



Department of
**Primary Industries and
Regional Development**

Fisheries Management Paper No. 273

DRAFT

**Blue Swimmer Crab Resource of South-West
Western Australia Harvest Strategy**

2020-2025

Version 2.0

May 2020

Version Control

Version	Publication Series Title	Change Description	Date
1.0	Fisheries Management Paper No. 273	First published harvest strategy for Peel-Harvey Estuary blue swimmer crab fisheries	April 2015
2.0	Fisheries Management Paper No. 273	Scope of harvest strategy broadened to blue swimmer crab resource of South-West Australia	May 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: XXXX-XXX (Print) ISBN: 978-1-921258-16-9 (Print)

ISSN: XXXX-XXXX (Online) ISBN: 978-1-921258-17-6 (Online)

Copyright © Department of Primary Industries and Regional Development, 2020.

TABLE OF CONTENTS

1 INTRODUCTION	5
1.1 Review Process	5
2 SCOPE	6
2.1 Environmental Context	8
2.2 Target Species	8
2.3 Fishing Activities	9
2.3.1 Governance.....	9
2.3.2 Commercial Fishing	10
2.3.3 Recreational Fishing.....	10
2.3.4 Customary Fishing	11
2.4 Catch-Share Allocations	11
3 HARVEST STRATEGY	11
3.1 Long-term Objectives	12
3.1.1 Ecological Sustainability.....	12
3.1.2 Economic and Social Benefits.....	13
3.2 Operational Objectives.....	13
3.3 Harvesting and Management Approach.....	13
3.4 Ecological Sustainability.....	14
3.4.1 Performance Indicators and Reference Levels.....	14
3.4.2 Application of Harvest Control Rules.....	15
3.5 Fishery Performance	22
3.6 Monitoring and Assessment Procedures	23
3.6.1 Information and Monitoring.....	23
3.6.2 Assessment Procedures	25
4 MANAGEMENT MEASURES AND IMPLEMENTATION.....	26
4.1 Management Measures	26
4.2 Implementing Changes to the Management Arrangements	26
4.2.1 Consultation	28
4.3 Compliance and Enforcement	29
5 REFERENCES	31

LIST OF ACRONYMS

ARMA	<i>Aquatic Resources Management Act 2016</i>
CAES	Catch and Effort Statistics
CW	Carapace width
DBCA	Department of Biodiversity, Conservation and Attractions
DPIRD	Department of Primary Industries and Regional Development
EBFM	Ecosystem Based Fisheries Management
EPBC (Act)	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ERA	Ecological Risk Assessment
ESD	Ecologically Sustainable Development
ETP	Endangered, Threatened and Protected (species)
FRMA	<i>Fish Resources Management Act 1994</i>
FRMR	<i>Fish Resources Management Regulations 1995</i>
HCR	Harvest Control Rule
MSY	Maximum Sustainable Yield
OCP	Operational Compliance Plan
RFBL	Recreational Fishing from Boat Licence
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council

1 INTRODUCTION

Harvest strategies for aquatic resources in Western Australia (WA) that are managed by the Department of Primary Industries 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) and the *Aquatic Resources Management Act 2016* (ARMA), 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 harvest 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). The 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 recognises that fisheries change over time and that a review period should be built into each harvest strategy to ensure that it remains relevant (Department of Fisheries 2015). This document includes the second, updated version of the harvest strategy for the blue swimmer crab fishery in the Peel-Harvey Estuary, which was successfully certified as sustainable by the globally recognised Marine Stewardship Council (MSC) in 2016. As outlined in Section 2, the scope of the harvest strategy has now been extended to cover the broader South-West WA blue swimmer crab resource and includes a second key fishery in the Swan-Canning Estuary. The 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 relates to the blue swimmer crab (*Portunus armatus*) resource of South-West WA and the fishing activities that impact this resource. For the purpose of this harvest strategy, the South-West WA blue swimmer crab resource is defined as waters of the West Coast Bioregion from Geographe Bay up to, and including, the Swan and Canning Rivers (

Figure 1), consistent with the scope of the 2018 review of management arrangements for this resource (DPIRD 2018). Note that separate harvest strategies have been developed for the blue swimmer crab resource in Shark Bay (DPIRD 2020) and the North Coast Bioregion (DPIRD in prep.).

Blue swimmer crabs are targeted by a number of socially and economically important recreational and commercial fisheries within the West Coast Bioregion. Although this species extends into waters off southern WA, catches in Hardy Inlet and the South Coast Bioregion have been minor and sporadic to date, largely dependent on periods of a strong Leeuwin Current. The majority of commercial blue swimmer crab catches are taken by baited crab traps, whilst recreational fishers typically use drop nets, scoop nets or collect crabs by hand while diving/snorkelling.

This harvest strategy for the South-West blue swimmer crab resource is currently focused on two of the key areas for which stock assessments based on commercial catch rates and other available information are undertaken annually — the Swan-Canning Estuary and Peel-Harvey Estuary (

Figure 1). Although the level of connectivity of blue swimmer crabs in waters of South-West WA is uncertain, these two estuaries are considered to comprise two separate stocks (see Section 2.2). As data on recreational catch is more limited, the commercial data are currently used as proxies for monitoring the status of these stocks. Recognising that the abundance of blue swimmer crabs in either area may not be indicative of the status of the overall resource, however, management action will be applied at the most appropriate level (area, stock, or broader resource) on a case-by-case basis.

In addition to considering fishing impacts on the target species (i.e. blue swimmer crabs), this harvest strategy also covers impacts on other retained species, bycatch¹, endangered, threatened and protected (ETP) species, habitats and other ecological components, to ensure any risks to these elements are managed effectively. Note that this harvest strategy currently only considers the impact on these ecological components by recreational and commercial fishing activities in the MSC-certified Peel-Harvey Estuary fishery, where the majority of fishing activities targeting blue swimmer crabs in South-West WA occurs.

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

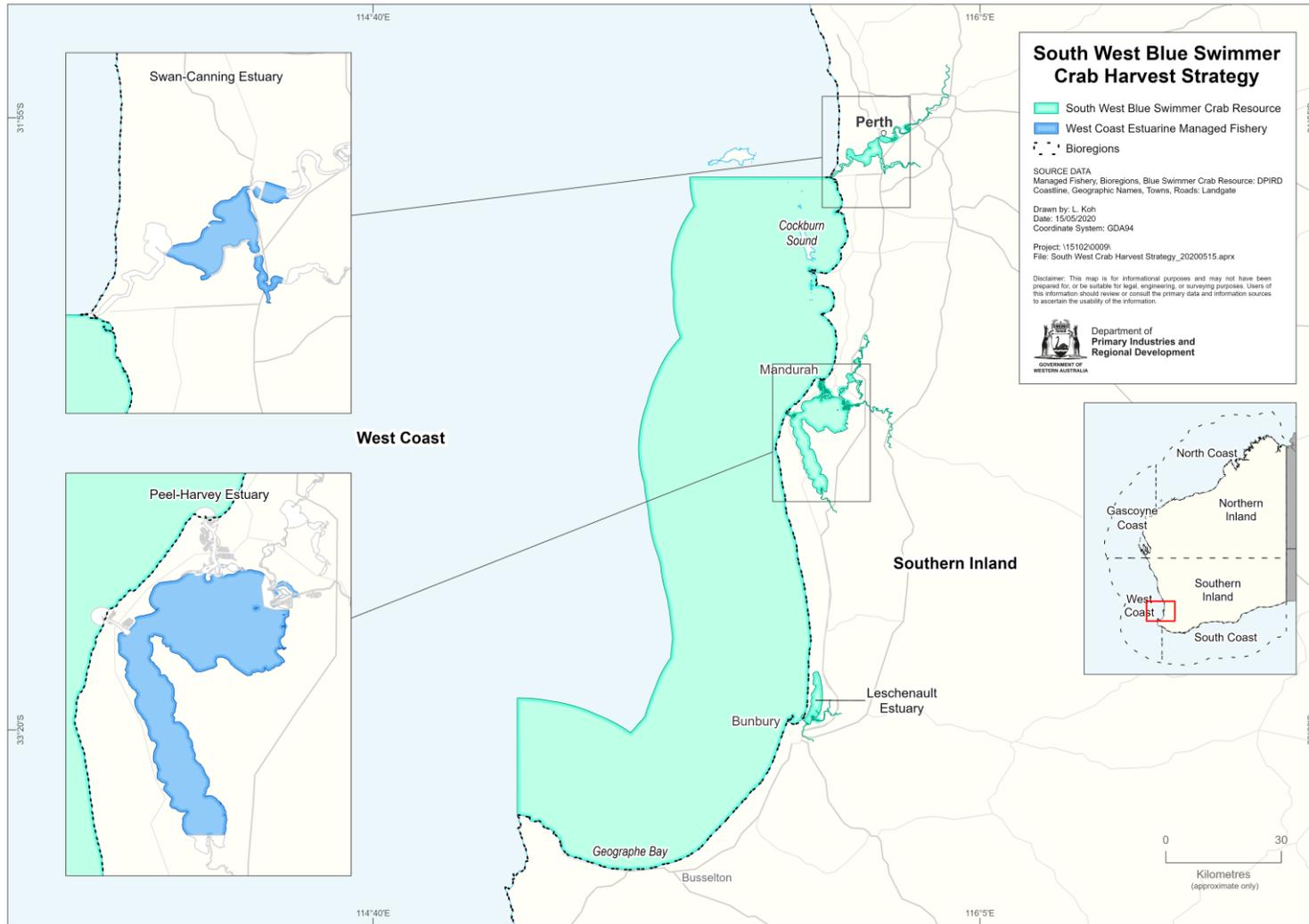


Figure 1. Extent of the Blue Swimmer Crab Resource of South-West WA and the key areas in which it is commercially and recreationally targeted.

2.1 Environmental Context

The marine environment of South-West WA is predominantly a temperate zone, with most rainfall occurring during the winter months. This region is heavily influenced by the Leeuwin Current that transports warm tropical water southward along the edge of the continental shelf. Coastal water temperatures range from around 18°C to 24°C in the West Coast Bioregion (Kalbarri to Augusta).

Within the West Coast Bioregion, there are two major marine embayments (Cockburn Sound and Geographe Bay) and four significant estuarine systems (the Swan-Canning, Peel-Harvey and Leschenault estuaries, and Hardy Inlet). All of these estuaries are permanently open to the sea and form an extension of the marine environment, except when freshwater run-off displaces the oceanic water for a short period in winter and spring.

The shallow estuarine and nearshore waters of South-West WA support extensive stands of macroalgae and seagrasses, which play an important role in nutrient and carbon cycling. These plants support large populations of small invertebrates, which in turn form the basis of a food chain that supports other invertebrates, fish, birds and mammals. The Peel-Harvey Estuary is considered an internationally-significant habitat for waterbirds, forming part of the Peel-Yalgorup Wetland System listed as a Ramsar Wetland of International Importance.

South-West WA is predicted to be heavily influenced by the impacts of climate change (e.g. increasing sea temperatures and declines in rainfall). Estuaries within the West Coast Bioregion have also been identified as being at significant risk due to high nutrient runoff from surrounding catchments, which coupled with climate change has the potential to markedly affect fish and other communities. Fish mortality events have been periodically reported in Cockburn Sound and from within the Peel-Harvey and Swan-Canning estuaries.

2.2 Target Species

Blue swimmer crabs are a tropical species widely distributed throughout the Indo-West Pacific, ranging from east Africa to Japan, Tahiti and northern New Zealand (Kailola et al. 1993). In Australia, the species inhabits estuarine and coastal marine waters from the south coast of WA, around the north to the south coast of New South Wales. Southerly populations are also found in the warmer waters of the South Australian gulfs.

The blue swimmer crab resource in South-West WA is likely represented by a series of overlapping biological stocks, with gene flow between geographical regions largely controlled by the degree of water exchanges (Sezmiş 2004). Genetic studies have shown that the genetic compositions of the assemblages of blue swimmer crabs in Cockburn Sound and the Swan-Canning Estuary are homogenous and genetically distinct from other South-West assemblages, including crabs in the Peel-Harvey Estuary (Chaplin and Sezmiş 2008). Given the uncertainty around stock structure, a conservative approach is taken to assess the key fisheries that target this resource as separate management units.

Climate change is likely to have a marked effect on populations of blue swimmer crabs in South-West WA, given they are near the southern extremity of their natural environmental and temperature range. Stock levels in the estuaries fluctuate seasonally, with crabs moving into estuaries in late spring/summer as the salinity increases and back into coastal waters as the salinity in the estuaries decreases with winter rainfall. Changes to annual rainfall patterns and an increased frequency of extreme weather events could thus significantly impact the distribution and abundance of crabs within this region.

2.3 Fishing Activities

2.3.1 Governance

Blue swimmer crabs in South-West WA are targeted by commercial, recreational and customary fishing sectors. Although not an exhaustive list, these fishing sectors are managed by the Department under the following key legislation:

- *Fish Resources Management Act 1994* (FRMA, will be replaced by the ARMA once enacted);
- *Fish Resources Management Regulations 1995* (FRMR);
- *West Coast Estuarine Managed Fishery Management Plan 2014*;
- *Prohibition on Fishing for Blue Swimmer Crabs Order 2019*;
- *Prohibition on Fishing for Crabs (Cockburn Sound) Order 2014*;
- *Prohibition on Fishing for Crabs (Peel Inlet and Harvey Estuary) Order 2007*;
- *Prohibition on Fishing for Crabs (Geographe Bay) Order 2005*; and
- *Prohibition on Commercial Fishing (Leschenault Estuary) Order 2002*.

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

Commercial fishers in the estuarine and nearshore waters of South-West WA first started retaining blue swimmer crabs in the 1950s, initially using the same gillnets used to catch finfish species. Crab traps were first trialled in the mid-1990s as a means of improving fishing efficiency and catch quality, as well as reducing bycatch. Traps are now the main fishing gear used by commercial fishers to target blue swimmer crabs in South-West WA, with limited net fishing for crabs still occurring in the Swan-Canning Estuary.

Annual commercial catches of blue swimmer crabs in South-West WA peaked in 1997 at around 500 t, of which the majority (approximately 70%) was taken in Cockburn Sound. In response to declining stock levels in Cockburn Sound in 2006 and again in 2014, this area has been closed to fishing. The blue swimmer crab catch by other commercial fisheries in South-West WA have remained relatively stable over the history of fishing, largely fluctuating between 100 and 150 t annually. On average, over the last five years, commercial crab catches from the West Coast Bioregion have comprised 17% of the total commercial crab catch in WA, with the majority landed in Shark Bay.

The blue swimmer crab resource in South-West WA is currently targeted mainly by the West Coast Estuarine Managed Fishery (WCEMF), which includes the Swan-Canning Estuary (Area 1), the Peel-Harvey Estuary (Area 2), and Hardy Inlet (Area 3). The Peel-Harvey Estuary fishery, which has been certified as sustainable against the highly regarded MSC Standard for Sustainable Fishing since 2016, currently takes more than 90% of the total WCEMF catch of blue swimmer crabs.

2.3.3 Recreational Fishing

Fishing for blue swimmer crabs represents an iconic recreational fishing experience in WA, with the number caught by boat-based recreational fishers among the highest of all recreational species (Ryan et al. 2019; Harris and Johnston, in review). The majority of recreational crab fishers use baited drop nets, which are set (typically for around 10-15 minutes at any one time) from boats, bridges, jetties and canal houses. Blue swimmer crabs are also visually targeted with scoop nets, which are predominantly used while wading or from a drifting boat in shallow waters. Collection of crabs while diving, by hand, or using a blunt wire hook, is also permitted.

State-wide integrated surveys of boat-based recreational fishing show that blue swimmer crabs are currently the second most commonly retained invertebrate species (in numbers) by boat-based recreational fishers in WA (Ryan et al. 2019). Ninety percent of retained catches in 2017/18 were taken in the West Coast Bioregion, with the majority retained in the Metropolitan Zone which encompasses the Swan-Canning Estuary, the northern part of Cockburn Sound, Warnbro Sound and the Peel-Harvey Estuary. Catches were lower in the South West Zone, which encompasses the waters of Leschenault Estuary and Geographe Bay, as well as Hardy Inlet (Ryan et al. 2019).

Due to the lack of a sampling frame for a targeted survey, estimates of blue swimmer crab catches by shore-based (scoop-netting) recreational fishers are uncertain. In the Peel-Harvey

Estuary, estimates of recreational scoop-netting effort based on 24-hour thermal imaging cameras at three high activity locations (see Section 3.6.1.2.1) suggest more than 80% of scoop-netting activity at these sites occurs between November and February (Taylor et al. 2018). A roving onsite survey carried out across all publicly accessible parts of the estuary foreshore between March 2018 and February 2019 found that more than 93% of the scoop-netting activity occurred within the same four-month period (Desfosses et al. in prep.). The thermographic camera study also indicated that a substantial proportion of scoop-netting effort (up to 38%) occurs outside of daylight hours (Taylor et al. 2018).

2.3.4 Customary Fishing

There are no data on the level of customary fishing for blue swimmer crabs in South-West WA, however, anecdotal information suggests it is very low.

2.4 Catch-Share Allocations

Historically, the blue swimmer crab resource of South-West WA has been fished by commercial and recreational sectors without any explicit catch share allocation between sectors. This is, in part, due to the limited data on shore-based recreational catches needed to understand changes in catch shares between these sectors over time. Recognising the naturally fluctuating stock levels of blue swimmer crabs due to variable recruitment and seasonal movements between the marine and estuarine environments, this harvest strategy adopts annual catch tolerance levels in each of the main areas fished by both commercial and recreational fishers (see Section 3.5). Where stock levels are adequate, current catch information is compared to these tolerance levels as an approach to monitor the performance of the fisheries. This provides the management flexibility required for highly variable stocks, while acknowledging that catches below the overall tolerance level would be unlikely to affect the sustainability of the resource.

A Voluntary Fisheries Adjustment Scheme (VFAS) is currently underway to reduce the number of commercial licenses in the Peel-Harvey Estuary² and re-allocate a component of the resource to recreational fishers and the ecosystem. In response to a management review to improve the protection of blue swimmer crab breeding stocks, a buy-back of all commercial crab licences in Cockburn Sound, Warnbro Sound, and the Mandurah to Bunbury Developing Crab Fishery (including Comet Bay) was also recently initiated.

3 HARVEST STRATEGY

The procedures used within this harvest strategy involve two interrelated decision-making processes. The first constitutes the formal review of targeted stocks and other ecological assets against defined reference levels to determine performance against management objectives relating to ecological sustainability (Section 3.4). The second process involves an annual

² As of 1 January 2020, the number of commercial crab licences in the Peel-Harvey Estuary had been reduced from 10 to eight, each permitted to use 42 purpose-built hour-glass traps to target blue swimmer crabs.

fishery-level review that determines whether the current catch/effort by each of the relevant fisheries/sectors is consistent with the levels expected when ecological objectives are met (Section 3.5).

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 for this resource (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 high-level social and economic objectives for the fisheries/sectors targeting this resource. It is important to note that the social and economic objectives are applied within the context of ESD and are considered once the ecological objectives have been met (Department of Fisheries 2015).

3.1.1 Ecological Sustainability

- 1) To maintain spawning stock biomass of the target species (i.e. blue swimmer crabs) at a level where the main factor affecting recruitment is the environment;
- 2) To maintain spawning stock biomass of each other retained species at a level where the main factor affecting recruitment is the environment;
- 3) To ensure fishing impacts do not result in serious or irreversible harm³ to bycatch species populations;
- 4) To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected (ETP) species populations;
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function; and

³ 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.

- 6) To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.

3.1.2 Economic and Social Benefits

- 1) To provide commercial fisheries with reasonable opportunities to maximise their livelihood in supplying seafood to the community, within the constraints of ecological sustainability; and
- 2) To provide fishing participants with reasonable opportunities to maximise cultural, recreational and lifestyle benefits of fishing, within the constraints of ecological sustainability.

3.2 Operational Objectives

Long-term management objectives are typically operationalised as short-term (e.g. annual or periodic) objectives through one or more performance indicators that can be measured and assessed against pre-defined reference levels to ascertain actual performance. Within the context of the long-term ecological 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 Approach

The blue swimmer crab resource of the South-West WA is harvested using a constant exploitation approach, where the catches vary in proportion to variations in stock abundance.

In line with this approach, the commercial and recreational fisheries targeting this blue swimmer crab resource are managed using a range of input and output controls. Commercial fishing effort is constrained by a cap on the number of licences/vessels operating in each fishery (limited entry) and restrictions on fishing gear, including the number and size of crab traps, and the length of nets. Recreational fishing effort is managed by gear controls (e.g. limits on the number of drop nets used) and daily bag and boat limits. Recreational fishers operating from a boat are required to hold a current Recreational Fishing from Boat Licence (RFBL). Unlicensed fishers on recreational boats can fish if at least one other person on board has an RFBL, provided the total catch of everyone on board stays within the bag limits of the licenced fisher(s) (or combined boat limit).

Some estuarine and nearshore waters of South-West WA are permanently closed to commercial fishing (e.g. Leschenault Estuary) and can only be accessed by recreational fishers. In the estuaries open to commercial fishing, temporal closures typically prohibit licenced fishers from operating during weekends. A seasonal crabbing closure prohibits the take of blue swimmer crabs by all commercial, recreational and charter fishers from the Swan-Canning Estuary to 15 km south of Bunbury between 1 September and 30 November each year. Recreational fishers are not permitted to retain individuals smaller than the prescribed minimum size limit of 127 mm carapace width (CW), while minimum size limits for the commercial sector currently range from 127 mm CW in the Peel-Harvey and Swan-Canning estuaries to 130 mm

CW in Cockburn Sound (noting the latter is currently closed). All fishers are also prohibited from retaining berried⁴ female crabs.

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 ecological objective. Suitable indicators have been selected to determine the status of the blue swimmer crab resource of South-West WA, and other ecological assets, against defined reference levels established to separate acceptable from unacceptable performance (Section 3.4.1). Where relevant, these reference 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 relate to the status of each indicator compared to the reference levels (Section 3.4.2). A summary of the management objectives, performance indicators, reference levels and HCRs is provided in Table 1.

3.4.1 Performance Indicators and Reference Levels

3.4.1.1 Blue Swimmer Crabs

The status of the blue swimmer crab resource in South-West WA is assessed annually using a weight-of-evidence approach of all available data for the key areas in which the resource is commercially targeted; the Swan-Canning Estuary and the Peel-Harvey Estuary. As genetic studies have indicated that blue swimmer crabs in these estuaries are genetically distinct, these fisheries are currently monitored and assessed separately. Due to a lack of information about the total recreational effort and catch of blue swimmer crabs in South-West WA, the harvest strategy for these stocks is primarily based on standardised commercial catch rates relative to reference levels for each of the two key areas (Table 1).

For each area, reference levels have been calculated from the standardised catch rates observed annually during a reference period of relative stability when the fishery was considered to have been operating sustainably (Swan-Canning Estuary: 2008/09-2016/17, Peel-Harvey Estuary: 2000/01-2016/17). The reference periods are regularly reviewed to ensure they remain appropriate, given changes to management over time (e.g. current VFAS in the Peel-Harvey Estuary).

The target range extends between the maximum and minimum values recorded during that reference period, where the latter denotes the threshold level assumed to represent a proxy for the stock level at which Maximum Sustainable Yield (MSY) can be achieved. Any stock size

⁴ With eggs attached beneath its body.

above this level is therefore consistent with meeting the objectives for biological sustainability and also satisfy stock status requirements under the MSC standard for sustainable fishing. A conservative approach has been taken to set the limit reference level at 70% of the threshold value (i.e. $0.7B_{MSY}$) and is considered to represent the level below which recruitment may be impaired.

Abundance information for blue swimmer crabs in the Swan-Canning Estuary and Peel-Harvey Estuary is also derived from commercial monitoring and fishery-independent surveys, which currently informs the broader weight-of-evidence assessments of these stocks (see Section 3.6.1.3). It is anticipated that the fishery-independent indices may be used as performance indicators in future harvest strategies for these resources, once sufficient time series of data are available.

3.4.1.2 Other Ecological Assets

Other ecological assets incorporated in this harvest strategy include other retained and bycatch species, ETP species, habitats and ecosystem processes that may be affected by commercial and recreational fishing activities in the Peel-Harvey Estuary (Table 1). For all ecological components, reference levels have been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher (2015). An ecological risk assessment for the Peel-Harvey Estuary fishery will be undertaken in 2020 to inform these components of the harvest strategy, with these risk scores to be reviewed after no more than five years (see Section 3.6.2.2)

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 sustainability objectives (Table 1). These HCRs are designed to maintain the resource above the threshold level and close to a target level, or rebuild it where it has fallen below the threshold (undesirable) or the limit (unacceptable) levels.

For each target stock, a decrease in the performance indicator below the threshold reference level will trigger a reduction in catch by up to 50% of the current harvest level, applicable to each relevant fishing sector (Table 1). A review will be undertaken within three months to determine the level of reduction that is expected to rebuild the stock to the target level, which will be dependent on the extent of which the threshold has been breached and the required rebuilding rate.

For the commercial sector, the harvest level from which the catch reduction is calculated is the average catch observed in the three years leading up to the breach, to allow for inter-annual variability in catches. The catch reduction may be achieved by setting a nominal catch limit to ensure commercial catches do not exceed the benchmark that is expected to rebuild the stock. Alternatively, an equivalent decrease in catch can be achieved by reducing the fishing effort, for example by gear restrictions or reducing the length of the fishing season through the implementation of temporal closures.

As recreational catch information for blue swimmer crabs in South-West WA is often incomplete or uncertain, implementing the HCR as a reduction of the current catch for this sector may not be appropriate. A catch reduction for this sector will instead typically be applied indirectly through an equivalent reduction in the current bag/boat limit and/or the length of the fishing season expected to achieve the required response. Where data are available to suggest the current bag/boat limit is often not achieved by fishers, the review may determine that a stronger management response is necessary to achieve the desired catch reduction.

If a stock falls below the limit reference level, the catch (average of last three years) will be reduced by at least 50% as soon as practicable (Table 1). Within three months of the breach, the review will then determine what additional management actions are needed to recover the stock within two generation times (see section below on recovering depleted stocks).

For more information on the management tools available to achieve the catch reductions specified by the HCR, and the legal instrument under which the management measure occurs, see Section 4.1.

3.4.2.1 Recovering Depleted Stocks

A resource that has fallen below the acceptable level and for which suitable management adjustments have been implemented to reduce catch and/or effort (as outlined in the HCRs) is considered to be in a recovery phase (Department of Fisheries 2015). For target stocks that fall below the limit reference level, a recovery strategy will be developed and implemented to ensure that the resource can rebuild at an acceptable rate (i.e. within two generation times). Where the environmental conditions have led, or contributed significantly, to the resource being at an unacceptable level, the strategy needs to consider how this may affect the speed and extent of recovery.

Table 1. Harvest strategy performance indicators, reference levels and control rules for the blue swimmer crab resource of South-West WA, and associated ecological assets that may be impacted by fishing activities within the Peel-Harvey Estuary.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Target species	To maintain spawning stock biomass of blue swimmer crabs at a level where the main factor affecting recruitment is the environment	Blue swimmer crabs in South-West WA	Annual standardised commercial catch rate in the 1. Swan-Canning Estuary, and 2. Peel-Harvey Estuary	Target: Swan-Canning Estuary: 6.2-9.8 kg/100 m net length Peel-Harvey Estuary: 0.7-1.4 kg/traplift	Continue management aimed at achieving ecological, economic and social objectives.
				Threshold: Swan-Canning Estuary: 6.2 kg/100 m net length Peel-Harvey Estuary: 0.7 kg/ traplift	If the threshold level is breached, a review will be completed within three months to develop an appropriate management response. Management action (applicable to all relevant fisheries/sectors) will be taken to reduce catches by up to 50% ⁵ of the current harvest level to return stock to the target level.

⁵ The level of catch reduction to the relevant fisheries/sectors will be dependent on the extent by which the reference level has been breached, and the required rebuilding rate.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				Limit: Swan-Canning Estuary: 4.3 kg/100 m net length Peel-Harvey Estuary: 0.5 kg/traplift	If the limit level is breached, management action (applicable to all relevant fisheries/sectors) will be immediately taken to reduce catches by at least 50% of the current harvest level. A review will be completed within three months to determine what additional management actions (up to 100% catch reduction ⁵) are required to rebuild the stock to the target level within two generation times (i.e. informing the recovery strategy for the stock).
Other retained species	To maintain spawning stock biomass of each retained species at a level where the main factor affecting recruitment is the environment	All other retained species in the Peel-Harvey Estuary	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual commercial fishing effort and catch (retained and discarded), • species information, and • other available research. 	Target: Fishing impacts are expected to generate an acceptable risk level to other retained species, i.e. medium risk or lower.	Continue management aimed at achieving ecological, economic and social objectives.
				Thresholds: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to other retained species, i.e. high risk.	Review the reasons for this variation within three months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to other retained species, i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Bycatch (non-ETP) species	To ensure fishing impacts do not result in serious or irreversible harm to bycatch species' populations.	All (non-ETP) bycatch species in the Peel-Harvey Estuary	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual commercial fishing effort and catch (retained and discarded), • available information on recreational fishing effort and catch (retained and discarded), • review of alternative measures to minimise unwanted catch, • species information, and • other available research. 	Target: Fishing impacts are expected to generate an acceptable risk level to all bycatch species, i.e. medium risk or lower.	Continue management aimed at achieving ecological, economic and social objectives.
				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.	Review the reasons for this variation within three months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any bycatch species, i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.
Endangered, threatened and protected (ETP) species	To ensure fishing impacts do not result in serious or irreversible harm to ETP species' populations	All ETP species in the Peel-Harvey Estuary	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual commercial fishing effort and catch 	Target: Fishing impacts are considered to generate an acceptable level of risk to all ETP species' populations, i.e. medium risk or lower.	Continue management aimed at achieving ecological, economic and social objectives.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
			(retained and discarded), <ul style="list-style-type: none"> • available information on recreational fishing effort and catch (retained and discarded), • review of alternative measures to minimise unwanted catch, • number of reported ETP species interactions, • species information, and • other available research. 	Thresholds: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any ETP species' populations, i.e. high risk.	Review the reasons for this variation within three months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ETP species' populations, i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function	Benthic habitats in the Peel-Harvey Estuary	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual commercial fishing effort, • available information on recreational fishing effort, • extent of area fished, and • other available research. 	Target: Fishing impacts are considered to generate an acceptable level of risk to benthic habitats, i.e. medium risk or lower.	Continue management aimed at achieving ecological, economic and social objectives.
				Thresholds: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any benthic habitats, i.e. high risk.	Review the reasons for this variation within three months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any benthic habitats, i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes	Trophic interactions Community structure (in the Peel-Harvey Estuary)	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch, • number of reported ETP species interactions • species information, • extent of area fished annually, and • other available research. 	Target: Fishing impacts are expected to generate an acceptable level of risk to ecological processes within the ecosystem, i.e. medium risk or lower.	Continue management aimed at achieving ecological, economic and social objectives.
				Thresholds: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to ecological processes within the ecosystem, i.e. high risk.	Review the reasons for this variation within three months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to ecological processes within the ecosystem, i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.

3.5 Fishery Performance

Defining annual (or periodic) catch or effort tolerance levels for fisheries provides a formal and 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 can also consider the 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.

Annual catch tolerance levels have been developed for the two key commercial fisheries that target the blue swimmer crab resource in South-West WA (Table 2). For the Swan-Canning Estuary, these tolerance ranges have been based on historical catch information relative to estimates of MSY derived from a preliminary production model to indicate the period in which the fishery has been operating sustainably (2008/09-2016/17, noting that the final year of catch was excluded due to high summer rainfall leading to reduced fishing in that season). In the absence of MSY estimates for the Peel-Harvey Estuary (due to crab movement in and out of estuary), the tolerance ranges for the commercial fishery have been based on catch levels observed during the specified reference period of 2000/01-2016/17 and adjusted downwards to account for the effect of the current VFAS (see Table 2).

Tolerance ranges have also been developed for the boat-based recreational sector in the Swan-Canning and Peel-Harvey estuaries (Table 2), broadly based on preliminary catch estimates for each estuary from the four boat-based fishing surveys completed to date. For the Swan-Canning Estuary, the tolerance ranges have been adjusted downwards (by 30%) to account for recent changes to management, including a seasonal closure and reduction of bag limits. For the Peel-Harvey, the tolerance ranges have been adjusted upwards (by 20%) to account for recent changes to management, include the ongoing VFAS and extended seasonal closure to increase protection of breeding stocks. It is acknowledged that the tolerance levels will be refined with time and, for the Peel-Harvey Estuary, additional tolerance levels for the shore-based scooping sector (likely based on effort as a proxy for catch) may be added to this harvest strategy.

If the catch of either fishery/sector breaches the specified tolerance level and this cannot be adequately explained (e.g. clear environmental impacts or marketing reasons), the performance is termed 'Unacceptable'. This would also trigger a review to determine if management arrangements are still appropriate and if a re-assessment of resource status is necessary to inform adjustments to the HCRs and/or tolerance levels.

The economic objective for the fisheries that target the blue swimmer crab resource in South-West WA does not have an explicit performance measure within this harvest strategy. Rather, it is through the formal consultation process (facilitated by annual management meetings with the commercial fishers) that regulatory impediments to maintaining economic return, or opportunities for enhancing economic return, are discussed. If measurable indicators for monitoring performance against the economic objectives are identified, these will be included in future revisions of this harvest strategy.

Table 2. Annual catch tolerance levels (tonnes, t) for the key fisheries/sectors that target the blue swimmer crab resource in South-West WA. Note that annual boat-based recreational catch is only estimated every 2-3 years.

Area	Commercial	Recreational (boat-based)
Swan-Canning Estuary	6-11 t	4-12 t
Peel-Harvey Estuary	6×N (lower) - 12×N (upper)* t	31-55 t

*Once VFAS has been finalised, the upper tolerance level will be determined as 12 t times the number, N, of remaining licence holders with crab trap entitlement in the Peel-Harvey Estuary. The lower tolerance level will be reduced proportionally to the original tolerance range per fisher (approximately 6 t).

3.6 Monitoring and Assessment Procedures

3.6.1 Information and Monitoring

3.6.1.1 Commercial Fishing Information

3.6.1.1.1 Commercial Catch and Effort Reporting

Commercial fishers are required to report all retained species catches (kg), effort (e.g. days fished, trap lifts per day) and any ETP species interactions in statutory monthly catch and effort (CAES) returns, which have been used in the fishery since 1975 (noting that earlier catch data are available for some areas). These CAES data are used to calculate catch rates of blue swimmer crabs, which are currently used as the primary performance indicator to inform the assessments of the stocks in the Swan-Canning Estuary and Peel-Harvey Estuary.

All CAES returns are checked by Departmental research staff, and any possibly erroneous entries or gaps are verified directly with skippers or the relevant licensees. These data are also validated by commercial monitoring information collected by Departmental research staff on-board commercial vessels throughout the fishing season (see below).

3.6.1.1.2 Commercial Monitoring

On-board observer monitoring of commercial blue swimmer crab catch is undertaken across the key fisheries in South-West WA. Departmental research staff collect size-frequency data on-board commercial vessels on a monthly basis in the Swan-Canning Estuary, and twice a month in the Peel-Harvey Estuary (one monitoring trip in the Peel Inlet region and one in the Harvey Estuary region), when fishing occurs.

The commercial monitoring data, which are recorded per line of traps or length of net, includes the number of traps or metres of net in the line, the soak time (number of hours the traps or nets were in the water since last serviced), a start latitude and longitude, and a mean depth. Data recorded for each captured crab includes carapace width (the distance between the tips of the two lateral spines of the carapace measured to the nearest millimetre), sex and moult stage, along with the breeding condition and state of sexual maturity of female crabs.

Information on the size composition and sex ratio of the commercial catch, which includes both juvenile and legal-sized crabs, are used in the broader weight-of-evidence assessment of each stock. It also provides valuable information on bycatch and the spatial distribution of fishing, which are used to inform risk assessments that consider the impacts of the fishery on the broader ecosystem (see Section 3.6.2.2). As fishers are not directed to fishing spots and likely focus their fishing effort on areas of higher crab abundance, however, the data collected are unlikely to provide a representative sample of the population (as is often the focus of fishery-independent sampling programs).

3.6.1.2 Recreational Fishing Information

3.6.1.2.1 Recreational Fishing Surveys

Estimates of the blue swimmer crab recreational catch in South-West WA are available from periodic recreational fishing surveys undertaken by the Department since the 1990s. Some of the surveys have focused solely on a single estuary or embayment, while others have been designed to provide broader-scale bioregional estimates of recreational fishing catch and effort. As the scope of these surveys differ, estimates are often not comparable.

Dedicated recreational fishing surveys were conducted in the 1990s and 2000s in the Swan-Canning Estuary (Malseed and Sumner 2001a), Peel-Harvey Estuary (Malseed and Sumner 2001b; Lai et al. 2014), Cockburn Sound (e.g. Sumner and Malseed 2004; Bellchambers et al. 2005), Leschenault Estuary (Malseed et al. 2000), and in Geographe Bay (Sumner and Malseed 1999; 2004). Although these surveys provided information on both boat- and shore-based fishing effort and catch of blue swimmer crabs, they typically only captured daylight fishing and may thus have underestimated the total catch.

To allow the previously unknown component of fishing undertaken outside of daylight hours to be accounted for in future estimates of catch from the Peel-Harvey Estuary, fixed-location cameras have been used to monitor scoop netting activity at three locations on the Peel Inlet and Harvey Estuary foreshore since 2014/15 (Taylor et al. 2018). The cameras run continuously at three locations around the estuary, to identify patterns of recreational fishing activity for blue swimmer crabs over 24-hours each day, throughout the year. This information, together with data from a recently completed 15-month survey of recreational scoop netting, will be used to provide an estimate of scoop netting effort across the broader estuary (Desfosses et al. in prep.).

Since 2011, state-wide boat-based recreational surveys have been undertaken every two to three years to collect information on private (non-charter), boat-based recreational fishing in WA (Ryan et al. 2013; 2015; 2017; 2019). The survey uses three complementary components, off-site phone diary surveys, on-site boat ramp surveys and remote camera monitoring, to collect information on fishing catch, effort, location and other demographic information. Each survey provides a state-wide and bioregional estimate of the boat-based recreational catch of blue swimmer crabs; both retained and released (e.g. Ryan et al. 2019). Work is also currently being undertaken to estimate catch for some of the key crabbing areas within South-West WA, including the Swan-Canning Estuary and the Peel-Harvey Estuary.

3.6.1.2.2 Other Reporting

Interactions between recreational fishers and/or their gear with ETP species are generally reported to the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) via the Wildcare Helpline⁶.

3.6.1.3 Fishery-Independent Information

Fishery-independent monitoring of blue swimmer crabs has been carried out in several locations in South-West WA; in Cockburn Sound (Johnston et al. 2011a; b), Peel-Harvey Estuary (Johnston et al. 2014), Swan-Canning Estuary, Leschenault Estuary and Geographe Bay (Harris et al. 2017). These trap and trawl surveys provide important information on blue swimmer crab biology and changes in population dynamics over time. These preliminary indices of recruitment and breeding stock levels are currently used to inform the broader weight-of-evidence assessments of the stocks, however, it is intended that these will provide future performance indicators for the harvest strategy for this resource once a sufficient time series of data are available.

3.6.2 Assessment Procedures

The different methods used by the Department to assess the status of aquatic resources in WA have been categorised into five broad levels. These range from relatively simple analyses of annual catch levels and catch rates, through to the application of more sophisticated models, for estimating biomass and fishing mortality. Irrespective of the types of assessment methodologies used, all stock assessments undertaken by the Department take a risk-based, weight of evidence approach that considers all of the available (fishery-dependent and fishery-independent) information (Fletcher 2015, Wise et al. in prep.).

3.6.2.1 Blue Swimmer Crabs

3.6.2.1.1 Standardised Commercial Catch Rates

Annual commercial catch rates for blue swimmer crabs in Swan-Canning Estuary and Peel-Harvey Estuary are calculated using the total catch and effort (kg/100 m net length and kg/traplift, respectively), as recorded by commercial fishers in monthly CAES returns. The catch rates are standardised using a generalised linear modelling (GLM) approach to analysis of variance to account for effects of factors including fishing season, month and vessel. The observed catch rates are thus standardised for temporal shifts in fishing effort that occur from month to month each year. As catches are reported in a single CAES block for each fishery, it is not possible to standardise catch rates for spatial shifts in effort distribution.

⁶ More information about the Wildcare Helpline is available at:
<http://www.dpaw.wa.gov.au/about-us/contact-us/wildcare-helpline>

3.6.2.2 Risk Assessments

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

As stated in Section 2, the harvest strategy for this resource currently considers impacts on ecological assets other than the target stocks only within the Peel-Harvey Estuary. An ecological risk assessment for the Peel-Harvey Estuary fishery will be undertaken in 2020 to consider the ecosystem impacts of the fishing activities (commercial and recreational) targeting the resource, assessed both individually and cumulatively.

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

4 MANAGEMENT MEASURES AND IMPLEMENTATION

4.1 Management Measures

There are a number of management measures in place for the fisheries that target the blue swimmer crab resource of South-West WA (Table 3). These measures can be amended as needed to ensure management objectives are achieved, however, they do not preclude the consideration of other options.

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.

There are two main processes for making decisions about the implementation of management measures and strategies for the Peel-Harvey blue swimmer crab resource:

- annual decision-making processes that may result in measures to meet the short-term, 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, consultation with stakeholders may be undertaken to discuss the issue and determine appropriate management action, as needed.

Table 3. Management measures and instrument of implementation for the fisheries targeting the blue swimmer crab resource of South-West WA.

Measure	Description	Instrument
Limited Entry	Blue swimmer crabs can only be retained by commercial fishers with a Managed Fishery Licences that permits capture of this species.	Management Plans
Gear Restrictions	Commercial fishers can only fish within the specified capacity of their fishery (e.g. number of traps or net length). Only traps and nets of specific size/volume/length are permitted to be used.	Management Plans
	Inclusion of escape gaps in commercial crab traps (Peel-Harvey Estuary).	Voluntary
	Recreational crab fishers can only retain blue swimmer crabs by hand or using blunt wire hooks, drop nets (maximum of 10 per person and per boat) or scoop nets.	FRMR
Seasonal Closures	No fishing for crabs is permitted during the specified season closures to protect breeding crabs.	Management Plans FRMR
Temporal Closures	In some of the commercial fisheries, fishers have to abide by specific weekend and daytime closures.	Management Plans
Spatial Closures	Parts of estuarine and nearshore waters of South-West WA are permanently closed to commercial and recreational fishing activities.	Management Plans FRMR
Condition and Size Restrictions	Minimum size limits apply for commercial and recreational fisheries. No retention of berried female crabs is permitted.	FRMR
Bag and Boat Limits	Daily limit of 10 blue swimmer crabs per person and 20 blue swimmer crabs per boat (two or more Recreational Boat Fishing Licences required to take boat limit).	FRMR
Reporting	Licensed commercial fishers are required to report all retained species catches, effort, ETP species interactions and fishing location in statutory monthly logbooks.	FRMR

4.2.1 Consultation

Management changes are generally given effect through amendments to legislation, such as the commercial fishery management plan, regulations and orders. These changes generally require consultation with all affected parties and the approval of the Minister for Fisheries and/or the Department's Director General (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) The peak bodies of the Western Australian Fishing Industry Council (WAFIC) and Recfishwest are the primary source of advice and representation from the commercial and recreational harvesting sectors, respectively.

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

4.2.1.1 Commercial Sector Consultation

Under its funding agreement with the Department, WAFIC is required to undertake statutory consultation functions related to fisheries management and the facilitation of management meetings for licensed fisheries. The commercial Peel-Harvey Estuary fishers are represented by the Mandurah Licenced Fishermen's Association.

Annual Management Meetings (AMMs) between the Department, WAFIC and licence holders in the fisheries that target the blue swimmer crab resource in South-West WA are generally held around September/October and are important forums to consult on the management of these fisheries. During these meetings, Departmental (science, management and compliance) staff, licence holders and WAFIC discuss current and future management issues that may have arisen during the previous fishing season and any proposed changes to the management plan. Follow-up meetings may be held as required.

4.2.1.2 Recreational Sector Consultation

Under the funding agreement with Recfishwest, the Department is required to consult with Recfishwest as the recognised peak body for recreational fishing in WA. Recfishwest is required to engage and consult with recreational fishers as necessary in order to meet its obligations.

4.2.1.3 Consultation with Other Groups

Consultation on blue swimmer crab management with customary fishers and non-fisher stakeholders, including Government agencies, conservation sector Non-Government Organisations (NGOs) and other affected/interested parties, is undertaken in accordance with the Departmental 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, 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 sustainability, economic and social 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.

Management arrangements for the blue swimmer crab resource of South-West WA are enforced under Operational Compliance Plans (OCPs). The OCPs are informed and underpinned by a compliance risk assessment conducted for each fishery, which are reviewed every two years. These OCPs have the following objectives:

- to provide clear and unambiguous direction and guidance to Fisheries and Marine Officers for the yearly delivery of compliance in the fishery;
- to protect the fisheries' environmental values, while providing fair and sustainable access to the fishery's commercial and social values; and
- to encourage voluntary compliance through education, awareness and consultation activities.

Compliance strategies and activities that are used in the commercial and recreational fisheries targeting the blue swimmer crab resource of South-West WA include:

- land patrols;
- on-water patrols;

- road-side checkpoints;
- catch, licence and gear inspections;
- wholesale and retail inspections; and
- covert surveillance of persons of interest under approved operations.

5 REFERENCES

- Bellchambers, L., Sumner, N. and Melville-Smith, R. (2005). Development of stock allocation and assessment techniques in Western Australian blue swimmer crab fisheries. FRDC Project No. 2001/068. pp 33-71.
- Chaplin, J.A. and Sezmiş, E. (2008). A genetic assessment of the relationships among the assemblages of the blue swimmer crab, *Portunus pelagicus*, in Cockburn Sound, the Swan River Estuary and Warnbro Sound. Report prepared for the Department of Fisheries, Western Australia. Murdoch University, Western Australia.
- de Lestang, S. (2002). Biology of the blue swimmer crab, *Portunus pelagicus* (Linnaeus), in Western Australia. PhD thesis. Murdoch University, Western Australia, 173 pp.
- 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 (2015). Harvest Strategy Policy and Operational Guidelines 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.
- Department of Primary Industries and Regional Development (DPIRD) (2018). Protecting breeding stock levels of the blue swimmer crab resource in the south west. A review of management arrangements. Fisheries Management Paper No. 288. DPIRD, Western Australia.
- DPIRD (2020). Blue Swimmer Crab Resource of Shark Bay Harvest Strategy 2020-2025. Fisheries Management Paper No. 300. DPIRD, 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* 183: 594-608.
- Harris, D. and Johnston, D. (in review). More for less: can citizen science support the management of small-scale recreational fisheries. *ICES Journal of Marine Science*.
- Harris, D., Johnston, D., Baker, J. and Foster, M. (2017). Adopting a Citizen Science approach to develop cost-effective methods that will deliver annual information for managing small scale recreational fisheries: The Southwest Recreational Crabbing Project. Fisheries Research Report No. 281. Department of Fisheries, Western Australia. 124pp.
- Johnston, D., Harris, D., Caputi, N., de Lestang, S. and Thomson, A. (2011a) Status of the Cockburn Sound Crab Fishery. Fisheries Research Report No. 219. Department of Fisheries, Western Australia. 104pp.
- Johnston, D.J., Harris, D., Caputi, N. and Thomson, P. (2011b) Decline of a blue swimmer crab (*Portunus pelagicus*) fishery in Western Australia – history, contributing factors and future management strategy. *Fish. Res.* 109:119-130.
- Johnston, D., Chandrapavan, A., Wise, B. and Caputi, N. (2014). Assessment of blue swimmer crab recruitment and breeding stock levels in the Peel-Harvey Estuary and status of the Mandurah to Bunbury Developing Crab Fishery. Fisheries Research Report No. 258. Department of Fisheries, Western Australia, 142 pp.
- Kailola, P.J., Williams, M.J., Stewart, P.C., Reichelt, R.E., McNee, A. and Grieve, C. (1993). Australian Fisheries Resources. Bureau of Resource Sciences, Department of Primary Industries and Energy, and the FRDC, Canberra, Australia.
- Lai, E., Hall, N., Telfer, C., Eyres, J. and Wise, B. (2014). Recreational surveys of catch and effort for blue swimmer crabs in the Peel-Harvey Estuary. In: Johnston, D., Chandrapavan, A., Wise, B. and Caputi, N. (eds.), Assessment of blue swimmer crab recruitment and breeding stock levels in the Peel-Harvey Estuary and status of the Mandurah to Bunbury Developing Crab Fishery. Fisheries Research Report No. 258, pp. 70-105. Department of Fisheries, Western Australia.
- Malseed, B. E. and Sumner, N. R. (2001a). A 12-month survey of recreational fishing in the Swan-Canning Estuary Basin of Western Australia during 1998-99. Fisheries Research Report No. 126. Department of Fisheries, Western Australia. 44p.
- Malseed, B.E. and Sumner, N.R. (2001b). A 12-month survey of recreational fishing in the Peel-Harvey Estuary of Western Australia during 1998-99. Fisheries Research Report No. 127. Department of Fisheries, Western Australia, 52 pp.
- Malseed, B. E., Sumner, N. R. and Williamson, P.C. (2000). A 12-month survey of recreational fishing in the Leschenault Estuary of Western Australia during 1998. Fisheries Research Report No. 126. Department of Fisheries, Western Australia. 44p.
- Potter, I.C., Chrystal, P.J. and Loneragan, N.R. (1983). The biology of the blue manna crab *Portunus pelagicus* in an Australian estuary. *Marine Biology* 78: 75-85.

- Ryan, K.L., Wise, B.S., Hall, N.G., Pollock, K.H., Sulin, E.H. and Gaughan, D.J. (2013). An integrated system to survey boat-based recreational fishing in Western Australia 2011/12. Fisheries Research Report No. 249. Department of Fisheries, WA.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., Taylor, S.M. and Wise, B.S. (2015). Statewide survey of boat-based recreational fishing in Western Australia 2013/14. Fisheries Research Report No. 268. Department of Fisheries, WA.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., Taylor, S.M., Wise, B.S. (2017). Statewide survey of boat-based recreational fishing in Western Australia 2015/16. Fisheries Research Report No. 287, DPIRD, WA.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., Tate, A., Taylor, S.M., Wise, B.S. (2019). Statewide survey of boat-based recreational fishing in Western Australia 2017/18. Fisheries Research Report No. 297, DPIRD, WA.
- Sezmiş, E. (2004). The population genetic structure of *Portunus pelagicus* in Australian waters. PhD thesis. Murdoch University, Western Australia.
- 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. FRDC Report – Project 2010/061. Primary Industries and Regions, South Australia, Adelaide, March.
- Sumner, N. and Lai, E. (2012). Boat-based Recreational Fishing Catch and Effort in Cockburn Sound and Owen Anchorage during 1996/97, 2001/02 and 2005/06. Fisheries Research Contract Report No. 23. Department of Fisheries, Western Australia. 16p.
- Sumner, N.R. and Malseed, P.C. (1999). Quantification of changes in recreational catch and effort on blue swimmer crabs in Cockburn Sound and Geographe Bay. Fisheries Research Report No. 147. FRDC Project No. 2001/067. Department of Fisheries, Western Australia.
- Sumner, N.R. and Malseed, B.E. (2004). Quantification of changes in recreational catch and effort on blue swimmer crabs in Cockburn Sound and Geographe Bay. Fisheries Research Report No. 147. FRDC Project No. 2001/067. Department of Fisheries, Western Australia.
- Taylor, S.M., Blight, S.J., Desfosses, C., Steffe, A.S. (2018). Thermographic cameras reveal high levels of crepuscular and nocturnal shore-based recreational fishing effort in an Australian estuary. *ICES Journal of Marine Science* 75:2107-2116.