



Department of
**Primary Industries and
Regional Development**

Fisheries Management Paper No. 300

**Blue Swimmer Crab Resource of
Shark Bay Harvest Strategy**

2020-2025

Version 1.0

June 2020

Version Control

Version	Publication Series Title	Change Description	Date
1.0	Fisheries Management Paper No. 300	First published harvest strategy for this resource	June 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 © State of Western Australia (Department of Primary Industries and Regional Development) 2020

TABLE OF CONTENTS

LIST OF ACRONYMS	1
1 INTRODUCTION	2
1.1 Review Process	2
2 SCOPE.....	3
2.1 Environmental Context	3
2.2 Target Species	6
2.3 Fishing Activities	6
2.3.1 Governance.....	6
2.3.2 Commercial Fishing	7
2.3.3 Recreational Fishing.....	8
2.3.4 Customary Fishing	8
2.4 Catch-Share Allocations	8
3 HARVEST STRATEGY	9
3.1 Long-Term Objectives	9
3.1.1 Ecological Sustainability.....	9
3.1.2 Economic & Social Benefits	10
3.2 Operational Objectives.....	10
3.3 Harvesting and Management Approaches	10
3.4 Ecological Sustainability.....	11
3.4.1 Performance Indicators and Reference Levels.....	12
3.4.2 Application of Harvest Control Rules.....	13
3.4.2.1 <i>Recovering Depleted Stocks</i>	15
3.5 Fishery Performance	22
3.5.1 Tolerance Levels	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	27
4.2.1 Consultation	28

4.2.1.1 Commercial Sector Consultation	28
4.2.1.2 Recreational Sector Consultation	28
4.2.1.3 Shark Bay Crab Working Group	29
4.2.1.4 Consultation with Other Groups	29
4.3 Compliance and Enforcement	29
4.3.1 Operational Compliance Plans	30
5 REFERENCES	31
6 APPENDIX 1	33

LIST OF ACRONYMS

ARMA	<i>Aquatic Resources Management Act 2016</i>
CDR	Catch and Disposal Record
CPUE	Catch Per Unit Effort
CW	Carapace Width
EBFM	Ecosystem Based Fisheries Management
EPBC (Act)	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
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
ITQ	Individual Transferable Quota
MSY	Maximum Sustainable Yield
OCP	Operational Compliance Plan
RFBL	Recreational Fishing from Boat Licence
SBCMF	Shark Bay Crab Managed Fishery
SBPMF	Shark Bay Prawn Managed Fishery
SBSMF	Shark Bay Scallop Managed Fishery
TACC	Total Allowable Commercial Catch
VMS	Vessel Monitoring System
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council

1 INTRODUCTION

Harvest strategies for aquatic resources in Western Australian (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 processes 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 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 does 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.

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 harvest strategy will remain in place for a period of five years, after which time it will be fully reviewed. However, given that this is the first published harvest strategy for this resource, this document may be subject to review and amended as appropriate within this five-year period.

2 SCOPE

This harvest strategy relates to the blue swimmer crab resource in Shark Bay, WA and the fishing activities that impact the resource.

Blue swimmer crabs in the waters of Shark Bay are primarily harvested by trawl and trap based commercial fishers within the Shark Bay Crab Managed Fishery (SBCMF: Figure 1). The SBCMF is limited entry with 32 licences. Shark Bay consists of a single crab stock, however the SBCMF is divided into two zones with commercial operators having access to either one or both zones (Figure 1) reflecting historical access rights prior to the introduction of the *Shark Bay Crab Managed Fishery Management Plan 2015* (SBCMF Management Plan). Blue swimmer crabs are also an important recreational species in Shark Bay and are targeted using drop nets or scoop nets.

In addition to considering fishing impacts on the target species (blue swimmer crabs) and other retained (non-target) species, this harvest strategy also covers impacts on bycatch¹, endangered, threatened and protected (ETP) species, habitats and other ecological components to ensure any risks to these elements are managed appropriately. Note that only the impacts of commercial crab trapping on these ecological components are considered in this harvest strategy, while the impacts of prawn and scallop trawling (although they retain crabs) are addressed separately in the harvest strategies for the Shark Bay prawn and scallop resources (Department of Fisheries 2014; DPIRD in prep. a; b).

2.1 Environmental Context

The Shark Bay crab resource occurs within the Gascoyne Coast Bioregion of WA, which represents a transition between the tropical waters of the North West Shelf and the temperate waters of the lower west coast. This region has a semi-arid climate, characterised by hot, dry summers and mild winters. Water temperatures inside Shark Bay typically range from 23 °C to 26 °C between January and March and drop to 20-22 °C in winter.

Shark Bay is located 800 km north of Perth (at ~26°S) and covers an area of approximately 13,000 km². It is the largest marine embayment in Australia and supports the most extensive and diverse seagrass meadows in the world (Walker 1989). The hydrology of Shark Bay is influenced by the Leeuwin Current which carries warm, low-salinity water southward down the WA coast. The embayment is mostly shallow with an average depth of 9 m and increasing to 29 m deep in the north (Francesconi and Clayton 1996). The region only receives very infrequent cyclones and mean annual rainfall is low, ranging from 200 mm in the west of the bay to 400 mm in the east.

The embayment is of great significance to recreational, commercial and conservation sectors, and was added to the World Heritage List in 1991 (Francesconi and Clayton 1996; Figure 1). Areas of inner Shark Bay are also managed as part of the Shark Bay Marine Park (Figure 2).

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, its take could not be avoided or because legislative requirements preclude it being retained.

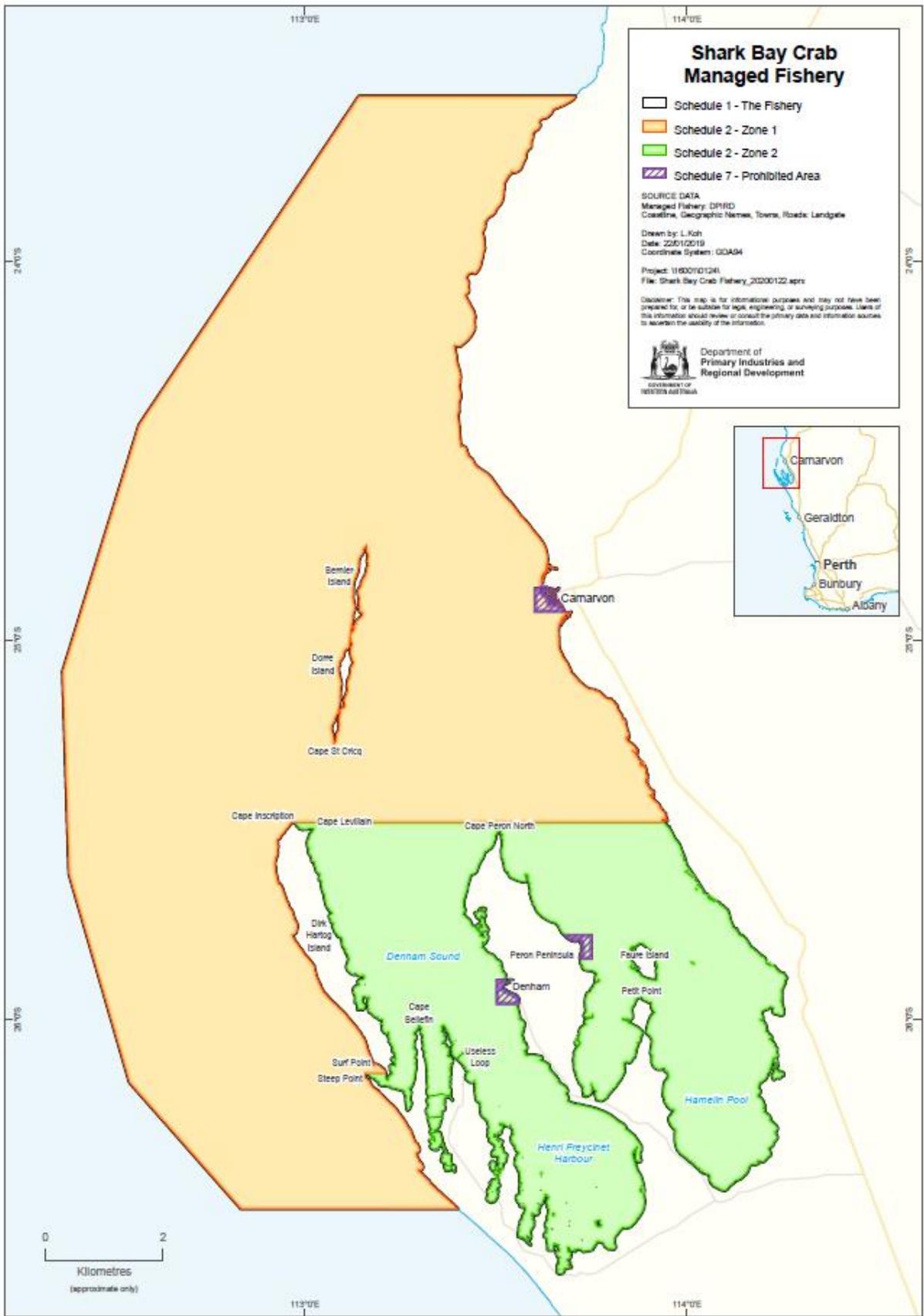


Figure 1. Boundaries and management zones of the Shark Bay Crab Managed Fishery.

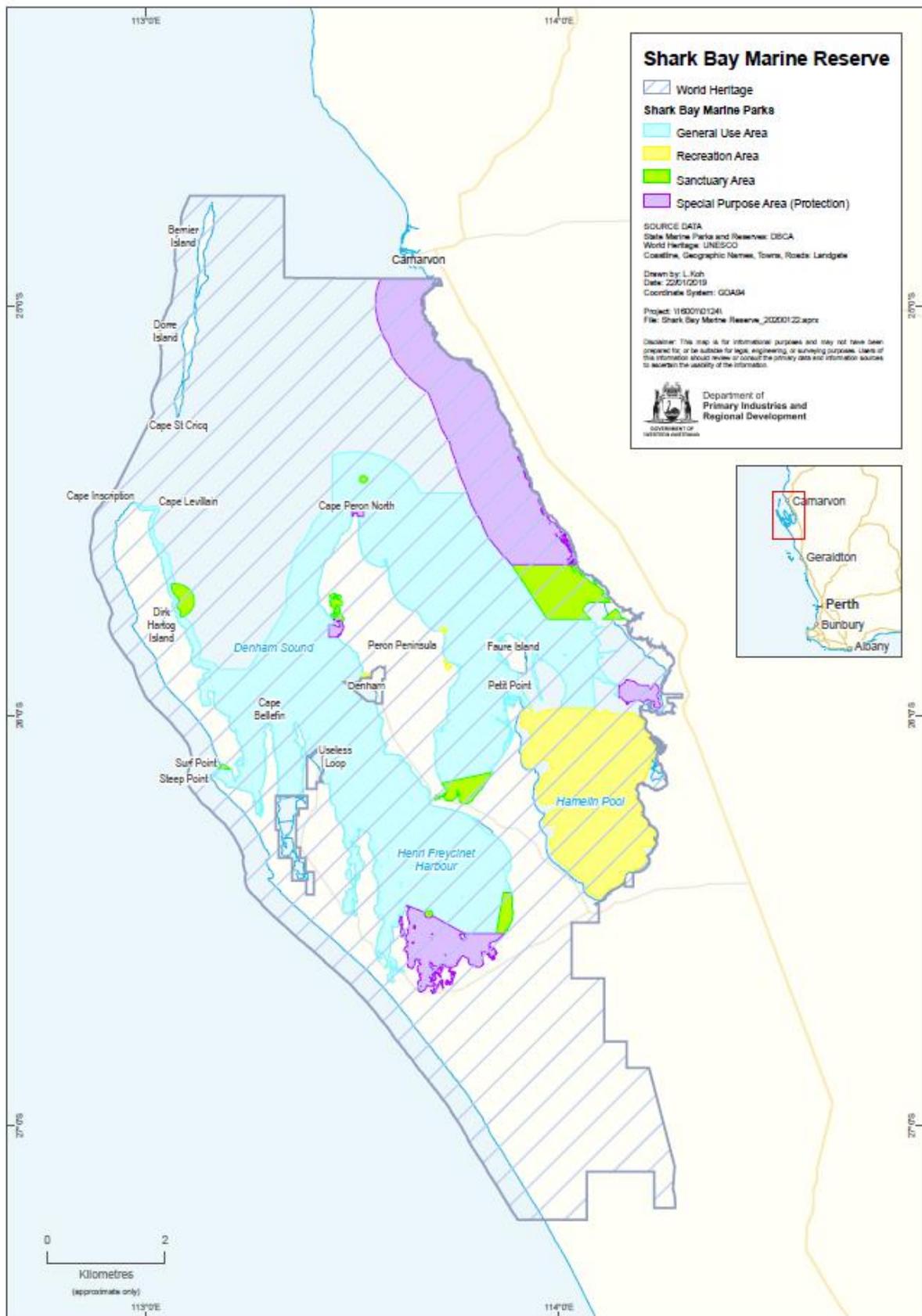


Figure 2. Shark Bay World Heritage Area and Marine Park.

2.2 Target Species

Blue swimmer crabs (*Portunus armatus*) 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 blue swimmer crab 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.

Blue swimmer crabs in Shark Bay exhibit protracted spawning year around with peak spawning activity higher during the cooler autumn/winter months which coincides with low winds and generally more stable atmospheric conditions, and thus likely to be favourable for larval retention (Kangas *et al.* 2012). Early recruits from the winter spawning are first sampled during the November survey and the peak recruitment pulse of 50-100 mm carapace width (CW) cohort sampled by trawling in February as ~ 6-8 month old crabs. In Shark Bay, the growth rate of crabs is at its maximum during the coolest months of the year, and minimal in the warmest months of the year. Thus, spring and early summer months are most suitable for fast growth which slows down during the warmer summer months. The 2011 extreme marine heatwave event was a major contributor to the 2012 stock decline as water temperatures rose 5°C above average and would have adversely impacted on the survival and growth of juveniles over that summer period.

Female crabs reach maturity at around 110 mm CW and males at 105 mm CW (Chandrapavan *et al.* 2018) in Shark Bay when they are ~10-12 months of age. Given the voluntary commercial minimum size limit is 135 mm CW (the legal minimum size limit is 127 mm CW), most females breed at least once before recruiting into the fishery. On average, the batch fecundities of legal-sized females are about twice those of sublegal-sized (mature) females which indicates that legal-sized females, depending on their abundance, may make an important contribution to overall egg production.

2.3 Fishing Activities

2.3.1 Governance

The blue swimmer crab resource of Shark Bay can be accessed by commercial, recreational and customary fishing sectors. The fishing activities of these sectors are 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);
- FRMA Part 6 — SBCMF Management Plan;
- FRMA Section 43 Order — *Prohibition on Commercial Fishing (Shark Bay Marine Park) Order 2004*; and

- FRMA Section 7 Instruments of Exemption.

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*;
- *WA Marine Act 1982*;
- *WA Wildlife Conservation Act 1950*;
- *WA Conservation and Land Management Act 1984*; and
- Any other legislation governing the use of the marine environment in which activities occur.

2.3.2 Commercial Fishing

Commercial fishers in Shark Bay have retained blue swimmer crabs since the early 1960s, primarily as incidental catch from prawn and scallop trawlers. Targeted exploitation of this resource began with an exploratory fishing phase during the 1980s before an experimental trap fishery was established in 1998 to assess the potential for further expansion.

The SBCMF Management Plan was implemented in November 2015 and provides the statutory quota management framework for the commercial take of blue swimmer crabs by the prawn trawl, scallop trawl and crab trap sectors in the waters of the SBCMF. The SBCMF is divided into two zones separating the inner gulfs (Zone 2) from the rest of Shark Bay (Zone 1) (Figure 1). The SBCMF is open for 12 months of the year (1 November to 31 October).

There are 32 licences in the SBCMF, which are divided into Class A and B licences. The Class of licence is defined by the use of traps in Zone 1 or 2 of the fishery. There are five trap-only licences; three Class A and two Class B. The holding of a Class A licence allows for trap fishing in Zone 1 only, while a Class B licence allows for trap fishing in both Zone 1 and Zone 2. Collectively, the prawn and scallop trawl sectors hold the remaining 27 Class A licences which allow them to fish for crabs in Zone 1 and Zone 2 using trawl gear in those areas permitted by their respective trawl arrangements. Alternatively, they may fish by trap in Zone 1 at any time, however this has not occurred to date, given the efficiency of the trawl sectors to catch their quota during the trawl season.

The prawn trawl season usually extends from March/April to October/November. During the trawl season, the trap operators move into the shallower grounds of the fishery to minimise gear interactions between the sectors. Historically, the scallop trawl season ran between April and November, with some fishing permitted in February/March in later years. Since 2016/17, scallop fishing has also been trialled between December and February. Noting this is the peak fishing period for trap operators, at-sea communications take place between the sectors to co-ordinate their fishing operations to avoid gear interactions.

The SBCMF voluntarily closed in late 2011 in response to a recruitment failure of the blue swimmer crab stock. This was the result of increased fishing pressure combined with the marine heatwave and flooding events in 2010/11. During the closure, the Department (with support from an FRDC project) dedicated a large amount of resources into additional monitoring programs to gain a better understanding of the crab stock and inform management decisions. With an improvement in the recruitment and harvestable size crab stock in Shark Bay, the commercial take of crabs was permitted again in September 2013 under a conservative Total Allowable Commercial Catch (TACC), which since this time has gradually increased. The status of blue swimmer crabs in Shark Bay is now considered recovered and the harvest strategy aims to maintain the stock at sustainable levels using a pre-cautionary approach for setting the annual TACC.

2.3.3 Recreational Fishing

The Shark Bay crab resource supports a small but regionally important recreational fishery that catches around 1-5 tonnes crabs annually (Ryan et al. 2013, 2015, 2017, 2019, Taylor et al. 2018). This sector is managed through a combination of statutory input and output controls including a minimum size limit of 127 mm CW, bag limit of 20 crabs per fisher and 40 crabs per boat (when there are two or more fishers in the boat). Recreational fishers operating from a boat are required to hold a Recreational Fishing from Boat Licence (RFBL). Unlicensed fishers on 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).

Recreational fishers utilise a variety of methods to fish for blue swimmer crabs, including drop nets (maximum of 10 drop nets per boat or per shore-based fisher), scoop nets and by snorkelling/diving. Recreational fishing for blue swimmer crabs is undertaken in all waters of Shark Bay and is permitted 12 months of the year. There is no limit on the total recreational catch of crabs in Shark Bay, largely due to the low proportion of the recreational take compared to the commercial sector.

Commercial fishing is prohibited in inshore waters adjacent to Carnarvon, Denham and Monkey Mia (as specified in the SBCMF Management Plan) to reduce interactions between commercial and recreational fishers.

2.3.4 Customary Fishing

Customary fishing for blue swimmer crabs is known to take place in Shark Bay, however there is no quantitative information available on catches. Based on anecdotal evidence, the customary catch is considered to be negligible.

2.4 Catch-Share Allocations

Historically, the blue swimmer crab resource in Shark Bay has been fished without an explicit catch share allocation between recreational, customary and commercial sectors.

In 2013, the (then) Minister for Fisheries adopted a formal commercial catch share arrangement to share the annual blue swimmer crab resource across the commercial sectors in the following

manner: trap sector – 66.0%; prawn trawl sector – 33.8%; and scallop trawl sector – 0.2%. These allocations were formalised through the implementation of the SBCMF Management Plan, with the quota unit entitlement fully transferable between licences.

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 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 management objectives (Section 3.1);
- 2) the short-term, operational objectives (Section 3.2); and
- 3) how these translate into the management strategy 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 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 blue swimmer crabs at a level where the main factor affecting recruitment is the environment;
- 2) To maintain the 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 harm² 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
- 6) To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.

3.1.2 Economic & Social Benefits

- 1) To provide flexible opportunities to ensure fishers can maximise economic return while maintaining or enhancing their livelihood, within the constraints of ecological sustainability;
- 2) To maintain or provide opportunity to maximise the flow of commercial fishing related economic benefit to the broader community, within the constraints of ecological sustainability; and
- 3) 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 so as 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 range or 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 the blue swimmer crab resource in Shark Bay is based on a constant exploitation approach where the annual catch varies in proportion to variations in stock abundance. The strategy recognises that recruitment of blue swimmer crabs is highly variable and uses a weight-of-evidence approach to assess the status of the stock and ensure catches are maintained at the appropriate level (see section 3.4.1.1).

² 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.

In line with this harvesting approach, the commercial sector that targets this resource is primarily managed using output controls in the form of an annual TACC, which is allocated to licence holders as Individual Transferable Quota (ITQ) units. The fishers also have to comply with a number of input controls, including gear restrictions, spatial closures and a minimum size limit for crabs. Recreational fishing for blue swimmer crabs in Shark Bay is managed using a mix of input and output controls (see section 4.1).

Commercial fishers in the SBCMF are permitted to trap for crabs all year around, in accordance with the arrangements outlined in the SBCMF Management Plan (trawl operations are in accordance with respective prawn and scallop management plans). The licensing period commences on 1 November each year, at which time entitlement is allocated to each licence in line with the TACC and resulting unit value.

The capacity for the SBCMF is specified in the SBCMF Management Plan as 650 tonnes, based on estimates from 2018 of the long-term maximum sustainable yield (MSY) for the blue swimmer crab resource under normal environmental conditions. Noting the short-lived and dynamic nature of blue swimmer crabs, the TACC is reviewed each year in April/May based on the state of the resource relative to specific reference levels.

DPIRD and industry have implemented a co-management arrangement whereby industry abides by a TACC that is less than the legislated capacity. This voluntary agreement provides DPIRD with the flexibility to increase or decrease the TACC in accordance with fluctuations in the crab stock. Although the capacity and TACC are based on data for blue swimmer crabs, other retained crab species (primarily coral and three spot crabs) are included and reported as part of the quota. Retained catches of these other species fluctuate between years, subject to abundance and market demand, and have historically been caught in small quantities (<5 tonnes).

The Shark Bay Crab Working Group (see section 4.2.1.3) is responsible for recommending and reviewing the annual TACC, based on available stock status information. The ability to undertake an earlier review, if the June or November survey or fishery-dependent data indicate a significant and unexpected change in stock levels may have occurred (e.g. due to a heatwave event), adds further precaution to this harvesting approach and ensures that fishing pressure on the stock can be rapidly altered.

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 determine the status of the blue swimmer crab resource in Shark Bay and other ecological assets, against defined reference levels established to 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);
- threshold level (i.e. where you review your position); and

- limit level (i.e. where you do not want the indicator to be and below which there is a significantly increased risk of recruitment impairment).

Harvest Control Rules (HCRs) define the management actions that should occur in relation to the value of each performance indicator relative 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 Shark Bay crab resource is assessed using a risk-based weight-of-evidence approach that incorporates all available fishery-independent and fishery-dependent data for the stock, as well as environmental and economic information. The primary performance indicators for the stock are based on fishery-independent survey data and are compared annually to specified reference levels to determine an appropriate TACC. As described in more detail in section 3.4.2, the TACC setting process also considers secondary performance indicators and other lines of evidence to ensure catches are maintained at an appropriate level.

Three primary performance indicators are used to evaluate the status of the blue swimmer crab resource in Shark Bay, which are:

- an index of peak spawning stock biomass (females 110 mm+ CW) (June survey);
- an index of harvestable size stock biomass (males and females 135 mm+ CW) (November survey); and
- an index of recruitment stock biomass (males and females <100 mm CW) (combined average of November and February survey during the following year).

Since 2012, the greatest abundance of 0⁺ recruits (< 100 mm CW) is typically recorded during the February survey, and this survey was established as the peak recruitment survey for blue swimmer crabs in Shark Bay. The June survey is considered to provide the most appropriate estimates of peak spawning biomass levels in Shark Bay while noting that lower levels of spawning does occur in other months. Peak recruitment is traditionally observed during the February survey, however an earlier recruitment pulse has been observed in November since 2016, likely related to the earlier onset of cooler temperatures in Shark Bay. As a result, the index of recruitment is currently determined as a combined average of recruits in the November and February surveys.

The November fishery-independent trawl survey program provides a long-term data series that better describes changes in biomass levels under different catch levels and management strategies. While the June survey provides a peak spawning stock level across the whole bay, the November survey provides an index of the harvestable size stock in the SBCMF. Although the legislated minimum size limit for blue swimmer crabs in Shark Bay is 127 mm CW for all sectors, commercial operators fish to a voluntary minimum size limit of 135 mm CW. As such,

the November index of harvestable size stock is based on the retention of crabs at or above 135 mm CW.

Reference levels for these indices are based on data both prior to the stock decline (following the marine heatwave and flooding events in 2010/11) and also during the rebuilding phase. The first spawning stock survey (June 2012) which was undertaken during the fishery closure period indicated a catch rate of 200 kg/nm². This has been set as the limit reference level as it is known that there was a significantly increased risk of recruitment impairment stock at this level. The first recruitment stock survey (February 2013) during the fishery closure period indicated a catch rate of 991 kg/nm². Similarly, this has been set as the limit reference level. Given the short time series available for these surveys, only limit levels have been specified for the spawning and recruitment stock indices. The appropriateness of these levels will be reviewed in future once a longer time series of data is available.

The annual TACC review assesses the primary performance indicators to determine the status of the stock in relation to the limit and threshold levels for each index, in consultation with the Shark Bay Crab Working Group (Figure 2). Final research advice on harvest levels presents an integration of all relevant findings, including the outcomes of the harvest control rules, and the indications from the weight-of-evidence approach to stock assessments.

3.4.1.2 Other Ecological Components

Other ecological assets incorporated in this harvest strategy include other retained species, bycatch, ETP species, habitats and ecological processes that may be affected by commercial crab trap fishing.

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 Shark Bay invertebrate fisheries (including crab trapping) was undertaken in September 2019 to inform these components of the harvest strategy, with these risk scored to be reviewed after no more than five years (see section 3.6.2.3).

3.4.2 Application of Harvest Control Rules

For each ecological performance indicator and reference level, an accompanying HCR directs the management action 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.

Where an indicator suggests that the fishery impact on a resource is no longer acceptable, the HCR typically initiates a review of all available information to determine an appropriate management response. The extent of management action taken is determined by the extent to which a performance indicator has breached a reference point, increasing in line with an increasing risk to the resource. This review process also includes consideration of future

research and monitoring to ensure the indicator returns to the target level, as well as the compliance response needed to ensure management changes are adequately enforced.

Although a wide range of management measures may be used to achieve the management responses broadly outlined by the HCRs (Table 3), examples for the Shark Bay blue swimmer crab resource include:

- reducing catch (i.e. TACC and recreational bag/boat limits), and
- restricting fishing effort by implementing spatial and/or temporal closures.

The ability and timeframe for implementing these changes depends on the legal instrument under which the management measure occurs (see Section 4.1 for more information).

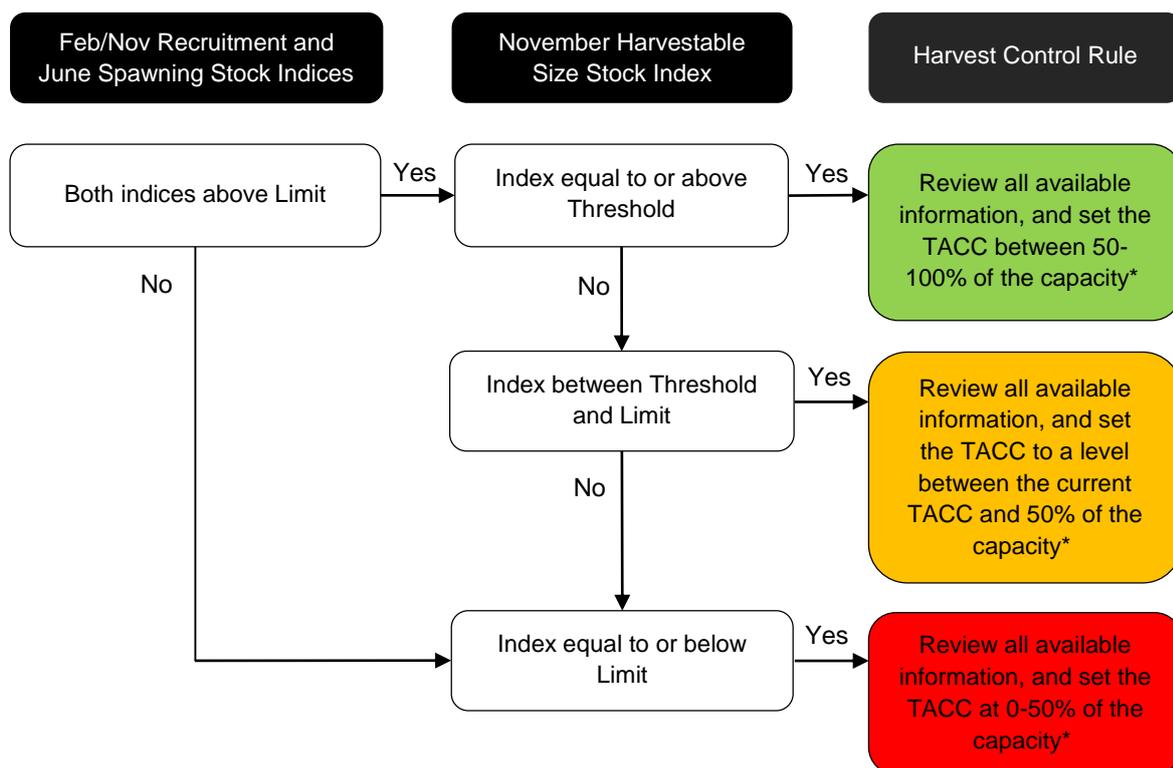
The TACC for blue swimmer crabs in Shark Bay is set annually as a proportion of the capacity specified in the SBCMF Management Plan (currently 650 tonnes). This proportion is determined based on the annual weight-of-evidence assessment of stock status, which is primarily informed by the primary performance indicators for the stock (see Figure 2, Table 3), as well as a review of secondary performance indicators that include:

- achievement of TACC for previous season; and
- annual commercial trap catch per unit effort (CPUE) (kg/traplift) (based on available monthly trap data for the current season).

Other lines of evidence used to guide decision-making include:

- spatial distribution of effort for trap sector;
- total catch of trap and trawl sectors;
- environmental factors;
- biodynamics model; and
- economic factors.

If a review of the lines of evidence indicates the stock is responding positively in light of fishing pressure and environmental conditions, consideration may be given to setting the TACC at the higher end of the TACC range identified by the primary performance indicators (Figure 2). If either of the secondary indicators is below the target, and there is no economic or operational cause for this, a more precautionary TACC will be set within the identified range. If the TACC is set at the capacity level and catch exceeds 95% of the capacity, this will trigger a review of the long term MSY on which the capacity is based. In lieu of this occurring, the long term MSY will be revised every five years, as part of a review of this harvest strategy.



*The magnitude of any increase or decrease in TACC will be subject to a weight-of-evidence assessment of all available information, including secondary indicators; commercial trap CPUE and achievement of the previous season's TACC.

Figure 2. Schematic of how the harvest control rules are used to inform the annual TACC for the blue swimmer crab resource in Shark Bay, WA.

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 implemented to ensure that the resource can rebuild at an acceptable rate. 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 Shark Bay blue swimmer crab resource, and associated ecological assets that may be impacted by fishing activities targeting blue swimmer crabs in Shark Bay. Note that only the impacts of commercial trap fishing on ecological assets other than the target species are currently assessed within this harvest strategy. Trawl fishing impacts on ecological assets other than crabs, are assessed within the Shark Bay prawns and scallop harvest strategies.

Component	Objective	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	Primary <ol style="list-style-type: none"> Annual standardised index of harvestable size stock biomass (November survey) Annual standardised index of peak recruitment stock biomass (February/November survey) Annual standardised index of peak spawning stock biomass (June survey) 	Target: Harvestable size stock index is >350 kg/nm ²	If the harvestable size stock index is above the threshold and both recruitment and spawning stock indices are above their respective limit levels (see below), set the TACC between 50 and 100% ³ of the capacity specified in the SBCMP.
				Threshold: Harvestable size stock index is 350 kg/nm ²	If the harvestable size stock index is between the threshold and limit levels and both recruitment and spawning stock indices are above their respective limit levels (see below), reduce the TACC to a level between the current TACC and 50% of the capacity ³ .
				Limit: Harvestable size stock index is 150 kg/nm ² Peak recruitment stock index is 991 kg/nm ² Peak spawning stock index is 200 kg/nm ²	If any primary performance indicator is equal to or below its respective limit, set the TACC between 0 and 50% of the capacity specified in the SBCMP ³ .

³ The magnitude of any increase or decrease will be subject to a review of the weight of evidence, including secondary indicators.

Component	Objective	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
			<p>Secondary</p> <p>4. Achievement of TACC for previous season</p> <p>5. Annual standardised commercial trap CPUE (kg/traplift) based on available monthly data from the current season</p>	<p>Target:</p> <p>≥90% of previous season TACC caught</p> <p>Annual standardised trap CPUE is ≥1.4 kg/traplift</p>	<p>If both targets are met, consider setting the TACC at the higher end of the TACC range identified by the primary indicators.</p> <p>If either target is not met and there is no economic or operational cause for this, set a more precautionary TACC within the range identified by the primary indicators.</p>
Other retained species	To maintain spawning stock biomass of each other retained species at a level where the main factor affecting recruitment is the environment	Coral crabs Three spot crabs	<p>Periodic risk assessments incorporating:</p> <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch, • species information, and • other available research 	<p>Target:</p> <p>Fishing impacts are expected to generate an acceptable level of risk to retained species' populations, i.e. moderate risk or lower.</p>	Continue management aimed at achieving ecological, economic and social objectives.
				<p>Thresholds:</p> <p>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 retained species' populations, i.e. high risk.</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>Limit:</p> <p>Fishing impacts are considered to generate an unacceptable level of risk to any retained species' populations, i.e. severe risk.</p>	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.

Component	Objective	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 bycatch species	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch (retained and discarded), • species information, and • other available research 	Target: Fishing impacts are expected to generate an acceptable level of risk to bycatch species' populations, i.e. moderate 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 3 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' populations, i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.

Component	Objective	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
ETP species	To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected (ETP) species populations	All ETP species	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, and • other available research 	Target: Fishing impacts are expected to generate an acceptable level of risk to ETP species' populations, i.e. moderate 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 ETP species' populations, i.e. high risk.	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.
				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.

Component	Objective	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function	All habitats	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort • extent of area fished annually, and • other available research 	Target: Fishing impacts are expected to generate an acceptable level of risk to benthic habitats, i.e. moderate 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 habitat i.e. high risk.	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.
				Limit: Fishing impacts are considered to generate an unacceptable risk level to any benthic habitat i.e. severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable.

Component	Objective	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes	Community structure and function	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual effort and catch (retained and discarded), • number of reported interactions with ETP species, • 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. moderate 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 ecological processes within the ecosystem, i.e. high risk.	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.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any 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) tolerance levels for fisheries provides a formal and efficient basis to evaluate the effectiveness of current management arrangements in delivering the expected 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.

If the annual catch/effort (or any other indicator specified to measure performance against the economic and social objectives) remains within the tolerance range, the fishery/sector is considered to be operating ‘acceptably’ with no need to review the management settings. If any fishery performance indicator falls outside of the tolerance range and this cannot be adequately explained (e.g. documented evidence of environmental or market-induced impacts), this will result in a review of the cause and re-assessment of the resource status against the performance indicators and HCRs. This could potentially lead to a change in management settings and therefore a revision of the tolerance levels.

3.5.1 Tolerance Levels

The annual commercial fishery performance in the SBCMF is evaluated by 1) assessing whether the fishery has achieved the TACC, and 2) comparing the annual commercial catch rate of blue swimmer crabs with the catch rate tolerance level. This assessment is undertaken as part of the annual TACC review for the fishery. The catch tolerance range for the SBCMF is currently defined as achieving at least 90% of the annual TACC, which was adopted recognising that there is a range of economic and operational reasons why the entire TACC may not be caught within any season. The catch rate tolerance level is based on the standardised annual commercial trap CPUE (kg/traplift) and defined as greater than 1 kg/traplift, which is when the fishery is considered to be operating at economically viable levels.

The performance of the recreational crab fishery in Shark Bay is assessed periodically (every 2-3 years) by comparing estimates of boat-based recreational crab catch with a recreational catch tolerance range of 0.2 – 1% of the total commercial catch. This tolerance range has been based on recent survey estimates of blue swimmer crab recreational catch in Shark Bay, when the stock is considered to have been at acceptable levels⁴. These include estimates for the Gascoyne Coast Bioregion from the two most recent Statewide surveys of boat-based recreational fishing undertaken in 2015/16 (1 t, Ryan et al 2017) and 2017/18 (5 t, Ryan et al.

⁴ The estimated recreational boat-based catch ranged from 1 - 5 tonnes for 2016, 2017 and 2018 which equates to between 0.2 and 1% of the TACC set in those years (450 – 550 tonnes).

2019), and an additional survey of boat-based recreational fishing undertaken in inner Shark Bay between March 2016 and February 2017 (1.3 t, Taylor et al. 2018).

As the annual TACC setting process (Appendix 1) is directly linked to the annual weight of evidence assessment of the Shark Bay crab resource, it is reasonable to assess the annual boat-based recreational catch tolerance in Shark Bay as a proportion of the sustainable harvest. This means that the recreational fishing catch tolerance for any one year may fluctuate, depending on the stock status and TACC that is set.

3.5.2 Economic & Social Benefits

Achieving economic and social benefits is intrinsic to the status of the Shark Bay crab resource. The annual assessment of the resource using a risk-based weight-of-evidence approach that incorporates all available fishery-independent and fishery-dependent data for the stock, as well as environmental, economic and social information.

No specific performance indicators or reference levels to evaluate economic benefit to fishers; or flow of commercial fishing related economic benefit to the broader community have been included in this harvest strategy. It is envisaged that this objective may be measured using socio-economic surveys in the future. In lieu of this, the annual commercial trap CPUE will be measured relative to the tolerance levels outlined above, as a measure of whether the fishery is operating at economically viable levels.

With respect to the social objective, no specific performance indicators or reference levels to evaluate recreational fisher satisfaction, and whether fishing participants have reasonable opportunities to maximise cultural, recreational and lifestyle benefits of fishing, have been included in this harvest strategy. It is envisaged that performance against the social objective for this sector may be measured using socio-economic surveys in the future. In the meantime, the catch tolerance for recreational boat-based fishing as described above remains the most meaningful evaluation of the social objective. Additionally, advice regarding recreational fisher satisfaction will be sought from Recfishwest as part of the annual weight-of-evidence assessment and TACC review process (Appendix 1), via the Shark Bay Crab Working Group (see Section 4.2.1).

3.6 Monitoring and Assessment Procedures

3.6.1 Information and Monitoring

3.6.1.1 Commercial Fishing Information

It is a statutory requirement for trap fishers in the SBCMF to provide daily logbook records of catch (number of crabs) and effort (e.g. days fished, number of traps, soak-time). These logbooks also provide information to the Department on the spatial distribution of fishing effort as fishers provide the latitude and longitude coordinates for the start and end of each line of traps. Trap catch rates calculated from the logbook data represent a secondary performance

indicator for measuring stock status, as well as to examine fishery performance against a trigger level above which the fishery is considered to be economically viable.

Prawn and scallop trawl fishers are also required to provide detailed catch and effort records in daily logbooks, however, the catch of byproduct species such as blue swimmer crabs are often aggregated over each night of fishing rather than separated for each trawl shot. As the trawling is targeted towards prawns and/or scallops, fishing effort cannot be accurately apportioned to crabs. The catch data derived from the logbooks is still used in the overall weight-of-evidence assessment of the blue swimmer crab resource in Shark Bay.

Following the transition to a quota-management framework in 2015, commercial fishers are now also required to complete a Catch and Disposal Record (CDR) when landing catch. The trap sector typically lands catch and complete their CDRs daily while the trawl sectors remain at-sea for longer periods and therefore complete the CDR at the end of each fishing trip, outlining their cumulated catch. The majority of crabs landed are raw, however some fishers cook the crabs at sea and therefore must apply a conversion rate of 1.07 to convert the cooked weight to raw weight for the purpose of quota management.

Fishers are required to submit a copy of each CDR to the Department's Operations and Compliance Division at the end of each fishing trip. Departmental staff enter and check logbook data against CDRs and processor receipts on a regular basis. Any possibly erroneous entries or gaps are checked with skippers and adjusted where necessary. Spatial data validation is undertaken by plotting maps of logbook effort and random checks of data against location records from the Vessel Monitoring System (VMS).

3.6.1.2 Recreational Fishing Information

Biennial surveys of boat-based recreational fishing have been undertaken since 2011/12 to provide bioregional estimates of recreational boat-based catches in WA (Ryan et al. 2013, 2015, 2017, 2019). This 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. These surveys are now conducted on a triennial basis.

3.6.1.3 Fishery-Independent Information

Fishery-independent multi-species surveys in Shark Bay have been undertaken annually in November and have recorded crabs since 2000. Additional February and June surveys were first introduced to northern Shark Bay in 2012 and were expanded to include Denham Sound since 2015. The surveys are undertaken using standardised twin-rigged otter trawl gear with 100 mm mesh cod-ends. The duration of each trawl is 20 minutes. As the speed of trawling influences the efficiency of the trawl gear, the catch (recruit, harvestable size and total) is adjusted to the equivalent catch at a trawl speed of 3.4 knots. Trawling is considered non-selective and thus provides a more comprehensive sample of size structure and life stages compared to crab traps.

The November survey provides abundance data (number per nautical mile) for the harvestable stock (all crabs ≥ 135 mm CW) at the end of one fishing season that is available for the start of the next season. Due to the long time series of data available from this survey, the November harvestable stock index is used as one of the primary performance indicator to evaluate stock status and inform the annual TACC review process. Although based on a much shorter-time series of data, an index of recruitment (males and females <100 mm CW) from the February survey (combined with the November survey) and an index of spawning stock biomass (females 110 mm+ CW) from the June survey are also assessed annually against specified limit reference points. The three surveys allow the stocks to be monitored closely throughout the fishing season and identify any changes to the stock during each of the key life stages.

3.6.2 Assessment Procedures

3.6.2.1 Blue swimmer crabs

The status of the blue swimmer crab stock in Shark Bay is assessed through a risk-based weight-of-evidence approach which takes into consideration all the available fishery-dependent and fishery-independent data, life-history traits, environmental conditions and model outputs. An estimate of MSY for the stock of 672 t has been derived from an annual biomass dynamics model fitted to catch data from 1989 and catch rate data since 2003. The estimate is based on assumptions around the stock-recruitment relationship under average environmental conditions and captures the observed changes in biomass, including its decline and recovery.

The three survey indices of abundance are compared annually to specified reference levels and used as the basis for the annual review of the TACC and ensuring it is maintained at an appropriate level within the fishery capacity of 650 t. Commercial catch and catch rate information from the trapping sector are also evaluated when considering any increase in TACC between years.

3.6.2.2 Other Retained Species

Other species retained by trap operators include coral crabs and three spot crabs. Due to highly variable and possibly inconsistent reporting of other crab catches retained over the history of the fishery (<5 tonnes annually), the impact of trap fishing on these species is currently assessed based on risk (see section below). It is anticipated that a sustainable harvest level for coral crabs and three spot crabs will be determined and implemented once these data have been improved.

3.6.2.3 Ecological 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, other retained species, bycatch, ETP species, habitats and ecological processes (Fletcher 2015). This framework has led the development of a periodic risk assessment process, which is used to

prioritise research, data collection, monitoring needs and management actions for fisheries and to ensure that fishing activities are managed both sustainably and efficiently.

An ecological risk assessment for the overall Shark Bay invertebrate resource was most recently undertaken in September 2019. The risk assessment considered the impacts of the key fishing sectors targeting the resource (crab trap, prawn trawl, scallop trawl and recreational fishers) on the ecosystem, assessed both individually and cumulatively. The risks of crab fishing to each of the ecological components (other than the target species) were assessed as Negligible or Low risk. The cumulative risks of the fishing sectors on these ecosystem component were all determined to be acceptable.

Risk assessments for the Shark Bay invertebrate resource will 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 managing the blue swimmer crab resource in Shark Bay (Table 2). These measures can be amended as needed to ensure the management objectives are achieved; however, these do not preclude the consideration of other options.

Table 2. Management measures and instrument of implementation for the blue swimmer crab resource in Shark Bay.

Measure	Description	Instrument
Limited Entry	Commercial - A limited number of Managed Fishery Licences (32) are able to operate.	SBCMF Management Plan (Clause 7)
Other Licence Requirements	Commercial - All commercial boats used in the fishery require a Fishing Boat Licence. Masters and crew undertaking fishing activities are required to hold a Commercial Fishing Licence.	FRMR
	Recreational - All recreational fishers fishing from a boat require a Recreational Fishing from Boat Licence.	FRMR
Gear Controls	Commercial – Crabs can only be caught using crab traps or trawl net configurations.	SBCMF Management Plan (Clause 26)
	Trawl nets may only be used by licence holders who also hold a Shark Bay Prawn or Scallop licence, during the Shark Bay Prawn or Scallop season.	SBCMF Management Plan (Clause 25)
	Recreational - Blue swimmer crabs can only be caught by hand or using blunt wire hooks, drop nets or scoop nets.	FRMR

Measure	Description	Instrument
Effort Controls	Commercial – The trawl sectors may only fish using the permitted headrope net length in their respective management plans.	SBPMF Management Plan SBSMF Management Plan
	Recreational - Maximum of 10 drop nets per person and per boat.	FRMR
Output controls	Commercial – An annual total allowable commercial catch for the fishery is divided into individually transferable quota entitlement of crab (whole weight)	SBCMF Management Plan (Clause 13)
	Recreational – Bag limit of 20 crabs per fisher and 40 crabs per boat (when there are two or more fishers in the boat)	FRMR
Spatial Closures	Commercial – Only Class B operators may fish by trap in Zone 2 (inner gulfs of Shark Bay). Trawl operators may only fish in the areas permitted during the Shark Bay Prawn or Scallop season. All operators are not permitted to fish in commercial area closures in Carnarvon, Monkey Mia, Denham and Quobba Point	SBCMF Management Plan (clause 41 & 42) <i>Prohibition on Commercial Fishing (Shark Bay Marine Park) Order 2004</i>
Species Restrictions	Commercial - Restrictions on the species permitted to be retained apply to all commercial fishers.	SBCMF Management Plan FRMR
Size Limits	Commercial – Voluntary minimum size limit of 135 mm CW for blue swimmer crabs.	Voluntary agreement
	Commercial and Recreational - Minimum size limit of 127 mm CW for blue swimmer crabs. No retention of berried female crabs.	FRMR
Reporting	Commercial – all operators are required to report all landed crabs in a CDR.	SBCMF Management Plan
	Trawl operators are required to report all retained species catches, effort, ETP species interactions and fishing location in statutory daily logbooks. Trap operators have a voluntary logbook to complete.	FRMR

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 a 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 blue swimmer crab resource in Shark Bay:

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

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

4.2.1 Consultation

Management changes are generally given effect through amendments to legislation, such as the SBCMF 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 CEO (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) DPIRD is the primary source of management advice; and
- 2) Peak bodies for the commercial and recreational harvesting sectors are the primary source of advice and representation i.e. Western Australian Fishing Industry Council (WAFIC) and Recfishwest, respectively.

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 DPIRD, WAFIC has been funded to undertake statutory consultation functions related to fisheries management and the facilitation of management meetings for licensed fisheries such as the SBCMF.

Management Meetings between DPIRD, WAFIC and licence holders in the SBCMF are an important forum to consult on the management of the fishery. During these meetings, current and future management issues that may have arisen during the previous fishing season and any proposed changes to the management arrangements are discussed. Follow-up meetings may be held as required.

The Department also consults directly with industry, where relevant, on specific management and operational issues.

4.2.1.2 Recreational Sector Consultation

Under the SLA with Recfishwest, DPIRD 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 Shark Bay Crab Working Group

The Shark Bay Crab Working Group was established in March 2017. It includes representatives for the commercial trap and trawl fishing sectors, Recfishwest and DPIRD (science and management). The Working Group generates recommendations for the consideration of all licence holders and the decision maker (Deputy Director General, Sustainability and Biosecurity) in relation to seasonal and longer-term management arrangements, annual TACC review and stock assessment discussions. The process of consultation ahead of determining the annual TACC is described in Appendix 1.

4.2.1.4 Consultation with Other Groups

Consultation with customary fishers and non-fisher stakeholders, including Government agencies, conservation sector Non-Government Organisations, statutory advisory committees and other affected/interested parties is undertaken in accordance with DPIRD's Stakeholder Engagement Guideline (SEG, Department of Fisheries 2016).

DPIRD'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 management plans, harvest strategies and recovery plans are subjected to both formal key stakeholder consultation and public consultation processes.

Parts of fishery operate within the Shark Bay World Heritage Area and the Shark Bay Marine Parks, key stakeholders that have been identified in accordance with the SEG include the Shark Bay World Heritage Advisory Committee, and Department of Biodiversity and Conservation.

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 (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 Western Australian 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 Plans

Enforcement of the management arrangements for the Shark Bay crab resource is guided by an Operational Compliance Plan (OCP) that is informed and underpinned by a compliance risk assessment. The OCP has the following objectives:

- to provide clear direction and guidance to officers regarding compliance activities that are required to support effective management of the fishery;
- to provide a mechanism that aids the identification of future and current priorities;
- to encourage voluntary compliance through education, awareness and consultation activities; and
- to review compliance strategies and their effective implementation.

The OCP is reviewed every 1-2 years.

4.3.1.1. Compliance Strategies

Compliance strategies and activities that are used to protect the Shark Bay crab resource include:

- land and sea patrols;
- catch validation against managed fishery licences;
- inspections of crab wholesale and retail outlets;
- inspections at crab processing facilities;
- inspections of vessels in port and pre-season briefings;
- at sea inspection of fishing boats; and
- closed area/season monitoring via VMS (trawl sector).

Inspections may involve:

- inspection of all compartments on board the vessels;
- inspection of all authorisations;
- inspection of logbooks; and
- inspection of catch on board the boat.

5 REFERENCES

- Chandrapavan, A., Kangas, M.I., Johnston, D., Caputi, N., Hesp, A., Denham, A., Sporer, E. (2018). Improving confidence in the management of the blue swimmer crab (*Portunus armatus*) in Shark Bay. PART I: Rebuilding of the Shark Bay Crab Fishery. Fisheries Research Report No. 283, Department of Primary Industries and Regional Development, Western Australia.
- 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 the Environment and Water Resources (2007). Guidelines for the ecologically sustainable management of fisheries 2nd Edition.
- Department of Fisheries (2014). Shark Bay Prawn Managed Fishery Harvest Strategy 2014-2019. Fisheries Management Paper No. 267. Department of Fisheries, Western Australia.
- 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). Fisheries compliance strategy. DPIRD, Western Australia.
- DPIRD (in prep. a). Prawn Resource of Shark Bay Harvest Strategy 2020-2025. Fisheries Management Paper No. xxx. DPIRD, Western Australia.
- DPIRD (in prep. b). Saucer Scallop Resource of Shark Bay Harvest Strategy 2020-2025. Fisheries Management Paper No. xxx. DPIRD, Western Australia.
- 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, Western Australia.
- 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 Science* 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>

- 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.
- 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, Western Australia.
- 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, Western Australia.
- 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. Department of Primary Industries and Regional Development, Western Australia.
- 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. Department of Primary Industries and Regional Development, 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, Adelaide, South Australia.
- Taylor, S.M., Steffe A.S., Lai, E.K.M., Ryan, K.L. and Jackson, G (2018). A survey of boat-based recreational fishing in inner Shark Bay 2016/17. Fisheries Research Report No. 291. Department of Primary Industries and Regional Development, Western Australia.
- Walker, D.I. (1989). Seagrass in Shark Bay – the foundations of an ecosystem. *In*: Seagrasses: A Treatise on the Biology of Seagrasses with Special Reference to the Australian Region, W.D. Larkum, A.J. McComb and S.A. Shepherd (eds.), pp.182-210, Elsevier/North Holland: Amsterdam.

6 APPENDIX 1

Outline of the consultation process for reviewing the annual TACC for the Shark Bay Crab Managed Fishery

