changes depends on the legal instrument under which the management measure occurs (see Section 4 for more information).



* The extent of TAC reduction will be determined by the extent to which the indicator has breached the threshold or limit reference point

Figure 2 Harvest control rule decision tree designed to achieve the ecological objective of maintaining crystal crab spawning stock biomass

Table 1. Summary of the harvest strategy for the West Coast Deep Sea Crustacean Managed Fishery. Note the reference levels essentially prescribe the operational objective which is to maintain each resource above the threshold level.

Component	Management Objectives	Resource/Asset	Performance Indicators	Reference Levels	Control Rules
Ecological					
Target species	To maintain spawning stock biomass of the target species at a level where the main factor affecting recruitment is the environment.	Crystal crabs (Class A unit)	Standardised commercial catch rate of legally-retainable crystal crab.	Target: Above lowest mean standardised catch rate of legally-retainable crabs during the reference period (2003-2012)	Continue management aimed at achieving ecological, economic and social objectives.
				Threshold: Minimum mean standardised catch rate of legally-retainable crabs during the reference period (2003-2012)	If the catch rate is equal to or below the threshold (but above the limit), the TAC will be reduced by up to 50 %.
				Limit: 80% of the minimum mean standardised catch rate of legally-retainable crabs during the reference period (2003-2012)	If the catch rate is equal to or below the limit level, the TAC will be reduced by 50 – 100 %.
Retained Species	To ensure fishing impacts do not result in serious harm to retained species populations.	Champagne crab (Class B) and Giant crab (Class C)	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • Current management arrangements; • Annual catch of each species from catch disposal records; and • Review of alternative measures to minimise unwanted catch. 	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to all retained species' populations, i.e. moderate risk or lower.</p> <p>Thresholds: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any retained species' populations, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any retained species' populations, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological, economic and social objectives</p> <p>Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable.</p> <p>Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.</p>
Bycatch (non-ETP) species	To ensure fishing impacts do not result in serious harm to	All (non-ETP) bycatch species	Periodic risk assessments incorporating:	Target: Fishing impacts are considered to generate an acceptable level of risk to all bycatch species' populations, i.e. moderate risk or lower.	Continue management aimed at achieving ecological, economic and social objectives

	bycatch species populations.		<ul style="list-style-type: none"> • Current management arrangements; • Catch rates of each species from observer monitoring; and • Review of alternative measures to minimise unwanted catch. 	<p>Thresholds: A potentially material change to risk levels is identified; or 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>Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable..</p> <p>Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.</p>
ETP species	To ensure fishing impacts do not result in serious or irreversible harm to ETP species populations.	All ETP species	<ol style="list-style-type: none"> 1. Number of interactions with ETP species annually 2. Periodic risk assessments: <ul style="list-style-type: none"> • Current management arrangements; and • Fishing methods (e.g. number of lines in the water). 	<p>Targets: ≤ 3 interactions with any particular ETP species in a year; and</p> <p>Fishing impacts are considered to generate an acceptable level of risk to any ETP species' populations, i.e. moderate risk or lower.</p>	No additional management action required
				<p>Thresholds: > 3 interactions with any particular ETP species in a year; A potentially material change to risk levels is identified; or</p> <p>Fishing impacts are considered to generate an undesirable level of risk to any ETP species' populations, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ETP species' populations, i.e. severe risk.</p>	<p>A review will be undertaken within three months to develop an appropriate management response. Management action will be taken to reduce risk to an acceptable level before the next season.</p> <p>A review will be undertaken within one month to develop an appropriate management response. Management action will be taken to reduce the risk to an acceptable level as soon as practicable.</p>
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to	Benthic habitats	<ol style="list-style-type: none"> 1. Extent of area fished annually. 2. Annual fishing effort (number of trap lifts). 	<p>Targets: The area fished is ≤ 125 blocks; Fishing effort is ≤ 169 000 trap lifts; and</p> <p>Fishing impacts are considered to generate an acceptable level of risk to any habitats, i.e. moderate risk or lower.</p>	No additional management action required

	habitat structure and function.		3. Periodic risk assessments.	<p>Thresholds: The area fished is > 125 blocks, or Fishing effort is > 169 000 trap lifts, A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any habitats, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any habitats, i.e. severe risk.</p>	<p>A review will be undertaken within three months to develop an appropriate management response. Management action will be taken to reduce risk to an acceptable level before the next season.</p> <p>A review will be undertaken within one month to develop an appropriate management response. Management action will be taken to reduce the risk to an acceptable level as soon as practicable.</p>
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.	Community structure and function	<p>Periodic risk assessments incorporating:</p> <ul style="list-style-type: none"> • Current management arrangements; • Annual catch of all retained and bycatch species; • Bait usage; • Number of interactions with ETP species annually; • Extent of area fished annually (blocks); and • Annual fishing effort (trap lifts). 	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to the ecosystem, i.e. moderate risk or lower.</p> <p>Thresholds: A potentially material change to risk levels is identified, or Fishing impacts are considered to generate an undesirable level of risk to the ecosystem, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to the ecosystem, i.e. severe risk.</p>	<p>No additional management action required</p> <p>A review will be undertaken within three months to develop an appropriate management response. Management action will be taken to reduce risk to an acceptable level before the next season.</p> <p>A review will be undertaken within one month to develop an appropriate management response. Management action will be taken to reduce the risk to an acceptable level as soon as practicable.</p>

3.5 Fishery Performance

Defining annual (or periodic) tolerance levels for fisheries performance provides a formal but efficient basis to evaluate the effectiveness of current management arrangements in delivering the levels of catch and/or effort specified by the HCRs and, where relevant, any sectoral allocation decisions (Fletcher et al. 2016). In line with the principles of ESD, this fishery-level review process also considers performance against any objectives relating to the economic and social amenity benefits of fishing. Where possible, and in due consideration of ecological sustainability, fisheries management arrangements can be adjusted or reformed to help meet these economic and/or social objectives.

The performance of the WCDSCMF is primarily assessed through the attainment of the crystal crab (A Class) TAC and the standardised catch rate of legally retainable crystal crabs (SCPUE; Table 2). If the TAC is achieved ($\geq 95\%$ TAC) and the SCPUE is above the threshold level, the fishery is considered to be operating 'acceptably' with no need to review the management settings, while not attaining the TAC or SCPUE being below the threshold level would necessitate a review of the fishery's performance (Figure 2).

Table 2. Social and economic objectives of the harvest strategy for the West Coast Deep Sea Crustacean Managed Fishery.

Social and Economic					
Component	Management Objectives	Resource/ Asset	Performance Indicators	Reference Levels	Control Rules
WCDSCMF	To provide flexible opportunities to ensure fishers can maintain or enhance their livelihood, within the constraints of ecological sustainability.	Crystal crab	Constraints on access to livelihood opportunities imposed by fisheries management <ul style="list-style-type: none"> • Annual commercial catch of crystal crab; and • Standardised commercial catch rate of legally-retainable crystal crabs. 	Target: Provide the option to increase the TAC (Class A) subject to the following ecological conditions being met: <ul style="list-style-type: none"> • Current TAC achieved ($\geq 95\%$ caught); • Mean catch rate of legally-retainable crabs is above the highest mean standardised catch rate (+95%CI) during the reference period (Table 1) 	If fisheries management actions are not constraining livelihood opportunities, no management action is required. The main way this is achieved is by providing fishers the option to increase the TAC (Class A). If $\geq 95\%$ of the TAC is caught <u>and</u> mean standardised commercial catch rate of legally-retainable crabs is <u>above</u> highest mean standardised catch rate (+95%CI) during the reference period (Table 1), proposals from industry to increase quota in any one season by a maximum of 10% will be considered.
				Threshold: Fisheries management actions are constraining access to livelihood opportunities for reasons other than ecological sustainability.	Review reasons for any constraints identified.
				Limit: Fisheries management actions are constraining access to livelihood opportunities for reasons other than ecological sustainability, for more than two consecutive years.	Where possible, implement management action to address ongoing constraints to livelihood opportunities.

3.6 Monitoring and Assessment Procedures

3.6.1 Information and Monitoring

3.6.1.1 Fishery-Dependent Information

3.6.1.1.1 Commercial Catch and Effort Reporting

The catch and effort data required to determine the catch of crystal, champagne and giant crabs as well as standardised catch rates for legally-retainable crystal crabs was originally obtained from monthly catch and effort (CAES) returns, catch disposal records (CDRs) and volunteer logbooks. However, in 2017 these three forms were amalgamated into a single form which covered the statutory obligation for catch, effort and ETP interaction reporting as well as a volunteer research component.

3.6.1.1.2 Commercial (Observer) Monitoring

On-board monitoring and tagging of crystal crab has been conducted by the Department at least four times a year from 2000 to 2016. During these trips, every second trap pulled was sampled, and research staff made detailed records of the target species catch (both retained and discarded), bycatch, environmental conditions and information on fishing activity. Remote monitoring through on-board cameras is also used to monitor by-catch and discard rates. This information was used to validate data collected as part of the volunteer logbook program.

3.6.1.1.3 Grade category

Processors have voluntarily released to the Department grade category data dating back to 2006 for of crystal crabs. This information is valuable in ascertaining the size and condition of crabs coming from the different fishing operators

3.6.1.2 Fishery-Independent Information

In 2017 and 2018, a fishery-independent survey supported by industry was conducted. This standardised survey will be repeated annually by a commercial fisher. Six lines are set, covering the major depth range of crystal crabs (400 – 800 m). Biological data (e.g. size, sex, reproductive state) are collected for each animal and recorded on a by-pot basis. Non-retained (undersize, berried or high graded) crabs are also tagged and released. Meshed pots are also located within the transect lines to retain small and undersized crabs, which may not be retained from the commercial pots that have escape gaps. Discussions are currently underway with industry members to establish a similar independent survey for champagne crabs.

3.6.2 Assessment Procedures

3.6.2.1 Crystal Crab

Catch rates are standardised for a range of variables using generalised linear models (GLMs) of the form: $\log_e(U + c) = \sum_{j=1}^p x_j \beta_j + \epsilon$, where U is catch rate (kg/potlift), c is an additive constant for logarithmic transformation, x_j are the p explanatory variables including quantitative and qualitative variables and interactions, β_j are estimated coefficients and $\epsilon \sim N(0, \sigma^2)$ is the error term. Standardisation of the catch rates of legally retainable crystal crabs account for changes in soak time, fishing vessel, month of fishing, latitude of fishing and depth.

3.6.2.2 ETP Species

Interactions with ETPs is a mandatory field recorded by fishers as part of the statutory CDR return. Some interactions with fishing gear are not witnessed by the fisher (e.g. whale entanglements). These interactions, when reported, are compiled in liaison with the Department of Biodiversity and Conservation annually.

3.6.2.3 Habitats

Fishery impacts of the benthic habitat are assessed by examining the amount and location of fishing effort annually. Spatially explicit effort data from the CDRs are used to assess benthic impacts from the fishery.

3.6.2.4 Risk Assessments

The Department uses a risk-based EBFM framework to assess the impacts of fishing on all parts of the marine environment, including the sustainability risks of target species, retained non-target species, bycatch, ETP species, habitats and the ecosystem. This framework has led the development of the periodic risk assessment process for the WCDSCMF, which is used to prioritise research, data collection, monitoring needs and management actions for this fishery and to ensure that fishing activities are managed both sustainably and efficiently.

An initial internal risk assessment took place for this fishery in 2002. As part of this process, the issues that needed to be addressed for the WCDSCMF were determined through an external workshop held for the West Coast Rock Lobster Managed Fishery and an internal workshop held for the South Coast Crustacean Fisheries due to the similarities between the three fisheries, i.e. fishing methods, species caught, habitats they operate over and location (Department of Fisheries 2003). The WCDSCMF was considered to be a moderate risk to crystal crab stocks, and a low or negligible risk to all other assets.

In 2014 an internal risk assessment was conducted on target, other retained, bycatch and ETP species for the WCDSCMF using the Productivity Susceptibility Analysis (PSA) methodology. Fifteen retained, bycatch and ETP species or species groups were assessed and the risk posed by the fishery was found to be low for all species.

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

4 MANAGEMENT MEASURES AND IMPLEMENTATION

4.1 Management Measures

There are a number of management measures in place in the fishery (Table 2), which can be amended as needed to ensure each fishery is achieving the resource objectives. These do not preclude the consideration of other options.

Table 2. Management measures and instrument of implementation for the West Coast Deep Sea Crustacean Managed Fishery

Measure	Description	Instrument
Limited Entry	A limited number (7) of Managed Fishery Licences are permitted to operate in the WCDSCMF.	WCDSCMF Management Plan
Fishery Capacity	The maximum quantity of crystal, champagne and giant crabs that can be removed from the fishery annually is limited by their TAC.	WCDSCMF Management Plan
Allocation of Units	Class A, B and C units entitle fishers to retain an amount (kg) of crystal, champagne and giant crabs respectively.	WCDSCMF Management Plan
Spatial Closures	Fishers are not permitted to fish landward of the 150 m isobath. There are additional state and federal closed areas	WCDSCMF Management Plan
Gear Controls	Fishers are only permitted to use fish traps with an internal volume less than 0.257 m ³ and two escape gaps	WCDSCMF Management Plan
Condition and Size Limits	The legal minimum size limits in place for crystal, champagne and giant crabs is greater than the size at maturity for both males and females. Female crabs that are actively breeding ('berried') are required to be returned to the sea.	FRMR
Species Restrictions	Fishers are not permitted to retain rock lobster or finfish, and scampi or white tailed bug cannot be retained east of 126° 58' E	WCDSCMF Management Plan
Reporting	All fishers are required to provide CDR forms to the Department within 48 hours of landing catch.	FRMR & WCDSCMF Management Plan
Specification of Port Areas and Approved Fish Processors	All catches must be unloaded at approved port areas. All catches must be sold or transferred to an approved fish processor.	WCDSCMF Management Plan / WCDSCMF Management Plan / WCDSCMF Notice of Approved Processors

4.2 Implementing Changes to the Management Arrangements

Decision-making processes can also 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.

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

- annual decision-making processes that may result in measures to meet the operational fishery objectives (driven by the control rules); and
- longer-term decision-making processes that result in new measures and / or strategies to achieve the long-term fishery objectives (i.e. changes to the management system).

However, if there is an urgent issue, stakeholder meetings may be called to discuss the issue and determine appropriate management action, as needed.

4.2.1 Consultation

Management changes are generally given effect through amendments to legislation, such as the WCDSMF management plan, regulations and orders. These changes require the approval of the Minister for Fisheries. 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 (Western Australian Fishing Industry Council [WAFIC] and Recfishwest) are the primary source of sector 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 plans and the facilitation of annual management meetings for licensed fisheries.

The both the FRMA and ARMA (when enacted) require the Minister to consult with affected parties when changes to a Part 6 management plan are being considered. In the case of the WCDSMF, it would include all licence holders. Management meetings 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 fishery. During these annual meetings, current and future management issues that may have arisen during the previous

fishing seasons, and any proposed changes to the management plan, are discussed. Follow-up meetings may be held as required.

4.2.1.2 Consultation with Other Groups

Consultation with customary fishers and non-fisher stakeholders, including Government agencies, marine users, Native Title parties, conservation sector Non-Government Organisations (NGOs) and other affected/interested parties, is undertaken in accordance with the Departmental Stakeholder Consultation Guidelines (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, seeking input from interested parties 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 subjected to both formal key stakeholder consultation and public consultation processes.

4.3 Compliance and Enforcement

As the key regulatory agency, DPIRD's compliance role is to achieve economic, social, equity and sustainability objectives by addressing:

- our ability and capacity to influence compliance with the rules; and
- the effectiveness, capacity and credibility of the compliance program.

The Western Australian Fisheries Compliance Strategy (the Strategy; DPIRD 2018) was published in 2018. The purpose of the Strategy is to provide an understanding of the principles underlying the DPIRD's compliance role and how its compliance services are delivered to the WA community. The Strategy aligns with, and complements, DPIRD's Compliance Framework and Risk Assessment Policy which informs the risk-based model, compliance planning and the governance structure applied to fisheries compliance services.

The Department's compliance model is based on the Australian Fisheries National Compliance Strategy 2016-2020 (the National Strategy). DPIRD's compliance program is aligned to support the three key compliance strategies recommended by the National Strategy:

- maximising voluntary compliance;
- effective deterrence; and
- organisational capability and capacity.

4.3.1 Operational Compliance Plan

Management arrangements are enforced under the combined Operational Compliance Plan (OCP) for minor commercial fisheries in the Midwest region of Western Australia. The OCP is informed and underpinned by compliance risk assessments conducted for each fishery. Annual planning

meetings are held for OCPs, with regular specific planning of day-to-day targeted and non-targeted patrols linked to the OCP based on resources and competing priorities.

The primary monitoring activity in the WCDSCMF relates to the reporting and validation of crystal, champagne and giant crab catches for quota-monitoring purposes. Other activities undertaken by Fisheries Officers in relation to the WCDSCMF include opportunistic in-port inspections, which may include catch, licence and gear checks.

5 REFERENCES

- Australian State of the Environment Committee (ASEC) (2001). Coasts and Oceans, Australia State of the Environment Report 2001 (Theme Report). CSIRO Publishing on behalf of the Department of the Environment and Heritage, Canberra.
- Davie, P.J. F., Ng, P.K.L. and Dawson, E.W. (2007). A new species of deep-sea crab of the genus *Chaceon* Manning & Holthuis, 1989 (Crustacea: Decapoda: Brachyura: Geryonidae) from Western Australia. *Zootaxa* 1505: 51-62.
- Department of Agriculture and Water Resources (2018a). Commonwealth Fisheries Harvest Strategy Policy. Canberra, June. CC BY 4.0.
- Department of Agriculture and Water Resources (2018b). Guidelines for the Implementation of the Commonwealth Fisheries Harvest Strategy Policy. Canberra, June. CC BY 4.0.
- Department of Fisheries (2003). Application to Environment Australia on the West Coast Deep Sea Crab Interim Managed Fishery against the Guidelines for the Ecologically Sustainable Management of Fisheries. Department of Fisheries, Western Australia.
- 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). Guideline for stakeholder engagement on aquatic resource management-related processes. Fisheries Occasional Publication No. 131. Department of Fisheries, 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 management framework. *ICES Journal of Marine Research* 72: 1043- 1056.
- 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*, Kruse, G.H. et al. (eds.), pp. 129-146, Alaska Sea Grant College Program, Fairbanks, Alaska.

- 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. and 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. <http://dx.doi.org/10.1016/j.fishres.2016.04.014>
- Gardner, C. (1998) The Tasmanian giant crab fishery: a synopsis of biological and fisheries information. Tasmanian Aquaculture and Fisheries Institute Report
- How, J. and Nardi, K. (2014). West Coast Deep Sea Crustacean Managed Fishery Status Report. In: Fletcher, W.J. and Santoro, K. (eds.), Status Report of the Fisheries and Aquatic Resources of Western Australia 2013/14, pp.133-136. Department of Fisheries, Western Australia.
- How, J., Webster, F., Travaille, K., Nardi, K. and Harry, A. (2015). West Coast Deep Sea Crustacean Managed Fishery. Western Australian Marine Stewardship Council Report Series No. 4. Department of Fisheries, Western Australia. 156pp
- Levings, A., Mitchell, B. D. McGarvey, R., Mathews, J., Laurenson, L., Austin, C., Heeron, T., Murphy, N., Miller, A., Roswell, M. and Jones, P. (2001). Fisheries biology of the giant crab *Psuedocarcinus gigas*. Final report to the FRDC on Projects No. 93/220 and 97/132, 390 pp.
- Melville-Smith, R., Norton, S.M.G. and Thomson, A.W. (2007). Biological and Fisheries Data for Managing Deep Sea Crabs in Western Australia. Final report to the FRDC on Project No. 2001/055. Fisheries Research Report No. 165. Department of Fisheries, Western Australia, 248 pp.
- Sloan, S.R., Smith, A.D.M., Gardner, C., Crosthwaite, K., Triantafillos, L., Jeffries, B. and 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.
- Smith, K.D., Potter, I.C. and Hall, N.G. (2004). Biological and fisheries data for managing the deep-sea crabs *Hypothalassia acerba* and *Chaceon bicolor* in Western Australia. Final Reports to the FRDC on Projects No. 1999/154 and 2001/055, 151 pp.