



Department of
**Primary Industries and
Regional Development**

*We're working for
Western Australia.*

Fisheries Management Paper No. 267

Prawn Resource of Shark Bay

Harvest Strategy

2022-2027

Version 2.0

June 2022

Version control

Version	Change description	Date
1.0	First published Harvest Strategy for this resource	November 2014
2.0	Updated after first five-yearly review. Key changes include the incorporation of the Bycatch Action Plan, Recovery Strategy, Principles for Setting Season Arrangements. Other changes include revised descriptions of season arrangements, and updated performance indicators and associated reference levels and harvest control rules. Other updates include general structural changes and revised wording in the generic sections to ensure consistency with other harvest strategies. The Harvest Strategy title now refers to prawn resource, instead of just the commercial prawn fishery.	June 2022

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) 2022

Contents

LIST OF ACRONYMS	V
1.0 INTRODUCTION	1
1.1 Review Process	1
2.0 SCOPE	2
2.1 Environmental Context	2
2.2 Target Species	5
2.3 Fishing Activities.....	5
2.3.1 Governance	5
2.3.2 Commercial Fishing	6
2.3.3 Recreational Fishing	7
2.3.4 Customary Fishing.....	7
2.3.5 Catch-Share Allocations	7
3.0 HARVEST STRATEGY	7
3.1 Long-term Objectives.....	7
3.1.1 Ecological Sustainability	8
3.1.2 Economic and Social Benefits	8
3.2 Operational Objectives	8
3.3 Harvesting and Management Approaches	8
3.3.1 Season Arrangements and Within Season Guidelines	9
3.4 Ecological Sustainability	11
3.4.1 Performance Indicators and Reference Levels	12
3.4.1.1 Target Prawn Species.....	12
3.4.1.2 Other Ecological Components	13
3.4.2 Application of Harvest Control Rules	14
3.4.2.1 Recovering Depleted Stocks.....	15
3.4.3 Bycatch Action Plan	15
3.5 Fishery Performance.....	29
3.6 Monitoring and Assessment Procedures.....	29
3.6.1 Information and Monitoring	29
3.6.1.1 Commercial Fishing Information	29
3.6.1.2 Recreational Fishing Information	30
3.6.1.3 Fishery-Independent Information	30

3.6.1.4	Recruitment Surveys.....	30
3.6.1.5	Spawning Stock Surveys	30
3.6.1.6	Denham Sound Surveys	31
3.6.2	Assessment Procedures	31
3.6.2.1	Target Species.....	31
3.6.2.2	Other Retained Species	32
3.6.2.3	Habitats.....	32
3.6.2.4	Ecological Risk Assessments	32
4.0	MANAGEMENT MEASURES AND IMPLEMENTATION.....	33
4.1	Management Measures	33
4.2	Implementing Changes to the Management Arrangements	34
4.2.1	Consultation.....	34
4.2.1.1	Commercial Sector Consultation.....	35
4.2.1.2	Voluntary Closures.....	36
4.2.1.3	Communication of season arrangements.....	36
4.2.1.4	Consultation with Other Groups	36
5.0	COMPLIANCE AND ENFORCEMENT	37
5.1	Operational Compliance Plans.....	37
5.2	Compliance Strategies.....	37
5.2.1	Vessel Monitoring System (VMS)	38
6.0	REFERENCES	39
	APPENDIX 1.....	42
	BYCATCH ACTION PLAN 2022-2027	42
	APPENDIX 2.....	49
	PRINCIPLES FOR SETTING ANNUAL SEASON ARRANGEMENTS.....	49
	APPENDIX 3.....	54
	IN-SEASON REVIEW PROCESS - APRIL.....	54
	IN-SEASON REVIEW PROCESS - JUNE	55
	APPENDIX 4.....	56
	SHARK BAY PRAWN FISHERY RECOVERY STRATEGY	56

List of Acronyms

ALC	Automatic Location Communicator
AMM	Annual Management Meeting
ARMA	<i>Aquatic Resources Management Act 2016</i>
B	Spawning Stock Biomass
BAP	Bycatch Action Plan
B _{MSY}	Biomass Maximum Sustainable Yield
BRDs	Bycatch Reduction Devices
CDR	Catch and Disposal Record
CCPL	Central Carnarvon Peron Line
CPL	Carnarvon Peron Line
CPUE	Catch Per Unit Effort
DPIRD	Department of Primary Industries and Regional Development (the Department)
DS	Denham Sound
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)
FARM	Fisheries and Agricultural Resource Management
FRMA	<i>Fish Resources Management Act 1994</i>
FRMR	<i>Fish Resources Management Regulations 1995</i>
HCR	Harvest Control Rule
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
NCPL	North Carnarvon Peron Line
NGO	Non-Government Organisation
OCP	Operational Compliance Plan
SBPMF	Shark Bay Prawn Managed Fishery
SBCMF	Shark Bay Crab Managed Fishery
SBPTOA	Shark Bay Prawn Trawler Operators' Association
SBSMF	Shark Bay Scallop Managed Fishery

SCPL	South Carnarvon Peron Line
SLA	Service Level Agreements
STL	Snapper Trawl Line
VMS	Vessel Monitoring System
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WCPL	West Carnarvon Peron Line
WTO	Wildlife Trade Operation

1.0 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), 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. This version of the Harvest Strategy also includes the Bycatch Action Plan (BAP) (refer to Appendix 1), formerly a standalone document.

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. It will also 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 Director General of DPIRD, or other delegated decision-makers to meet the objectives of the FRMA.

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

1.1 Review Process

The Department's 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 is the second version of the Harvest Strategy for the Shark Bay Prawn Managed Fishery (SBPMF). This Harvest Strategy, which is focused on the broader prawn resource in Shark Bay, will remain in place for a period of five years, after which time it will be fully reviewed. If required, this document may be subject to review and amended within this five-year period.

2.0 Scope

This Harvest Strategy relates to the prawn resource of Shark Bay, WA, and the fishing activities influencing this resource. Prawns in Shark Bay are primarily harvested by the commercial SBPMF: (Figure 1) using low-opening otter trawls. The key target species of the SBPMF are western king prawns (*Penaeus latisulcatus*) and brown tiger prawns (*P. esculentus*).

This Harvest Strategy considers the impact of commercial trawl fishing activities, as the primary sector targeting the prawn resource in Shark Bay. Recreational and customary fishing for prawns is permitted, however, catches are considered negligible in the context of managing harvest of the prawn resource of Shark Bay.

In addition to considering fishing impacts on the target species, this Harvest Strategy also covers impacts on other retained species, bycatch, endangered, threatened and protected (ETP) species, habitats and other ecological components. Potential risks for all factors identified within the ecological risk assessment (ERA) (refer to Section 3.6.2.4) are managed effectively through the implementation of this Harvest Strategy, control rules (refer to Table 2) and BAP (refer to Appendix 1).

2.1 Environmental Context

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 Shark Bay prawn 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 mild winters and hot, dry summers. The temperature of offshore ocean waters ranges from about 22° C to 28° C, while the waters of inner Shark Bay can drop much lower in winter and warmer in summer. The hydrology of Shark Bay is influenced by the Leeuwin Current, which carries warm, low-salinity water southward down the WA coast. Trawl fishing in Shark Bay occurs predominantly over sand/mud/shell habitats in the deeper areas of the central bay, north of Cape Peron, and in the northern area of Denham Sound. The majority of Shark Bay sponge/coral habitats are contained within and protected by specific trawl closure areas (Kangas et al. 2015).

The embayment is comprised of two gulfs (Figure 1) and for most part is relatively shallow, with an average depth of 9 m and increasing to 29 m deep in the north (Francesconi and Clayton 1996). The inner shallow regions are hypersaline, a preferred habitat for juvenile prawns that migrate to the deeper oceanic waters as they mature. Shark Bay is only infrequently impacted by cyclonic flooding and the mean annual rainfall is low, ranging from 200 mm in the west 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). Parts of Shark Bay are also managed as part of the Shark Bay Marine Park (Figure 2).

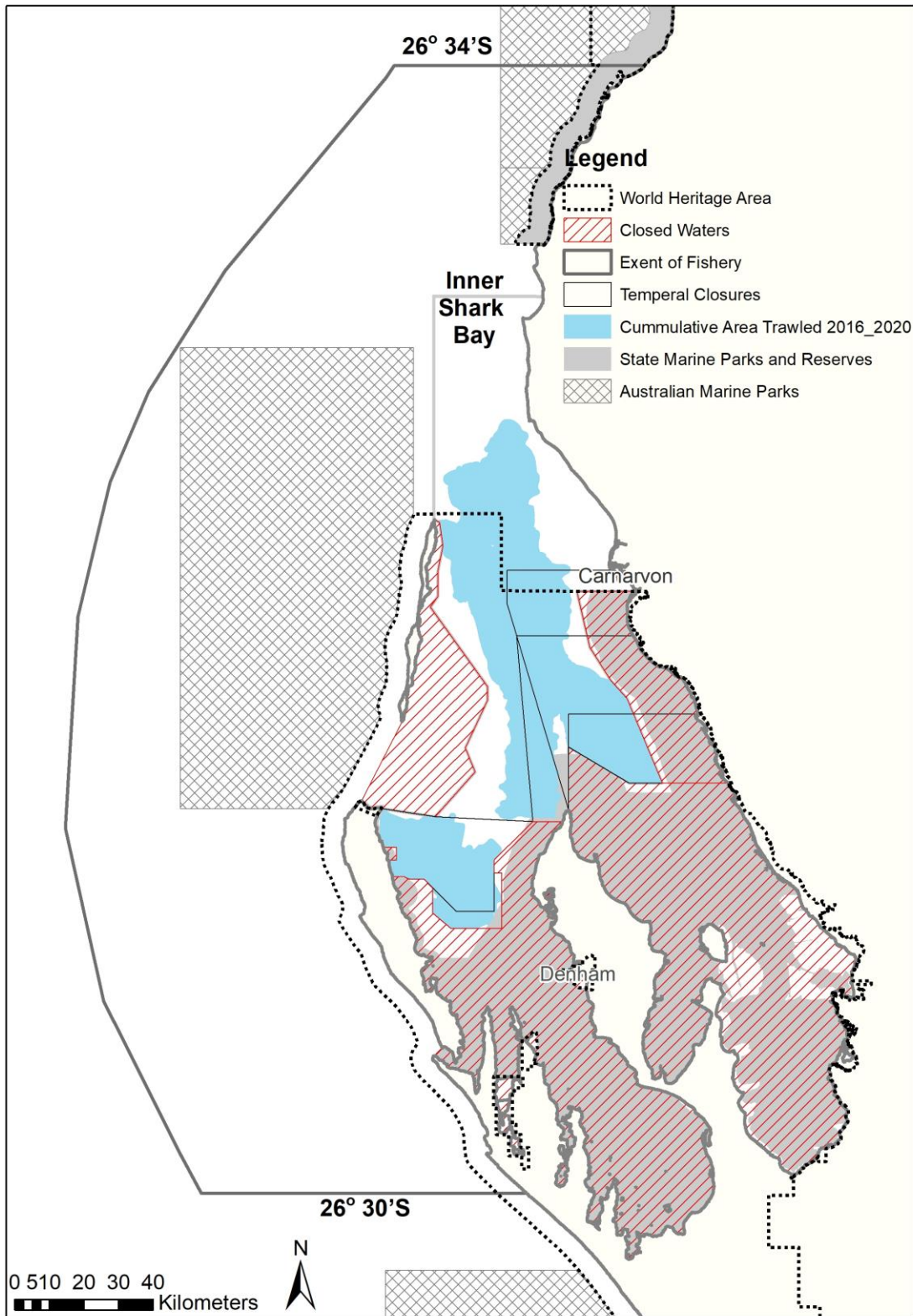


Figure 1: Extent of the SBPMF, closure areas, the cumulative area trawled across five years and Marine Parks.

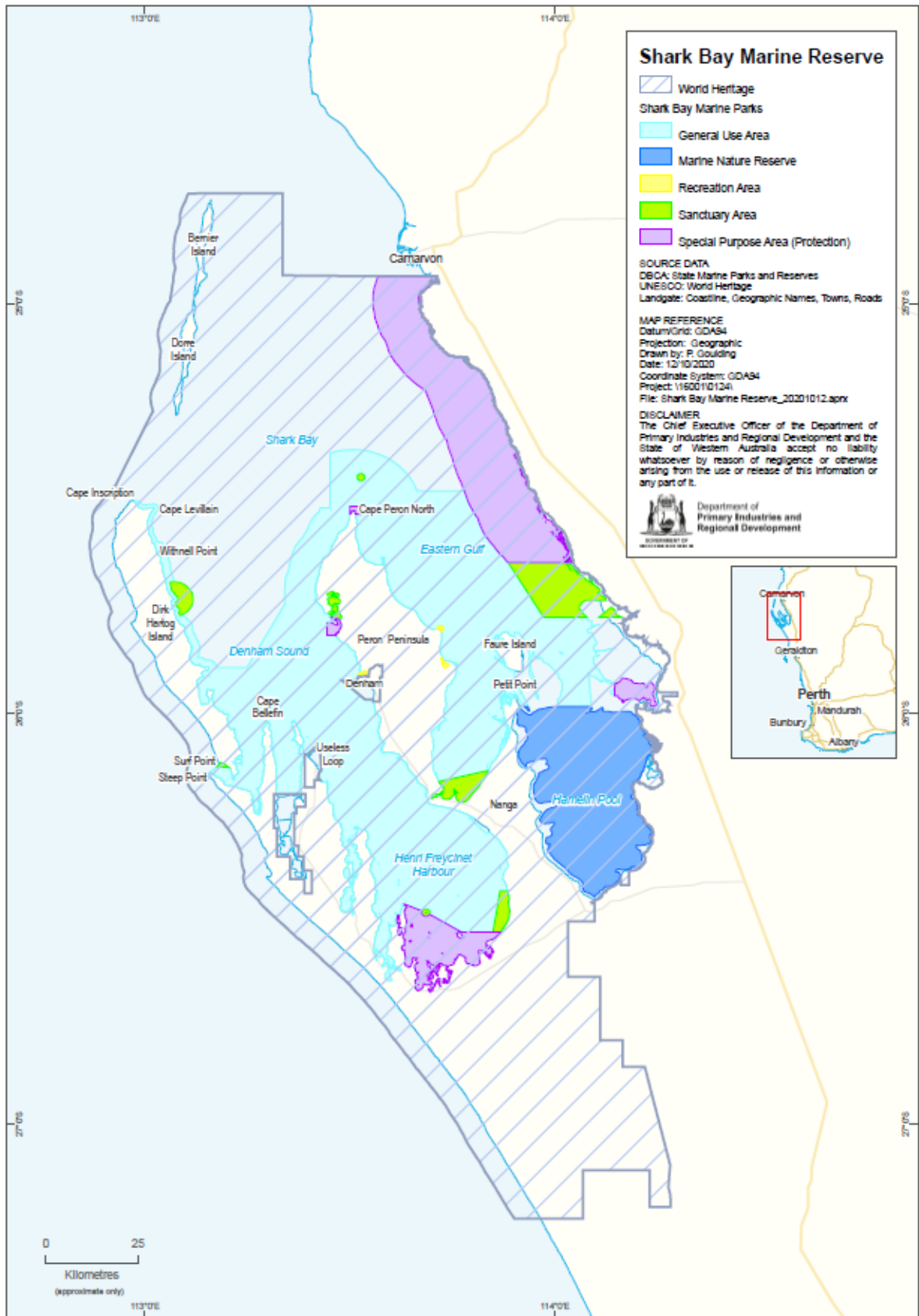


Figure 2: Shark Bay World Heritage Area and Shark Bay Marine Park areas

2.2 Target Species

Western king prawns (*P. latisulcatus*) and brown tiger prawns (*P. esculentus*) are decapod crustaceans that belong to the family Penaeidae. The western king prawn is widely distributed throughout the Indo-West Pacific region, whilst the brown tiger prawn is generally regarded as endemic to Australia (Grey et al. 1983; Ward et al. 2006). Both species occur in northern Australian waters from New South Wales to WA, however, Shark Bay represents the southern extent of brown tiger prawns in WA whilst the distribution of western king prawns extends into South Australia. Stock structure studies have indicated that the populations of each species in Shark Bay function as independent, self-sustaining stocks (Richardson 1982; Ward et al. 2006).

Both western king and brown tiger prawns are short-lived, fast-growing and have variable recruitment that is primarily environmentally driven. Juvenile prawns occupy shallow, nearshore areas where seagrass and algal communities form important nursery habitats for brown tiger prawns (Kenyon et al. 1997) whereas juvenile western king prawns prefer sandy/muddy habitats (Penn and Stalker 1975, Kangas and Jackson 1998). As they reach maturity at around six to seven months of age, they migrate to deeper, more offshore waters to spawn (Penn and Stalker 1979; Penn 1980). Spawning occurs primarily between May to October in Shark Bay, with the peak spawning period varying between the two species and is mainly driven by water temperature (Penn 1980; Penn & Caputi 1986).

2.3 Fishing Activities

2.3.1 Governance

The Shark Bay prawn resource can be 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, as a minimum:

- *Fish Resources Management Act 1994* (FRMA, will be replaced by the ARMA once enacted).
- *Fish Resources Management Regulations 1995* (FRMR).
- FRMA Part 6 — *Shark Bay Prawn Managed Fishery Management Plan 1993* (SBPMF Management Plan).
- FRMA Section 43 Order — *Prohibition on Commercial Fishing (Shark Bay Marine Park) Order 2004*.
- FRMA Section 7 Instruments of Exemptions.

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*.
- Any other legislation governing the use of the marine environment in which fishing.

2.3.2 Commercial Fishing

Prawn fishing in Shark Bay commenced in 1962, with the fleet developing incrementally from four vessels to a maximum of 35 vessels in the mid-1970s. There are currently 18 licences in the SBPMF, with each vessel using low-opening demersal otter trawl gear in quad-rigged formation. All vessels are equipped with on-board processing and freezing facilities. The SBPMF currently has an estimated annual value of \$20-30 million with a catch range around 1350 to 2150 t per annum.

In addition to the two target species, western king and brown tiger prawns, the SBPMF also retain a variety of minor prawn species, including coral prawns (mainly *Metapenaeopsis crassissima*) and endeavour prawns (*Metapenaeus* spp.). Other retained species include mantis shrimp (Fam. Squillidae) and cephalopods such as squid, cuttlefish (*Sepia* spp.) and octopus, as well as bugs (*Thenus* spp.) and various finfish. Catches of blue swimmer crabs (*Portunus armatus*) and Ballot's saucer scallops (*Ylistrum balloti*) by prawn trawl fishers are managed by quota as part of the Shark Bay Crab Managed Fishery (SBCMF) and Shark Bay Scallop Managed Fishery (SBSMF), respectively.

Bycatch in the SBPMF is variable, comprising a wide range of finfish and invertebrates (Kangas and Thomson 2004, Kangas et al. 2007). The fishery also has the potential to interact with several groups of endangered, threatened and protected (ETP) species, including sea snakes, turtles, syngnathids (pipefish and sea horses) and elasmobranchs. Bycatch reduction devices (BRDs) consisting of grids and square mesh panels have been mandatory since 2002 and, when captured, unwanted and prohibited catch is returned to the water as quickly as possible. A large proportion of the Inner Shark Bay area is permanently closed to trawling and fishing generally interacts with 14-18% of the Bay annually.

The SBPMF is subject to an input control management system. Overall effort in the fishery is constrained by a cap on the number of licences (limited entry), limits on fishing gear (headrope capacity), restrictions on the number of available fishing days each year (seasonal closure) and restricted trawl hours (mainly night-time trawling). Monthly moon closures around each full moon and significant permanent and temporary closed areas throughout the fishery also reduce the effective fishing effort. Fishing activity is monitored using the Vessel Monitoring System (VMS) (see Section 5.2.1 for further information).

The SBPMF has been assessed under the provisions of the EPBC Act (Part 13A) and has been found to meet the Australian Government Guidelines for the Ecologically Sustainable Management of Fisheries (Commonwealth of Australia [CoA] 2007). Initial assessment of the fishery took place in 2002, with the most recent reassessment and approval granted in August 2015¹ As such, the SBPMF is an approved Wildlife Trade Operation (WTO) permitted export product until 30 May 2025.

[1] Full details of the current and previous assessments are available at: <http://www.environment.gov.au/marine/fisheries/wa/sbprawn>

The fishery received third party MSC accreditation in 2015, and was recertified in 2020, demonstrating its achievement of high standards in relation to sustainability of fish stocks, the minimisation of environmental impacts and effective management.

2.3.3 Recreational Fishing

Recreational fishers are permitted to catch prawns in Shark Bay using a single hand dip net, hand scoop net, hand throw net, or prawn hand trawl (drag) net that is not more than four metres across with a mesh of not less than 16 mm and must not be attached to a boat or set. The most recent state-wide survey of boat-based recreational fishing in 2017/18 indicate that catches of prawns in the Carnarvon and Shark Bay zone of the Gascoyne Coast Bioregion were negligible (Ryan et al. 2019).

2.3.4 Customary Fishing

Although there is no quantitative information available on the customary catch of prawns in Shark Bay, these activities are unlikely to impact the overall management context.

2.3.5 Catch-Share Allocations

The prawn resource in Shark Bay has historically been fished mainly by the commercial sector, without an explicit catch share allocation with recreational and customary fishing sectors.

3.0 Harvest Strategy

This Harvest Strategy is structured to describe, hierarchically:

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

This is followed by a more detailed description of the:

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

3.1 Long-term Objectives

The main objective for the Shark Bay Prawn Resource is to ensure the enduring sustainability of the resource while optimising the economic utilisation to the benefit of the Western Australian community.

In addition to the above overarching objective, this Harvest Strategy includes broader ecological objectives for each ecosystem component, as well as a social

and economic objective for the fishery as a whole. It is important to note that the social and economic objective is applied within the context of ESD.

3.1.1 Ecological Sustainability

- 1) To maintain spawning biomass of each target species stock/s 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 harm² to bycatch species populations.
- 4) To ensure fishing impacts do not result in serious or irreversible harm to ETP species populations.
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.
- 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

To provide industry the opportunity to optimise the economic returns generated by the SBPMF within a sustainable fishery framework.

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, or rebuild the resource if it has fallen below the threshold or the limit levels.

3.3 Harvesting and Management Approaches

The SBPMF is managed based on a constant escapement harvesting approach, which aims to maintain sufficient abundance of prawns prior to spawning. Management arrangements for the fishery have been developed over time based on a comprehensive understanding of the biology of western king and brown tiger prawns in Shark Bay, with the annual cycle of operation depending on the strength and timing of recruitment as prawns migrate from the inshore nursery areas and enter the trawl grounds during autumn. The Harvest Strategy has been designed to provide sufficient protection to spawning stocks and allow flexibility to achieve economic objectives.

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.

3.3.1 Season Arrangements and Within Season Guidelines

The prawn fishing season in Shark Bay typically extends from March/April through to September/October each year (see Figure 3), with specific opening and closing dates set according to the lunar phase and a wide range of other information.

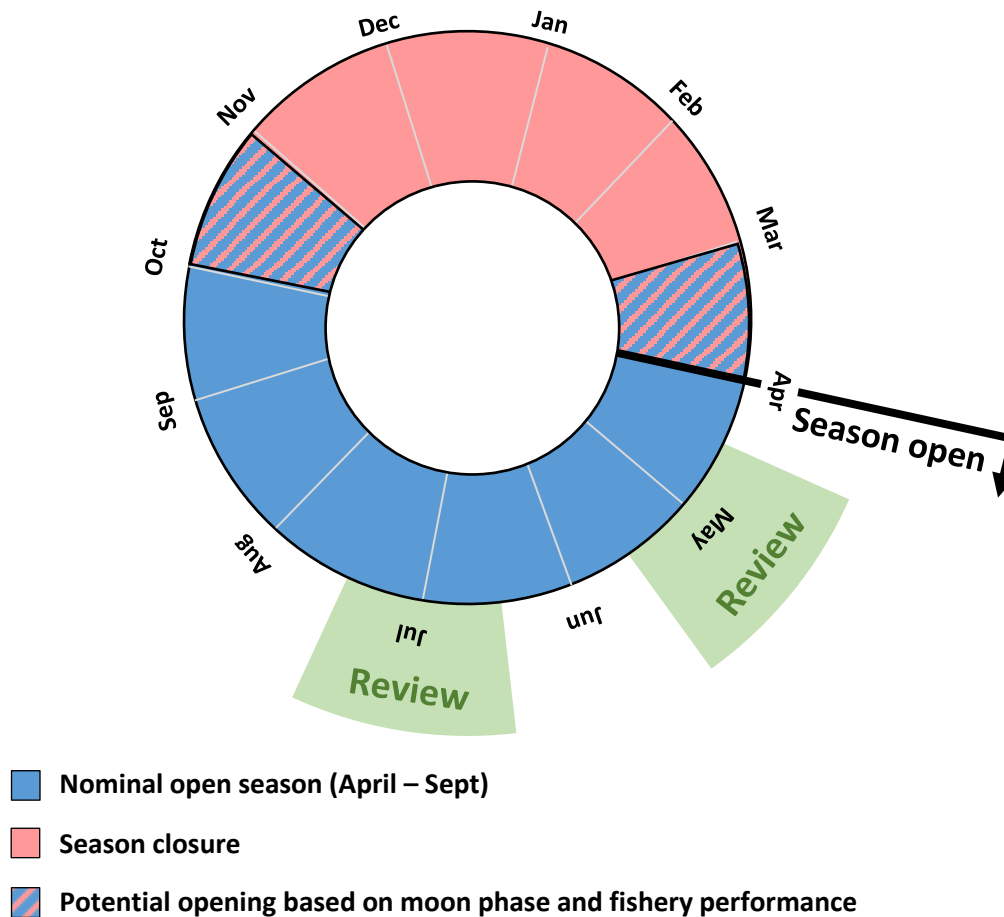


Figure 3: Schematic of Shark Bay prawn fishing season. Note: the figure is indicative only and specific season dates can differ between years.

Each year, the season arrangements for the SBPMF are developed in consultation with industry following a review of the previous fishing season. The development of season arrangements is guided by a set of principles (Figure 4 and Appendix 2) based on the performance against the index of spawning stock abundance for western king and brown tiger prawns and consideration of all available data, including fishery-independent survey information, fishery-dependent catch rates and size information, and environmental data. Season arrangements outline the fishing periods, spatial closures, moon breaks, annual survey schedule and also include guidelines for in-season decision making to provide clear guidance for considerations of survey data and associated operational responses.

In-season decision-making is centered around two main review points in April and June (Figure 6 and Appendix 3), which are used to inform a series of rolling spatial openings and closures of defined areas within Shark Bay. These in-season decisions are to achieve ecological objectives relating to prawn and other species, as well as economic and social benefits.

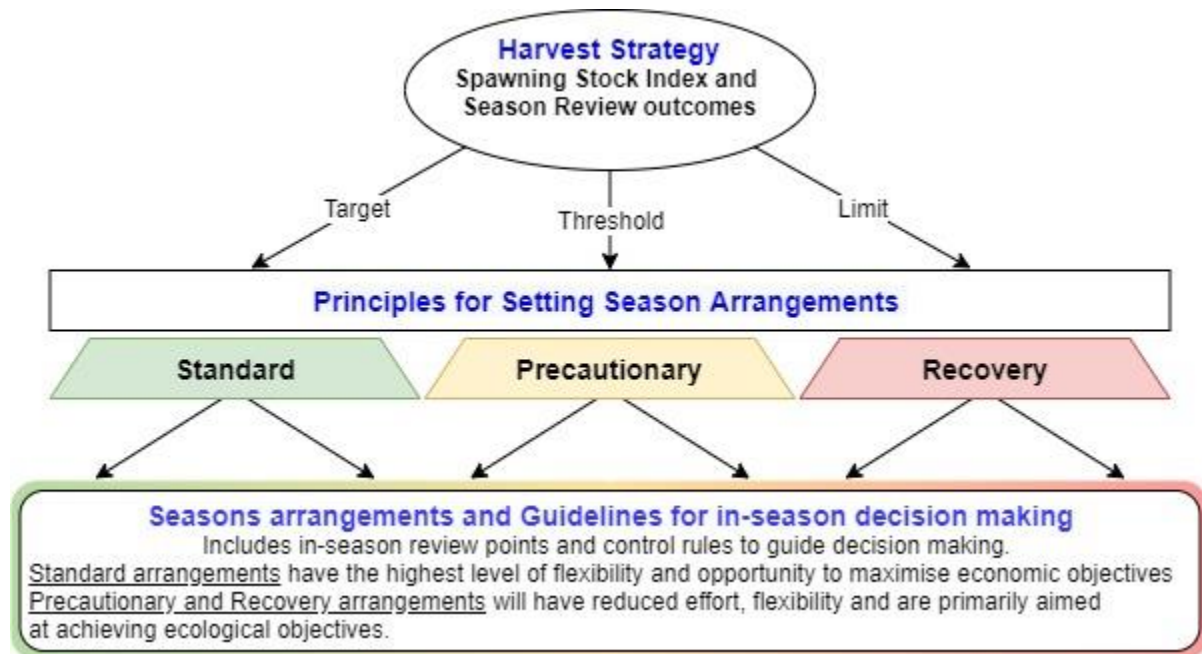


Figure 4: Development of season arrangements based on Principles which respond to Harvest Strategy performance indicators and season review outcomes.

No fishing is permitted to the east of the Carnarvon Peron Line (CPL, see Figure 1) prior to the May fishing period to reduce catches of small-size prawns and ensure sufficient protection prior to the key spawning period (June – October). Fishery-independent recruitment surveys are undertaken in March and April, with information on prawn abundance and size used to inform the appropriateness of the planned season arrangements and extent of fishing to the east of the CPL (see Section 3.4.1). The recruitment index for either species may trigger a review and potential revision of the season arrangements to adjust the number of available fishing days and spatial openings and closures.

Spatial closures are implemented annually during the key spawning period to protect brown tiger and western king prawns in key areas east of the CPL. These closures prohibit prawn fishing in the North Carnarvon Peron Line (NCPL) from around the start of June and the South Carnarvon Peron Line (SCPL) generally does not open before June/July and is again closed from the start of August (specific dates dependent on lunar phase and specified in the season arrangements) to protect recruiting overwintered prawns which start to appear on these grounds from August onwards.

Indices of spawning stock abundance derived from the spawning surveys conducted in the NCPL in June and July/August are currently the primary performance

indicators used to assess the status of the target prawn stocks (see Section 3.4.1). The spawning stock survey catch rates of both target species in the SCPL further informs in season decision making due to annual variation in the distribution of prawns and the proportion of the stock within the NCPL, CCPL or the SCPL during spawning stock surveys. These indices are considered as part of a weight-of-evidence approach to inform the management arrangements for the next fishing season. In addition, data from the June survey is also used to assess appropriateness of fishing arrangements for the latter part of the current season including decisions made regarding the opening of the SCPL.

The survey in July/August also provides prawn abundance indices that determine the extent of prawn fishing permitted in Denham Sound when this opens around July/August.

3.4 Ecological Sustainability

The Department conducts a formal, resource-level review to assess the status of target stocks and performance in relation to each ecological objective. Suitable indicators are selected to describe the status of targeted prawn species, and other ecological assets, against defined reference levels established to separate acceptable from unacceptable performance (Section 3.4.1). Where relevant, these levels include the following, defined and illustrated within Figure 5:

- 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).

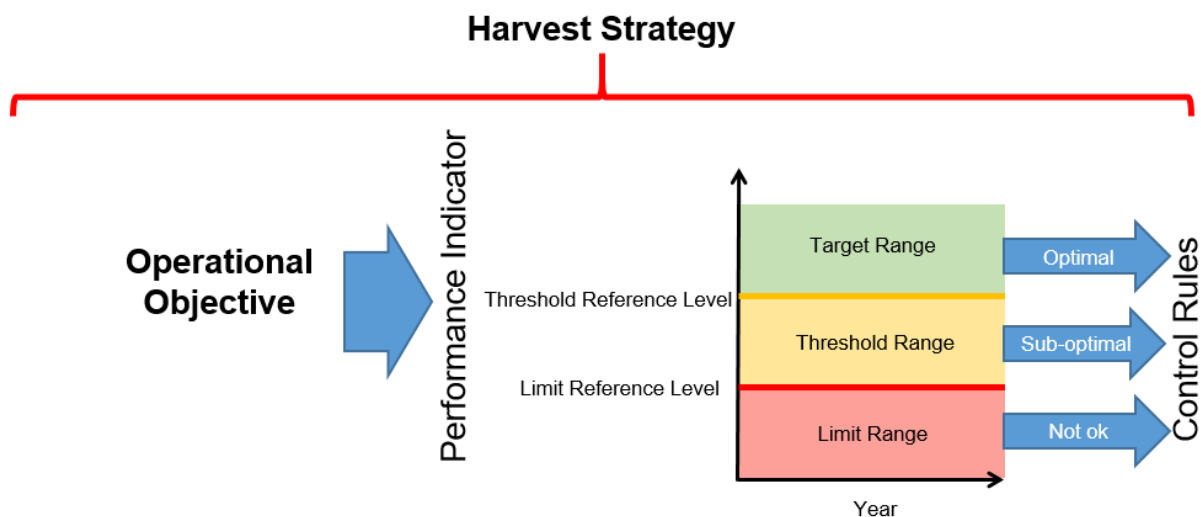


Figure 5: Performance indicators, limits, thresholds and targets

Harvest Control Rules (HCRs) define the management actions that should occur in relation to the value of each indicator compared to the reference levels (Section 3.4.2). The HCRs aim to maintain each resource at their target level and return the resource to this level when a threshold or limit level has been breached. A summary of the management objectives, performance indicators, reference levels and HCRs is provided in Table .

3.4.1 Performance Indicators and Reference Levels

3.4.1.1 Target Prawn Species

3.4.1.1.1 Spawning Stock Biomass

The primary performance indicator used to monitor stocks and inform the stock assessment of target species; western king and brown tiger prawns is spawning stock biomass (B) or an appropriate proxy (see Table 1). An index of spawning stock abundance for both target species is derived from the fishery independent spawning stock surveys (see 3.6.1.3.2) and used as the proxy for spawning stock biomass. For each stock, the index of spawning stock abundance is estimated annually and compared to associated reference levels (B_{Target} , $B_{Threshold}$ and B_{Limit}) consistent with the levels identified in the Department’s Harvest Strategy Policy.

In line with the ecological objectives of this harvest strategy, the reference levels and control rules act to maintain stocks of target prawn species above the biomass maximum sustainable yield (B_{MSY}), with management action triggered should they drop below this level. Any stock size above the B_{MSY} threshold is consistent with meeting the objectives for biological sustainability. Maintaining the stock at or above the B_{MSY} threshold is also sufficient to meet the stock status requirements as defined for purposes of certification under the Marine Stewardship Council’s standard for sustainability. Note that while being above the B_{MSY} threshold meets the biological sustainability objective for this harvest strategy, a specific target level above B_{MSY} to meet economic objectives has not been set. Economic objectives are instead considered as part of the annual season arrangements development process.

Table 1. Performance indicators and reference levels used to evaluate the status of target prawn species

Performance Indicator	Reference Levels		
	B_{Target}	$B_{Threshold}$	B_{Limit}
Spawning biomass (B)	$>B_{30}$	$\leq B_{30}$	$\leq B_{20}$
Proxy: Spawning Stock Index	$>B_{MSY}$	$\leq B_{MSY}$	$\leq 0.5 B_{MSY}$

3.4.1.1.2 Index of Recruitment

An index of recruitment for both target species stocks is derived from the fishery independent recruitment surveys (See 3.6.1.3.1). The recruitment index is used to review the appropriateness of the season arrangements at the start of the fishing season to ensure adequate protection of spawning stocks. Reference levels for both species have been selected considering the performance of the commercial fishery over time based on the index of recruitment across the reference period 2000-2021. The threshold reference levels represent the point below which precautionary arrangements should be considered to ensure fishing effort during the season does not result in the spawning stock biomass being below the threshold reference level in June and July/August.

3.4.1.1.3 Preliminary Spawning Stock Index

The preliminary index of spawning stock abundance is based on the first spawning stock survey (normally June) and is used to track progress towards achieving the desired spawning stock biomass for the spawning period in spring. The reference levels are set at the same level as the corresponding spawning stock biomass reference levels. The threshold and limit reference levels are set to allow corrective action to be taken during the remainder of the season where there is an indication that the subsequent index of spawning stock biomass may be below the threshold reference level.

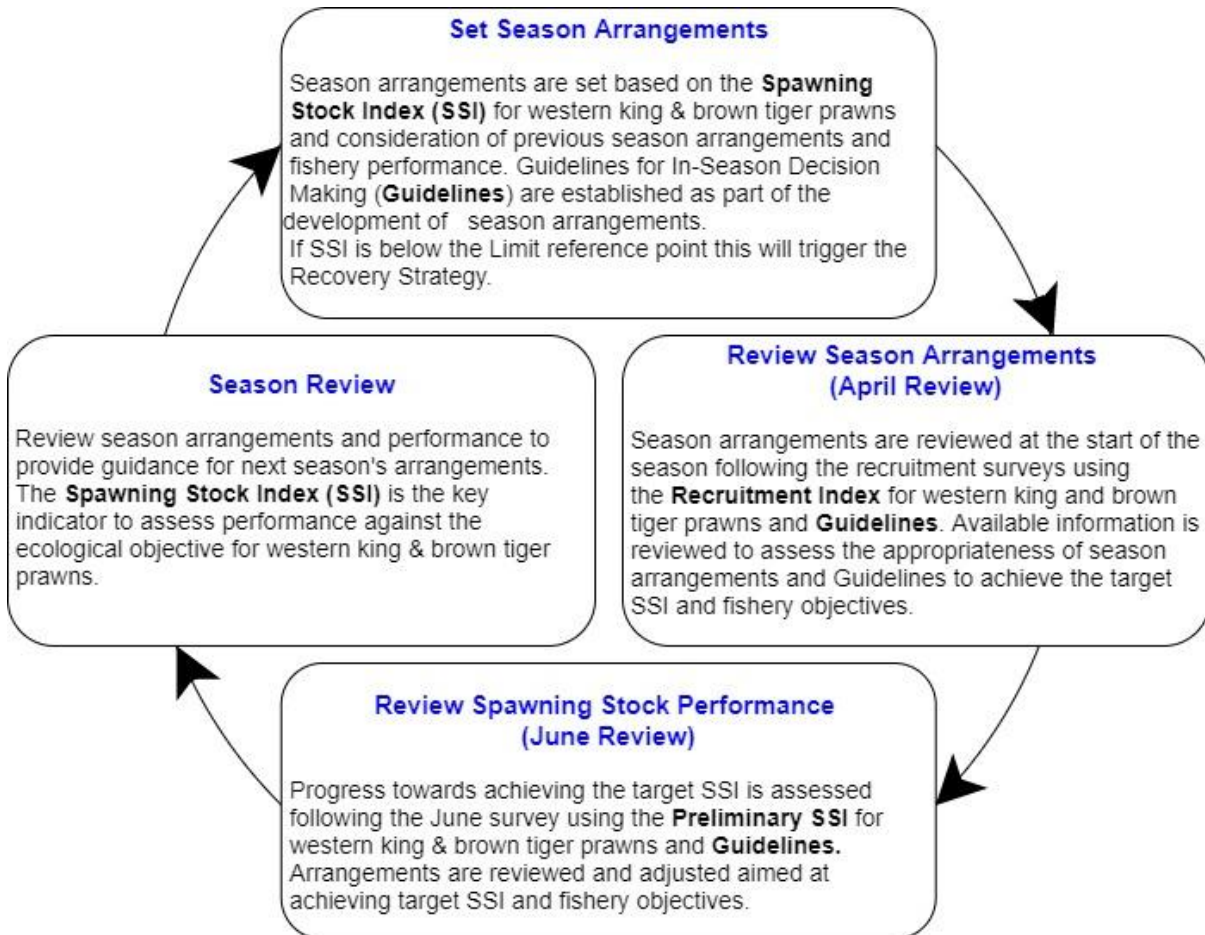


Figure 6: Relationship between target species performance indicators to review and assess performance of target species stocks.

3.4.1.2 Other Ecological Components

Other ecological assets incorporated in this Harvest Strategy include other retained species, bycatch, ETP species, habitats and ecosystem processes that may be affected by prawn trawling.

Where reliable quantitative information is available, reference levels used to monitor performance against management objectives relating to these ecological assets have been set based on data available from ongoing monitoring. The retained catch of each other penaeid prawn species (mainly coral and blue endeavour prawns) is compared annually to a threshold level of 5% of the total retained catch of the

SBPMF. Although the fishery generally operates over sandy areas to target prawns, and avoids areas that can damage fishing gear (e.g. reefs), there is potential for the fishery to interact with other benthic habitats which may be vulnerable to trawl fishing, such as sponges, seagrasses and soft corals. The impact of prawn trawling on habitats is monitored by estimating the annual spatial trawl footprint of the fishery and ensuring it does not extend across more than 20% of Inner Shark Bay (see Figure 1). A move on rule will be triggered when the component of vulnerable habitat bycatch on commercial vessels exceeds a specified amount (see Table 2). Independent surveys are used to monitor sensitive habitats in traditional trawl fishing areas.

For all ecological components, reference levels have also been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher (2015). An ERA for the SBPMF was undertaken in September 2019 (DPIRD 2020a) to inform these components of the harvest strategy, with these risk scores to be reviewed after no more than five years.

The risk of prawn fishing on saucer scallops and blue swimmer crabs in Shark Bay is assessed annually as part of the risk-based weight-of-evidence assessment of these resources, which informs the Harvest Strategies for the Shark Bay scallop and blue swimmer crab resources (DPIRD 2020b, c) and considers if additional management measures (such as spatio-temporal restrictions) are necessary.

3.4.2 Application of Harvest Control Rules

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

Where an indicator falls below the threshold reference level, 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 other relevant information as well as 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 outlined by the HCRs (Table 2), examples for the Shark Bay Prawn Fishery include:

- Revising the season arrangements (i.e., overall season length and structure).
- Modifying the timing and spatial extent of fishing during the season.
- Adjustment of other effort restrictions.

The ability to, and timeframe for, implementing these changes depends on the legal instrument under which the management measure occurs (see Section 4.0 for more information).

3.4.2.1 *Recovering Depleted Stocks*

A resource is considered to be in a recovery-phase when key indicators have 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) (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.

Due to biological differences between the two target species, the recovery strategy for Shark Bay prawns (see Appendix 4) needs to consider appropriate measures to facilitate recovery of the depleted target stock/s on a case-by case basis. Recovery measures also need to consider other fishing operations in Shark Bay, the potential impacts of these on recovery, and implications of recovery measures on those fisheries. Recovery or precautionary principles are applied when setting season arrangements during the recovery period.

Before the stock is considered to have rebuilt, a review will be undertaken to ensure the Harvest Strategy and management arrangements remain appropriate to maintain the stock above the threshold levels in the future.

3.4.3 *Bycatch Action Plan*

The SBPMF Bycatch Action Plan (BAP) and associated information is provided in Appendix 1. The BAP addresses current bycatch issues in accordance with the fishery's Harvest Strategy, other relevant legislation and other voluntary agreements. The BAP provides management actions to:

- address unacceptable ecological risks associated with the fishery assessed through periodic ERAs;
- minimise fishery interactions with ETP species listed under the EPBC Act; and
- address MSC requirements to maintain MSC certification.

Table 2. Harvest Strategy performance indicators, reference levels and control rules for the Shark Bay prawn resource and associated ecological assets that may be impacted by fishing activities targeting prawns within Shark Bay.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Target species	To maintain spawning stock biomass of each target species at a level where the main factor affecting recruitment is the environment.	Western king prawns.	Annual estimate of spawning stock biomass (B, or appropriate proxy)	Target: B_{Target}	If Target is met, continue management aimed at maintaining spawning stock biomass above the Threshold and achieving ecological, economic and social objectives.
				Threshold: $B_{\text{Threshold}}$	If Threshold is breached, review all available information and reduce effort to return the spawning stock to above the Threshold the following year.
				Limit: B_{Limit}	If the Limit is breached, review all available information and implement management response to: <ol style="list-style-type: none"> 1. restrict fishing as soon as possible to protect the stock for the remainder of the current season, and 2. the Recovery Strategy will be triggered (See Appendix 4). This will set arrangements for the following season to return the spawning stock to at least above the Limit reference level that year and rebuild the stock to above the Threshold within three years.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Target species	To maintain spawning stock biomass of each target species at a level where the main factor affecting recruitment is the environment.	Brown tiger prawns.	Annual estimate of spawning stock biomass (B, or appropriate proxy)	Target: B_{Target}	If Target is met, continue management aimed at maintaining spawning stock biomass above the Threshold and achieving ecological, economic and social objectives.
				Threshold: $B_{\text{Threshold}}$	If Threshold is breached, review all available information and reduce effort to return the spawning stock to above the Threshold the following year.
				Limit: B_{Limit}	If the Limit is breached, review all available information and implement management response to: <ol style="list-style-type: none"> 1. restrict fishing as soon as possible to protect the stock for the remainder of the current season, and 2. the Recovery Strategy will be triggered (See Appendix 4). This will set arrangements for the following season to return the spawning stock to at least above the Limit reference level that year and rebuild the stock to above the Threshold within three years.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Target species	To maintain spawning stock biomass of each target species at a level where the main factor affecting recruitment is the environment.	Western king prawns.	1. Index of recruitment (mean catch rate of western king prawns from both March and April surveys in areas east of the CPL) 2. Average size composition of western king prawns in the NCPL and CCPL (excluding soft & broken) from the April survey.	Target: >70 kg/hr, and >30% of western king prawns are larger than 21/30 grade (count per pound)	If both Targets are met, continue management aimed at maintaining spawning stock biomass above the Threshold and achieving ecological, economic and social objectives. In years of exceptional recruitment, consider arrangements to allow increased yield. (subject to adequate recruitment of brown tiger prawns).
				Thresholds: ≤ 70 kg/hr, or ≤ 30% of western king prawns are larger than 21/30 grade (count per pound)	If either Threshold is breached, review all available information, including guidelines for in-season decision making, and consider appropriate management response. Management action will be aimed at achieving the spawning stock biomass Target that season.
		Brown tiger prawns.	Index of recruitment (mean catch rate of brown tiger prawns from March and April surveys in areas east of the CPL).	Target: >40 kg/hr	If Target is met, continue management aimed at maintaining spawning stock biomass above the Threshold and achieving ecological, economic and social objectives. In years of exceptional recruitment, consider arrangements to allow increased yield. (subject to adequate recruitment of western king prawns).
				Threshold: ≤ 40 kg/hr	If Threshold is breached, review all available information, including guidelines for in-season decision making, and consider appropriate management response. Management action will be aimed at achieving the spawning stock biomass Target that season.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Target species	To maintain spawning stock biomass of each target species at a level where the main factor affecting recruitment is the environment.	Western king prawns & brown tiger prawns.	Preliminary index of spawning stock abundance for each species (mean catch rate of each species from June survey in NCPL).	Target: B_{Target}	If Target is met, continue with current season arrangements.
				Threshold: $B_{\text{Threshold}}$	If Threshold is breached, review all available information, including guidelines for in-season decision making, and consider appropriate management response. Management action will be aimed at achieving the spawning stock biomass Targets that season.
				Limit: B_{Limit}	If the Limit is breached, review all available information and implement management response to restrict fishing to protect the spawning stock for the remainder of the current season.
			<ol style="list-style-type: none"> 1. Combined index of spawning stock abundance for both target species (mean catch rate of western king prawns and brown tiger prawns) in the DS Snapper Trawl Line extension area from the July/August spawning stock survey. 2. Number of pink snapper caught per hour trawled in DS. 	Target: >50 kg/hr, and <100 pink snapper per trawl hour	If the Target is achieved, open the Snapper Trawl Line extension area for a maximum of 10 days across July/August/September.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
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.	Blue swimmer crabs.	Refer to Blue Swimmer Crab Resource of Shark Bay Harvest Strategy		
		Ballot's saucer scallop.	Refer to Saucer Scallop Resource of Shark Bay Harvest Strategy		
		Other Penaeids.	Annual proportion of total retained catch of each species	Target: < 5% of total annual catch	Continue management aimed at achieving ecological, economic and social objectives
			Annual proportion of total retained catch of each species	Threshold: ≥ 5% of total annual catch	A review will be undertaken within three months to investigate the reason for the change and assess risk to the affected species. Management action will be taken to reduce risk to an acceptable level before the next season if required.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
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.	All retained species.	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch • species information, and • other available research. 	Target: Fishing impacts are expected to generate an acceptable level of risk (i.e. moderate risk or lower) to all retained species' populations.	Continue management aimed at achieving ecological, economic and social objectives.
				Threshold: Fishing impacts are considered to generate an undesirable level of risk (i.e. high risk) to any retained species' populations.	Review the reasons for this variation within three months and develop an appropriate management response to reduce risk to an acceptable level before the next season.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk (i.e. severe risk) to any retained species' populations.	Review the reasons for this variation within one month and develop an appropriate 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.	Ballot's saucer scallop.	The risk of prawn fishing and potential discarding of saucer scallops is assessed annually as part of the overall weight-of-evidence assessment of stock status that informs the Shark Bay Scallop Resource Harvest Strategy.		
		All bycatch species.	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch (including discards), • review of alternative measures to minimise unwanted catch, • species information, and • other available research. 	Target: Fishing impacts generate an acceptable level of risk (i.e. moderate risk or lower) to all bycatch species' populations.	Continue management aimed at achieving ecological, economic and social objectives.
				Threshold: A potentially material change to risk levels is identified; and/or Fishing impacts generate an undesirable level of risk (i.e. high risk) to any bycatch species' populations.	Review the reasons for this variation within three months and implement an appropriate management response to reduce risk to an acceptable level before the next season.
				Limit: Fishing impacts are considered to generate an unacceptable level of risk (i.e. severe risk) to any bycatch species' populations.	Review the reasons for this variation within one month and develop an appropriate 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
ETP species	To ensure fishing impacts do not result in serious or irreversible harm to ETP species' populations.	All ETP species.	Periodic risk assessments and annual reporting 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 (i.e. moderate risk or lower) to all ETP species' populations.	Continue management aimed at achieving ecological, economic and social objectives.
				Threshold: A potentially material change to risk levels is identified; and/or Fishing impacts are considered to generate an undesirable level of risk (i.e. high risk) to any ETP species' populations.	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 (i.e. severe risk) to any ETP species' populations.	Review the reasons for this variation within one month and develop an appropriate 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
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.	All habitats.	1. Extent of area of Inner Shark Bay trawled annually, and 2. Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort, • extent of area trawled annually, and • other available research. 	Targets: Total area trawled annually is <20% of Inner Shark Bay; and Fishing impacts are expected to generate an acceptable level of risk (i.e. moderate risk or lower) to all benthic habitats.	Continue management aimed at achieving ecological, economic and social objectives.
				Thresholds: Total area trawled annually is \geq 20% of Inner Shark Bay; and/or A potentially material change to risk levels is identified, and/or Fishing impacts are considered to generate an undesirable level of risk (i.e. high risk) to any benthic habitats.	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 (i.e. severe risk) to any benthic habitats.	Review the reasons for this variation within one month and develop an appropriate 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
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.	Vulnerable habitats ³	Amount of fishery bycatch comprised of vulnerable habitats.	Threshold: >1 basket (600L x 420W x 320H (mm)) of vulnerable habitat per nautical mile trawled in a shot.	Move on rule triggered. Cease fishing in the area and report coordinates for the area trawled during shot to the Department such that a notice can be distributed to all active vessels to avoid area. Return to historically fished prawn grounds until additional habitat assessments have been conducted.
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, • catch levels, • number of reported ETP species interactions, • extent of area trawled annually, and • other available research. 	Target: Fishing impacts are expected to generate an acceptable level of risk (i.e. moderate risk or lower) to the ecosystem.	Continue management aimed at achieving ecological, economic and social objectives.
				Threshold: A potentially material change to risk levels is identified, and/or Fishing impacts are considered to generate an undesirable level of risk (i.e. high risk) to the ecosystem.	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 (i.e. severe risk) to the ecosystem.	Review the reasons for this variation within one month and develop an appropriate management response to reduce the risk to an acceptable level as soon as practicable.

³ Structurally complex and/or ecological vulnerable habitats (e.g. seagrass, sponges, corals)

3.5 Fishery Performance

Defining annual tolerance levels for fisheries provides a formal but efficient basis to evaluate the effectiveness of current management arrangements in delivering the levels of catch and/or effort specified by the HCRs and, where relevant, any sectoral allocation decisions (Fletcher et al. 2016). In line with the principles of ESD, this fishery-level review process 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.

A broad catch tolerance range of 1350 – 2150 t for both target species combined has been developed for the SBPMF, based on historical variations in fishing operations. Catches of western king and brown tiger prawns are also compared annually to a predicted catch range resulting from the recruitment indices for each species. The catches relative to these tolerance levels are reviewed annually and published in the State of Fisheries and Aquatic Resources Report and in the Department's Annual Report to the WA Parliament. If the annual catch falls outside the tolerance range and this cannot be adequately explained (e.g. clear environmental or market-induced impacts), the performance is termed 'Unacceptable'. This result would 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 HCRs and/or tolerance levels.

The economic and social objective for the SBPMF does not currently have explicit performance measures within the harvest strategy. Regulatory impediments to maintaining or enhancing economic return, and maximising social benefits of fishing, are discussed during formal consultation processes and setting of season arrangements. This broadly considers the ability of fishers to retain prawns at times when it is most economically favourable (based on the size and quality of prawns, as well as other retained species), combine prawn trawl effort with other Shark Bay trawl fisheries to create operational efficiencies and minimising the interaction with other fishing fleets in Shark Bay.

3.6 Monitoring and Assessment Procedures

3.6.1 Information and Monitoring

3.6.1.1 Commercial Fishing Information

Fishers are required to report all retained species catches, effort, any ETP species interactions and fishing location (detailed shot-by-shot latitude and longitude) in daily logbooks, which have been in place since the fishery began in the 1960s and became compulsory in the fishery in 2008. These logbooks are used to provide information on the daily catch (kg) and grade categories of each target species and effort (hours trawled) expended in specific fishing areas. Verification of catches recorded in logbooks has been undertaken against processor returns, which are submitted to the Department by the processor on a monthly/fishing period basis.

Fishers with allocated quota of blue swimmer crabs and saucer scallops are now also required to fill in a Catch and Disposal Record (CDR) when landing catch of these species.

The Department uses VMS to monitor fishing activities in the fishery as part of its compliance plan (see Section 5.0) and to determine the spatial extent of fishing. Although there have been no major gear changes in the SBPMF for a number of years (i.e. number of nets or headrope length), fishing efficiency has likely increased through advances in GPS and contour mapping technology, use of bigger boats and provision of annual survey information to allow skippers to focus on higher abundance areas with less exploration. For these reasons, fishery-independent survey data are considered a more reliable indicator of abundance than fishery-dependent catch rate data.

3.6.1.2 *Recreational Fishing Information*

Surveys of all boat-based recreational fishing in WA have been undertaken periodically since 2011/12 to provide bioregional estimates of recreational boat-based catches (e.g. Ryan et al. 2019).

3.6.1.3 *Fishery-Independent Information*

Fishery-independent trawl surveys are undertaken in Shark Bay each year to monitor the recruitment and spawning stock levels of brown tiger and western king prawns. Monitoring is conducted by Department staff using commercial fishing boats or the Department's R.V. *Naturaliste*. The timing of surveys and the sites sampled have been determined based on the understanding of the biology and movement patterns of the western king and brown tiger prawns in Shark Bay, historical fishing patterns, early research surveys and the natural topography of the embayment. At each survey site, the actual catch of each prawn species and their size grade is recorded, and a representative sample of each species is collected from each trawl to provide information on size composition and sex ratios. During spawning stock surveys (see below), data are also collected on the reproductive stage of female prawns in the survey catch.

3.6.1.4 *Recruitment Surveys*

Two fishery-independent recruitment surveys are undertaken each year, generally in March and April, to monitor the annual recruitment of western king and brown tiger prawns to the fishery area. Each survey includes sites across the main fishing grounds to the east of the CPL. At each survey site, catch rates and size structure information (grades and length frequencies) are collected. The mean catch rate for the sites sampled for each target species are used as indices of recruitment strength and provide an indication of likely catch ranges for the season. These data are also used, together with size information, to inform the extent and timing of fishing for the season, particularly for areas within the CPL (e.g. NCPL and SCPL).

3.6.1.5 *Spawning Stock Surveys*

Fishery-independent spawning stock surveys are undertaken each year during the key spawning period (June – September) to monitor the annual spawning stocks of

western king and brown tiger prawns in the fishery area. These surveys are conducted in the NCPL and SCPL (June, July/August and September) and the CCPL (June) as these are the key brown tiger prawn spawning areas and provide a proxy spawning index for western king prawns whose distribution is more extensive to the west of the NCPL. The mean catch rates of both target species from the NCPL in the June and August surveys are used as spawning stock indices which act as proxies for spawning stock biomass and are used to assess stock status.

3.6.1.6 *Denham Sound Surveys*

Fishery-independent surveys are also undertaken in Denham Sound as part of the June and July/August surveys to assess prawn abundance prior to fishing in the area. The data collected during the July/August survey is also used to determine the potential extension to the southern boundary of Denham Sound, Snapper Trawl Line (STL).

3.6.2 Assessment Procedures

3.6.2.1 *Target Species*

The stock status of western king and brown tiger prawns in Shark Bay is assessed annually using a weight of evidence approach considering inter-annual and within-season trends in spawning stock abundance, recruitment levels and catch as well as other available information.

The spawning stock index for brown tiger and western king prawns obtained from the June and August spawning stock surveys is used as the primary performance indicators to assess stock status of each species. These indices are assessed against reference points to determine the success of the season's arrangements in maintaining an adequate spawning stock biomass. Maintaining spawning stock biomass at the target level is aimed at limiting fishing impacts so the main driver for the level of recruitment in the following season is environmental (or other) factors. Although spawning stock abundance is the primary indicator for fishery impacts on stock biomass, other information, such as fishery performance and environmental data may provide insights on other factors impacting the stock that are taken into consideration when assessing stock status and developing season arrangements.

In order to ensure adequate protection of prawn spawning stocks, information from the fishery-independent recruitment surveys during the start of the fishing season is used to review the appropriateness of the season arrangements. Information from the June spawning stock survey is used to provide a measure of abundance of prawns in the NCPL at the start of the brown tiger prawn spawning season which provides a preliminary spawning stock index. This is used as to assess progress towards achieving the target spawning stock index for both species. The catch rate of both target species in the SCPL from the June survey further informs in season decision making due to annual variation in the distribution of prawns and the proportion of the stock within the NCPL, CCPL or the SCPL during spawning stock surveys.

3.6.2.2 *Other Retained Species*

Other key species retained by fishers in the SBPMF that also hold licences in the SBSMF and/or SBCMF include saucer scallops (*Y. balloti*) and blue swimmer crabs (*P. armatus*), respectively. The catches of these species in Shark Bay are managed through quotas in the SBSMF and SBCMF and are assessed annually as part of separate harvest strategies focused on the scallop and blue swimmer crab resources (DPIRD 2020b,c).

The retained catch of other penaeid prawn species (excluding the target prawn species) by the SBPMF is monitored annually and compared to the total retained catch in the SBPMF. If the catch of any individual penaeid species exceeds 5% of the total retained catch, a review will be undertaken to examine the reasons behind the variations and determine if the risk to these species, which is assessed periodically as part of ERAs (see below), has increased to an unacceptable level.

3.6.2.3 *Habitats*

The spatial extent of fishing in the SBPMF is calculated annually using fishery-dependent logbook data and the Department's VMS. The spatial location of fishing is plotted using the VMS data which is trimmed to the start and end times of fishing, as recorded in the fishery-dependent logbook data. This fine-scale spatial effort data can be used to determine the annual footprint of the fishery, to assess if it has exceeded the threshold level of 20% of Inner Shark Bay.

Fishery independent surveys and fishery dependant reporting are also used to monitor for the presence of sensitive habitats within the SBPMF. This information may be used when developing season arrangements and during in-season reviews to set or adjust arrangements to minimise risk of impact to these sensitive habitats.

3.6.2.4 *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 ERA for the overall Shark Bay invertebrate resource was most recently undertaken in September 2019 (DPIRD 2020a). The risk assessment considered the impacts of the key fishing sectors targeting the resource (prawn trawl, scallop trawl and crab trap) on the ecosystem, assessed both individually and cumulatively. The risks of prawn fishing to most of the ecological components (other than the target species) were assessed as Negligible or Low risk (DPIRD 2020a). Fishing impacts on sea snakes and trophic interactions (through discarding/provisioning) were scored as a Medium risk, which are still considered acceptable. The cumulative risks of the fishing sectors on these ecosystem components were all determined to be acceptable.

Risk assessments for the SBPMF will continue to be undertaken periodically (at least every five years) to reassess any current or new issues that may arise in this fishery. 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.

4.0 Management Measures and Implementation

4.1 Management Measures

Table 3 lists the management measures in place for the fisheries that target the Shark Bay prawn resource. These measures can be amended as needed to ensure management objectives are achieved, however, they do not preclude the consideration of other options.

Table 3. SBPMF management measures and instruments of implementation

Measure	Description	Instrument
Limited entry	A limited number of Managed Fishery Licenses (18) are permitted to operate in the SBPMF.	SBPMF Management Plan
Effort restrictions	The fishery currently operates under a maximum headrope capacity of 724 metres (396 fathoms).	SBPMF Management Plan FRMA (Section 7 Exemptions)
Gear controls	Include controls on boat length, maximum headrope length (58.4m), maximum size of the ground chain (10 mm diameter) and the dimensions of the otter boards, including metal shoes.	SBPMF Management Plan FRMA (Section 7 Exemptions)
Bycatch Reduction Devices (BRDs)	The fleet is required to have BRDs in the form of grids and fish exclusion devices (FEDs), such as an opening made of square mesh panels, in all standard nets.	MFL Condition
Restrictions on number of fishing days	The fishery is closed to fishing between October and March each year, with the number of fishing days specified annually in the season arrangements	SBPMF Management Plan (clause 10 determination)
Spatial closures	Parts of Shark Bay are permanently closed to trawling activities to preserve seagrass and other sensitive habitats that are essential nursery areas for prawns and other species. There are also two Port Area Closures in place within three nautical miles of Carnarvon and Denham.	SBPMF Management Plan
	There are permanent trawling closures in Hamelin Bay as part of the Shark Bay Marine Park.	Section 43 order (Shark Bay Marine Park)
	Statutory and Non-statutory spatial closures in the management areas are used throughout the season to provide protection to prawns at key stages of the lifecycle and achieve economic objectives.	SBPMF Management Plan (clause 10 determination) Co-operative arrangement (non-statutory)

Measure	Description	Instrument
Temporal closures	Fishing is only permitted at night, as prawns are nocturnal. Fishing closures also occur around each full moon.	SBPMF Management Plan (clause 10 determination) Co-operative Agreement
Reporting	Fishers are required to report all retained (target and non-target) species catches, effort, ETP species interactions vulnerable habitat interactions and fishing location in statutory daily logbooks.	FRMR
Monitoring	Fishing activities are also monitored via the satellite Vessel Monitoring System (VMS) and the master must submit a nomination of intention to enter the fishery via VMS.	SBPMF Management Plan

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 Shark Bay prawn resource:

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

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

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 (SLA) to undertake their representation / advisory and consultation roles.

4.2.1.1 Commercial Sector Consultation

Under its SLA with the Department, WAFIC has been funded to undertake statutory consultation functions related to fisheries management and the facilitation of management meetings for licensed fisheries such as the SBPMF.

Consultation with licence holders is required before changes can be made to the SBPMF Management Plan and determinations made by the Department's Director General under clause 10 of the Management Plan cannot be given effect.

Annual Management Meetings (AMMs) between the Department, WAFIC and licence holders in the SBPMF are generally held after each fishing season and are an important forum to consult on the management of the fishery. 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 setting. Follow-up meetings may be held as required.

The Department works closely with licence holders to develop the annual season arrangements for the SBPMF and undertake in-season reviews. The framework for undertaking these processes and associated consultation is shown in Appendix 2 and 3 respectively.

The Department also holds meetings on an "as needs" basis with licensees. These meetings could be with the licensees or skippers and include activities such as season arrangement workshops and skipper's briefings.

4.2.1.1.1 Annual Consultation and Decision-Making (Season Arrangements)

Annual seasonal arrangement decisions are based primarily on maintaining sustainable stocks, while providing the opportunity for industry to maximise economic returns from the prawn resource.

The Department consults with industry to discuss the previous season and develop the forthcoming season's fishing arrangements including season opening and closing dates, moon closure periods and survey dates. Proposed season arrangements are then provided to the Executive Director Fisheries and Agriculture Resource Management for consideration and approval (Appendix 2).

4.2.1.1.2 In-Season Consultation and Decision-Making

Further to the permanent closures in the SBPMF, spatial closures are used during the season to control, manage and direct fishing effort. Decisions around in-season spatial areas openings and closures are primarily based on maintaining breeding stocks of brown tiger and western king prawns (i.e. ecological objective), while providing the opportunity for industry to harvest optimum size/value prawns (i.e. economic objective). Performance indicators and control rules used to open and

close areas are determined in consultation with industry and documented as part of the development of the annual season arrangements.

The Department conducts in-season reviews with all licence holders following the recruitment surveys and first spawning stock survey to review the appropriateness of the season arrangements. The process for undertaking these reviews is shown in Appendix 3.

4.2.1.2 *Voluntary Closures*

Voluntary arrangements (non-statutory) may be used during the season to open and close area creating a more responsive management framework through facilitating rapid decision making in response to survey results. Based on a cooperative framework, the Department and industry collaborate to determine the timing, extent and criteria for of voluntary area openings and closures. These arrangements may be developed as part of the annual season arrangements or during in-season reviews.

4.2.1.3 *Communication of season arrangements*

The Department provides detailed season arrangement to licence holders prior to the commencement of the season. 'Moon letters' detailing operational arrangements for each fishing period are provided to licence holders for distribution to skippers prior to the commencement of each fishing period. VMS messaging may also be used to provide information directly to skippers as required.

4.2.1.4 *Consultation with Other Groups*

Consultation on prawn management with Recfishwest, 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 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.

As parts of the prawn fishery operates within the Shark Bay World Heritage Area and the Shark Bay Marine Park, key stakeholders identified in accordance with the Stakeholder Engagement Guideline include the Shark Bay World Heritage Advisory Committee and Department of Biodiversity, Conservation and Attractions.

5.0 Compliance and Enforcement

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

- Maximising voluntary compliance.
- Effective deterrence.
- Organisational capability and capacity.

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

5.1 Operational Compliance Plans

Management arrangements for the SBPMF are enforced under an Operational Compliance Plan (OCP) that is informed and underpinned by a compliance risk assessment and is reviewed every 1-2 years. The objectives of the SBPMF OCP are to:

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

5.2 Compliance Strategies

Compliance strategies and activities that are used in the fishery include:

- Land and sea patrols.
- Catch validation against managed fishery licences.
- Inspections of wholesale and retail outlets.
- Inspections at processing facilities.
- Inspections of vessels in port and pre-season briefings.
- At sea inspections of fishing boats.
- Closed area/season monitoring via VMS.

Inspections may involve inspection of:

- All compartments on board the vessels;

- All authorisations;
- Logbooks; and
- Catch on board the boat.

5.2.1 Vessel Monitoring System (VMS)

Boats operating within the SBPMF require a VMS and need to be fitted with a device known as an automatic location communicator (ALC). The ALC is used to track the location of a boat by transmitting information such as the geographical position, course and speed of the boat to VMS compliance officers at the Department.

The use of VMS in the SBPMF allows the Department to carry out real-time monitoring of the SBPMF fleet's adherence to spatial closures, provides intelligence for investigations and provides information and analysis to the science and management branches on vessel activities and patterns.

6.0 References

- 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.
- DPIRD (2018). Fisheries compliance strategy. Department of Primary Industries and Regional Development (DPIRD), Western Australia.
- DPIRD (2020a). Western Australian Marine Stewardship Council Report Series No. 16: Ecological Risk Assessment of the Shark Bay Invertebrate Fisheries. Department of Primary Industries and Regional Development (DPIRD), Western Australia.
- DPIRD (2020b). Scallop Resource of Shark Bay Harvest Strategy 2020-2025. Fisheries Management Paper No. 301. Department of Primary Industries and Regional Development (DPIRD), Western Australia.
- DPIRD (2020c). Blue Swimmer Crab Resource of Shark Bay Harvest Strategy 2020-2025. Fisheries Management Paper No. 300. Department of Primary Industries and Regional Development (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, 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.

- Francesconi, K. A., Clayton, D. (1996). Shark Bay World Heritage Area – management paper for fish resources. Fisheries Management Paper No. 91. Department of Fisheries, WA.
- Grey, D., Dall, W., Baker, A. (1983). A guide to the Australian Penaeid Prawns. Darwin: Department of Primary Production, Northern Territory.
- Kangas, M.I., and Jackson, W.B. (1998). Sampling juvenile *Penaeus latisulcatus* Kishinouye with a water-jet net compared with a beam-trawl: spatial and temporal variation and nursery areas in Gulf St Vincent, South Australia. *Marine and Freshwater Research* 49(6): 517-523. <https://doi.org/10.1071/MF98038>
- Kangas, M., and Thomson, A. (2004). Implementation and Assessment of Bycatch Reduction Devices in the Shark Bay and Exmouth Gulf Trawl Fisheries. Final Report on FRDC Project No. 2000/189. Perth: Department of Fisheries, WA. 70 pp.
- Kangas, M.I., Morrison, S., Unsworth, P., Lai, E., Wright I., Thomson A. (2007). Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. Final FRDC Report 2002/038. Fisheries Research Report No. 160. Perth: Department of Fisheries WA, 333 pp.
- Kangas MI, Sporer EC, Hesp SA, Travaille KL, Brand-Gardner SJ, Cavalli P, and Harry AV. 2015. Shark Bay Prawn Managed Fishery, Western Australian Marine Stewardship Council Report Series 2: 294 pp.
- Kenyon, R.A., Loneragan, N.R., Hughes, J.M., Staples, D.J. (1997). Habitat type influences on the microhabitat preferences of juvenile brown tiger prawns (*Penaeus esculentus* and *Penaeus semisulcatus*). *Estuarine and Coastal Shelf Science* 45: 393-403.
- Penn, J.W. (1980). Spawning and fecundity of the western king prawn, *Penaeus latisulcatus*, Kishinouye, in Western Australian waters. *Australian Journal of Marine and Freshwater Research* 31: 21-35.
- Penn., J.W., Caputi, N. (1986). Spawning stock-recruitment relationships and environmental influences on the brown tiger prawn (*Penaeus esculentus*) fishery in Exmouth Gulf, Western Australia. *Australian Journal of Marine and Freshwater Research* 37: 491-505.
- Penn, J. W., and Stalker, R. W. (1975). A daylight sampling net for juvenile penaeid prawns. *Australian Journal of Marine and Freshwater Research* 26, 28791.
- Penn, J.W., Stalker, R.W. (1979). The Shark Bay prawn fishery (1970-1976). Report No. 38. Department of Fisheries and Wildlife, WA, 38 pp.
- Richardson, B.J. (1982). The geographical distribution of electrophoretically detected protein variation in Australian commercial fisheries. III Western king prawn (*Penaeus latisulcatus* Kishinouye). *Australian Journal of Marine and Freshwater Research* 33: 933-937.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., 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, South Australia.

Walker, D.I. (1989). Regional studies - seagrass in Shark Bay, the foundation of an ecosystem. pp. 182–210. *In*: A.W.D. Larkum, A.J. McComb & S.A. Shepherd (ed.) *Biology of Seagrasses*, Elsevier, New York.

Ward, R.D., Ovenden, J.R., Meadows, J.R.S., Grewe, P.M., Lehnert, S.A. (2006). Population genetic structure of the brown tiger prawn, *Penaeus esculentus*, in tropical northern Australia. *Marine Biology* 148: 599-607.

Appendix 1

Bycatch Action Plan 2022-2027

Bycatch is the part of the catch, which is returned to the sea (usually referred to as non-retained or discarded) either because it has no commercial value or because legislative requirements preclude it being retained. In the SBPMF, this includes unmarketable finfish and invertebrate species, along with ETP species such as marine mammals, reptiles and some elasmobranchs. Further information on the fishery's bycatch and interactions with ETP species is provided in the ERA (DPIRD 2020).

In line with Government policy to minimise bycatch in all commercial fisheries, Bycatch Reduction Devices (BRDs) have been mandatory in trawl nets used by the SBPMF since 2002/03. The fishery also aims to return to the water any bycatch alive and in the best possible condition. Some species are less robust than others, with survival rates of returned finfish thought to be lower than many invertebrates (e.g. crustaceans; Kangas et al. 2007). Predatory fish feeding on discards may also have a marked impact on survival rates. The introduction of in-water holding tanks and conveyor systems on the SBPMF trawlers in 2002 has made a substantial improvement on the number of non-target species returned to the water alive.

The SBPMF Bycatch Action Plan (BAP), provided in Table 1, is designed to address risks to non-retained species identified in the most recent ERA, EPBC assessment (WTO export approval) and the 2020 MSC re-assessment. The ERA also provides explanations of actions attributable to each ERA risk rating, which are considered in the development of proposed additional activities listed in Table 1. The objective of the BAP is to:

- Develop and implement cost-effective strategies to pursue continual improvement in reducing bycatch;
- Review relative changes in bycatch due to bycatch mitigation and extend information on best practice to industry;
- Develop measures to further reduce interactions with, or impacts on, ETP species;
- Respond to adverse impact on Shark Bay ecology from prawn fishing activity; and
- Develop measures to better utilise the component of the catch that would otherwise be discarded.

Key ongoing elements of the BAP include the following, which are described in more detail below:

- 1) Gear controls.
- 2) A Bycatch Monitoring Program (BMP) to validate the Fishery's mandatory reporting of ETP species and composition of non-ETP bycatch.

- 3) Research Program to improve understanding of priority ETP species in Shark Bay and performance of BRDs.
- 4) Better reporting of interactions with ETPs, focussing on species identification and indication of condition status, and continued high-quality reporting.

Gear Controls

Gear controls in place that are linked to bycatch reduction include:

- A maximum ground chain link diameter of (10 mm) to address the impact the chain has on benthic habitat and non-target species.
- A maximum otter board height to restrict the vertical net opening and facilitate escapement of non-target species over the top of the net.
- A maximum board length to address shoe contact with the benthic habitat and non-target species.
- The use of a Texas drop chain arrangement to promote passage of unwanted flora and fauna underneath the net.
- The mandatory use of turtle exclusion devices (TEDs) (grids) in all nets.
- The mandatory use of fish exclusion devices (FEDs) (square mesh panels) in all nets.

Bycatch (Non-retained and ETP species) Monitoring Program

The BMP is an ongoing collaborative program between the Department and the commercial fishing industry. The key objectives of the BMP are to:

- use the results of ongoing monitoring programs to determine if the results from previous assessments remain relevant; and
- develop protocols to improve consistency of reporting of all ETP species interactions in the fishery.

The information collected on bycatch and ETP species interactions will be used to assess whether the risk to Shark Bay marine communities potentially posed by the fishery are acceptable or not through ongoing ERA processes.

Monitoring of bycatch species will be conducted through a combination of sampling methods to provide the most cost-effective approach to assess the sustainability of all major bycatch groups, including:

- fishery-dependant monitoring (via mandatory crew logbook reporting) of all ETP species, with particular emphasis on improved reporting of sea snake and sawfish interactions and return status of all ETP animals;
- fishery-independent monitoring of ETP species interactions during fishery-independent surveys to validate fishery-dependant reporting;
- fishery-independent surveys to collect non-ETP bycatch species composition data every five years; and
- support for the industry-led Crew-member observer program (CMOP).

The most recent quantitative ERA conducted in 2019 assessed the fishery-induced risks to selected bycatch and ETP species. The continued development and

undertaking of ERAs will ensure targeted measures can be developed to address remaining and emerging ecological risks in the SBPMF. ERAs are repeated every five years, to ensure they remain relevant and provide accurate and ongoing demonstration of risks for all bycatch species.

Reference levels, triggers and management actions will be developed as needed based on ERA outcomes. Alternative management strategies may also need to be developed for rare species that cannot be robustly assessed using the above BMP.

The BMP will be reviewed periodically as part of the ERA review process and adapted to address the cost effectiveness of the program and needs of fishery management. This includes the removal or addition of species in the monitoring program according to their revised risk levels and the use of upgraded risk assessment techniques.

Research Program

The Department have collaborated with the fishing industry and academic institutions in developing research projects to assess the sustainability of bycatch and reduce capture of ETP species. Ongoing projects are on an adaptive basis,

The key objectives of the research program are to:

- improve the understanding of fishery impacts to ETP species (particularly sea snakes);
- engage with external stakeholders to provide estimates of ETP species' population size within Shark Bay; and
- provide support for further BRD development and testing of effectiveness for reducing bycatch.

Previous research in the fishery has focused on reducing the capture of large ETP species, such as sea turtles, through the implementation of grids in trawl nets. However, grids have not been shown to significantly reduce the catch of sea snakes to acceptable levels in this or similar fisheries. Further, there is limited information on sea snake populations within Shark Bay or on the impact of the fishery on these populations. To improve understanding, the Department has developed and implemented an industry education program to increase awareness of the importance of sea snake protection, promote sensible handling techniques and improve species identification through sea snake identification training (to the species level). This forms part of the CMOP.

Additionally, the Department will engage the appropriate agencies to encourage actions that result in an estimation of the population of sea snake species within Shark Bay to improve the risk assessment process and / or determine an estimate of the acceptable level of sea snake bycatch in the SBPMF.

Table 1: SBPMF Bycatch Action Plan (2022 – 2027)

Component	Fishery objective	Current information	Current activities	ERA risk ranking	Proposed additional activities
Bycatch (non-ETP species)	To ensure fishery impacts do not result in serious or irreversible harm to bycatch species populations.	<ul style="list-style-type: none"> • Bycatch data (species lists and level of bycatch) from BRD trials in 2000 – 2003. • Bycatch interactions as reported by fishers in daily logbooks. • Fishery independent survey data. • 2015-21 bycatch survey. 	<ul style="list-style-type: none"> • Conduct fishery-independent surveys (i.e., Departmental staff) to collect bycatch (non-retained) species composition data every five years. • Continue to support the industry-lead development, testing and assessment of the effectiveness of BRDs and alternative bycatch mitigation measures in reducing fishery bycatch in accordance with the industry-led MSC continuous improvement program. • Support industry to investigate alternate measures to reduce incidental mortality of captured bycatch species. 	Negligible-to-low for all bycatch species.	No additional.
ETP species	To ensure fishing impacts do not result in serious or irreversible harm to ETP species' populations.	<ul style="list-style-type: none"> • ETP species interactions as reported by fishers in daily logbooks; return status also monitored. • Fishery independent survey data. 	<ul style="list-style-type: none"> • Continue to use ETP interactions in fishery independent surveys (i.e. Departmental staff) to validate fishery dependant ETP data. • Continue to support the industry-led development, testing and assessment of the effectiveness of BRDs and alternative bycatch mitigation measures in reducing fishery bycatch in accordance with the industry-led MSC continuous improvement program. • Support industry to investigate measures to reduce incidental mortality of captured ETP species. • Provide species level identification and training materials for skippers and crew. 	Negligible-to-low for all bycatch species, except for sea snakes, which was ranked medium.	• No additional.

Component	Fishery objective	Current information	Current activities	ERA risk ranking	Proposed additional activities
			<ul style="list-style-type: none"> Engage with external stakeholders to estimate impacts of the fishery on ETP species within Shark Bay. Continue support for industry-run CMOP 		
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.	<ul style="list-style-type: none"> VMS data. Logbook data. Existing habitat maps. 	<ul style="list-style-type: none"> Monitor and report on annual trawl footprint, overlaid with benthic habitat maps, assessing the fishery's potential interactions with habitat types. 	Negligible-to-low for all habitat types.	No additional.
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecosystem processes.	<ul style="list-style-type: none"> Biodiversity and community composition data for trawled and un-trawled areas of Shark Bay from 2004. 2015-21 bycatch survey. 	<ul style="list-style-type: none"> Monitor fishery impacts at component level (as part of harvest strategy). Conduct fishery-independent surveys (i.e. Departmental staff) to collect bycatch (non-retained) species composition data every five years. 	Negligible-to-low for all ecosystem structures except for trophic interactions — discarding & provisioning, which was ranked as medium.	No additional.

Table 2: SBPMF bycatch mitigation summary

Bycatch mitigation in place	Planned action
Grids (TEDs)	<ul style="list-style-type: none">• Monitor on ongoing basis• Support trialling and assessment of alternative BRD designs
Fish Escape Panels (FEDs)	<ul style="list-style-type: none">• Monitor on ongoing basis• Support trialling and assessment of alternative FED designs
Reporting of ETP and bycatch species	<ul style="list-style-type: none">• Extent and uniformity of reporting to be reviewed.• Promote improved species identification.• Improve completeness and accuracy of mandatory reporting
Use of return hoppers	<ul style="list-style-type: none">• Ongoing.• Return of bycatch ASAP to minimise mortality, injury or other adverse impacts
Seasonal and/or spatial closures	<ul style="list-style-type: none">• Monitor on ongoing basis
Industry education and promotion	<ul style="list-style-type: none">• Continue industry run CMOP• Support ongoing training and development
Monitoring of new bycatch reduction strategies and technology	<ul style="list-style-type: none">• Ongoing
Limit total area trawled	<ul style="list-style-type: none">• Monitor on ongoing basis

Appendix 2

Principles for Setting Annual Season Arrangements

Background

Annual development of Season Arrangements is undertaken by the Department of Primary Industries and Regional Development (Department) in consultation with the SBPMF licence holders. The process for the development of the Season Arrangements and consultation with industry is shown in Figure 1.

Development of season arrangements is conducted following a review of the previous fishing season. Arrangements are primarily guided by performance of the Spawning Stock Index (SSI) for western king and brown tiger prawns as well as consideration of arrangements and performance from previous seasons and advice from industry.

Arrangements are set in January/February each year and are reviewed shortly after the season commences as part of the April Review following the Recruitment Index for western king and brown tiger prawns with arrangements revised as considered appropriate. Progress toward achieving the desired SSI reference level is reviewed following the first spawning stock survey which provides a preliminary SSI to inform suitability of arrangements for the remainder of the season.



Figure 1 Annual cycle for setting and reviewing season arrangements.

Objectives

The key aim of the season arrangements is to achieve the ecological objectives for the western king and brown tiger prawns which is:

To maintain spawning stock biomass of each target species stocks at a level where the main factor affecting recruitment is the environment.

Season arrangements are also developed with regard for other ecological, economic and social objectives.

Considerations

The primary consideration for development of the season arrangements is the stock status of the western king and brown tiger prawns. The key performance indicator for measuring stock status is the SSI, combined with an overall weight of evidence assessment of stock status. Development of season arrangements also takes into consideration previous season's arrangements and performance as well as other available information including:

- Fishery independent survey information
- Fishery dependent catch information
- Size of prawns
- Depletion rates
- Spatial fishing information (VMS and logbook)
- Previous in-season decision points and associated criteria and outcomes
- Analysis and results of research projects
- Environmental data

Arrangements also consider opportunities to maximise economic and social outcomes for the fishery. Economic considerations will be guided by industry but may include targeting prawns at particular size for greatest value and/or increased yield and opportunity to take saucer scallop and blue swimmer crab as part of prawn trawling.

Principles

Guiding principles

Standard, Precautionary and Recovery principles provide preliminary guidance for setting season arrangements. Based on the level of performance of either western king or brown tiger prawns against the SSI Target, Threshold or Limit, season arrangements are developed based on Standard, Precautionary or Recovery principles taking into consideration previous season's arrangements and outcomes. Precautionary principles may also be adopted where the fishery is considered to be under-performing. Fishery performance will be based on the review of previous seasons and consideration of overall catch, catch in relation to catch predictions, size of prawns, other relevant information and consideration of the SSI and Recruitment Indices.

Season arrangements and associated guidelines for in-season decision making established under Standard, Precautionary and Recovery management principles will all endeavour to achieve the following:

- Provide adequate protection for small recruiting prawns.
- Provide adequate protection to key spawning areas and escapement into these areas for peak spawning periods.
- Aim for whole/larger area openings and avoid small/partial area openings.
- Provide flexibility for in-season adjustments based on scheduled survey results.
- Seek to maximise economic return without compromising ecological objectives.
- Provide clear objectives and criteria to guide in-season decision making.
- Identify timing for surveys and distribution of associated information.

Table 1: Principles for setting season arrangements under Standard, Precautionary and Recovery arrangements

<p><u>Standard principles</u></p> <p>Where both species are above the SSI threshold (considered to be sustainable), standard principles will be applied, aimed at maintaining spawning stock biomass above the threshold and achieving ecological, economic and social objectives.</p>	<p><u>Precautionary principles</u></p> <p>If either species has a SSI below the threshold (i.e. considered to be depleting or recovering), Precautionary principles are applied aimed at returning the SSI to above the threshold by the end of the season.</p>	<p><u>Recovery principles</u></p> <p>Where either species falls below the limit (i.e. considered to be depleted), recovery principles are applied to achieve target SSI levels set out in the Recovery Strategy .</p>
<p>Standard principles will:</p> <ul style="list-style-type: none"> • Have flexibility over season start and end dates for industry consideration. • Aim for minimum seven-day moon breaks over the full moon. • Provide increased opportunity for consideration of economic and social objectives, including use of voluntary arrangements. • Provide increased flexibility for consideration of alternative spatial and temporal fishing arrangements to achieve ecological and/or economic objectives. 	<p>Precautionary principles will:</p> <ul style="list-style-type: none"> • Focus on arrangements to achieve the target SSI by the end that season. • Have more restrictive season start and/or end dates. • Aim for a minimum of seven-day moon breaks over the full moon. • Consider increased spatial or temporal protection of spawning and juvenile prawns. • Consider season structures that provide required protection as well as opportunity to improve access in response to in season survey results. • Provide less opportunity for consideration of economic and social objectives. <p>Where Precautionary arrangements are triggered for a second year in a row, additional or alternative management measures will be considered to reduce overall effort and improve the likelihood of achieving and sustaining the target SSI by the end of that season.</p>	<p>Recovery principles will:</p> <ul style="list-style-type: none"> • Focus on arrangements to achieve Recovery Strategy targets, primarily by reduction in overall effort. • Have more restrictive season start and/or end dates. • Aim for a minimum of seven-day moon breaks over the full moon. • Consider increased spatial or temporal protection of spawning and juvenile prawns. • Consider alternative management arrangements to improve the likelihood of achieving and sustaining recovery targets. • Consider season structures primarily aimed at providing required protection. • Provide limited opportunity for consideration of economic and social objectives.

In-season Review

Two key reviews of fishery performance will be undertaken during the season, the April and the June review. These reviews are conducted by the Department with licence holders to evaluate and discuss fishery performance and appropriateness of fishing arrangements. The April review is conducted following fishery independent recruitment surveys and focuses on the appropriateness of the full season arrangements and specific arrangements to meet economic and social objectives. The June review is conducted following the first spawning stock survey and focuses on progress toward achieving the target SSI and appropriateness of arrangements for the remainder of the season to achieve this.

Guidelines

Each season's arrangements will include guidelines to aid in-season decision making and evaluation of fishery performance at review points. These guidelines may include control rules aimed at achieving short term ecological, economic and social objectives, generally to be applied as part of in-season reviews in response to fishery independent survey results. Control rules may also be established to take effect outside of these reviews and be established at industry's request. This allows for dynamic and flexible decision making based on survey results and fishery observations. In time, fishery dependant information may be incorporated into in-season decision making as processes evolve to make availability of this data more timely.

The need for in-season adjustment of fishing arrangements may require regulatory changes. Where possible, the season arrangements and guidelines for in-season decision making will be structured to try and minimise the potential regulatory burden. Voluntary arrangements may be used in some circumstances through cooperative agreement between licence holders and the Department. The Department will monitor compliance of voluntary arrangements using available means to assess to appropriateness of this management framework and provide any breaches of these rules to industry as appropriate.

Review

These Principles will be reviewed as required, or as part of the review of the resource Harvest Strategy, in consultation with SBPMF licence holders.

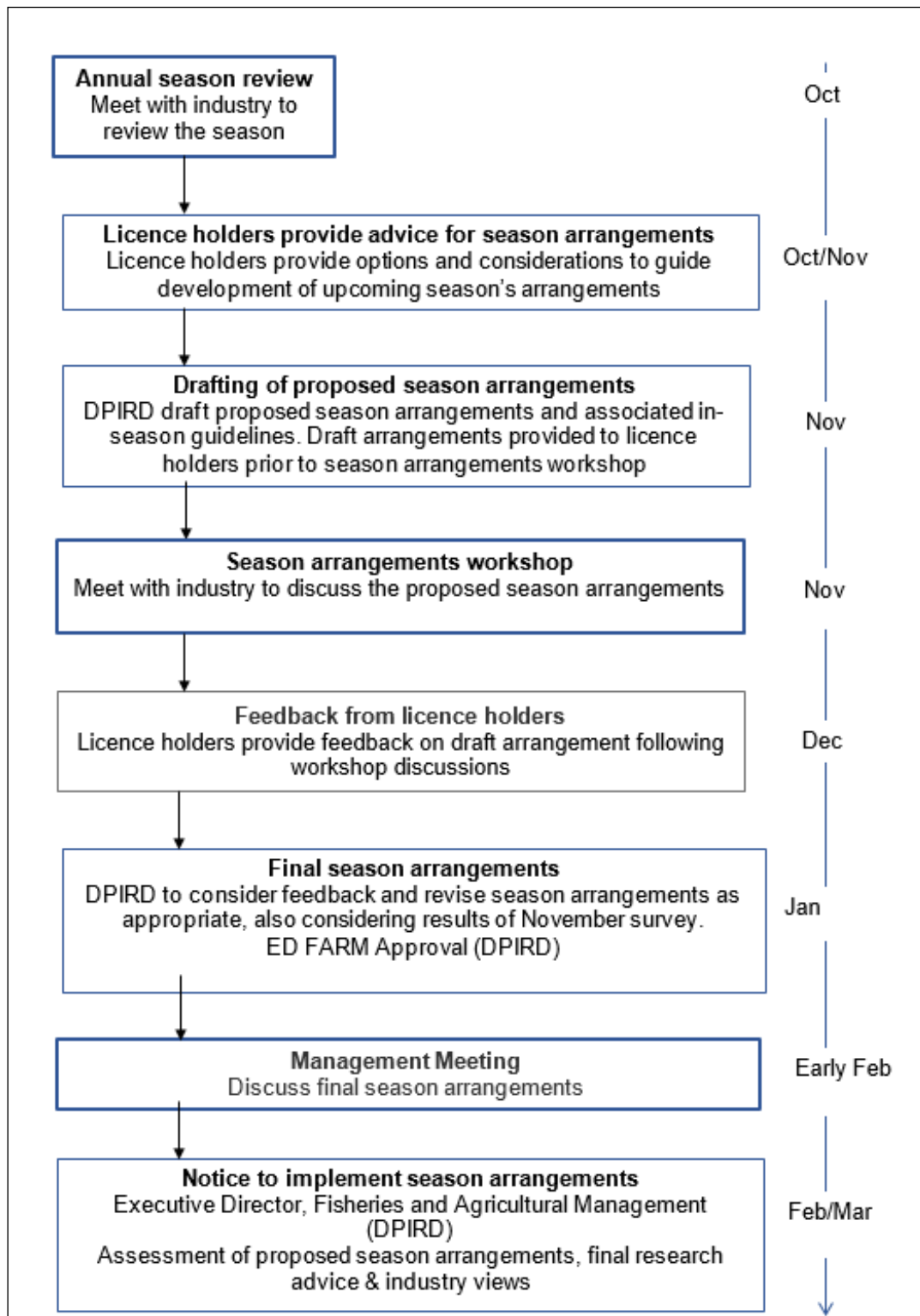


Figure 2: Process for the development of Shark Bay Prawn annual season arrangements

Appendix 3

In-Season Review Process - April

Purpose: To review the aspects of the season arrangements outlined below, in light of the recruitment index for western king and brown tiger prawns derived from the March/April surveys:

- total number of nights allocated to fishing;
- appropriateness of scheduled spatial openings and closures;
- opening of the North CPL; and
- opening of the Central CPL.

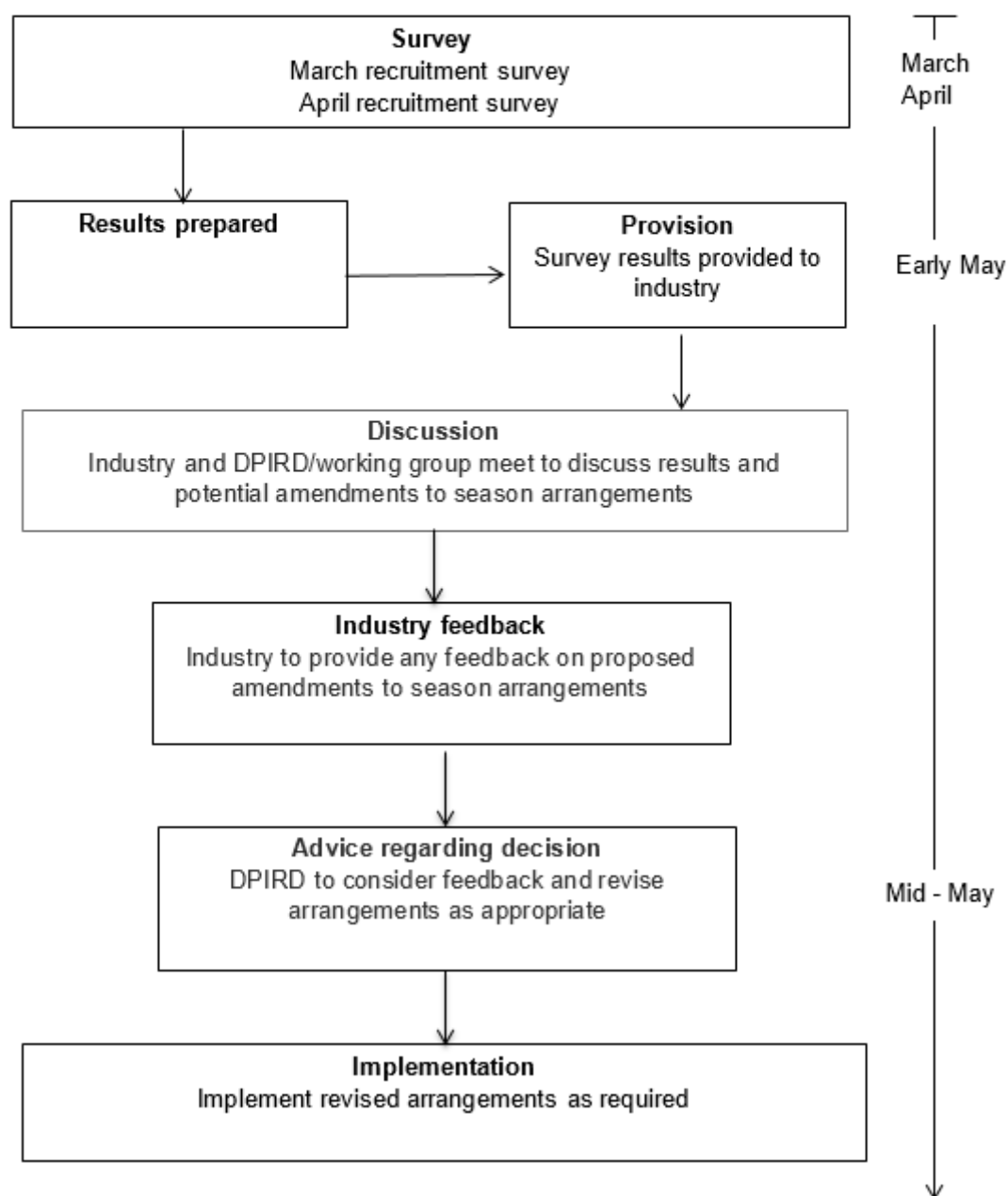


Figure 1: Shark Bay April in-season review process.

In-season Review Process - June

Purpose: To review the aspects of the season arrangements outlined below, in light of the spawning index for western king and brown tiger prawns derived from the June survey:

- appropriateness of scheduled spatial openings and closures; and
- opening of the South CPL.

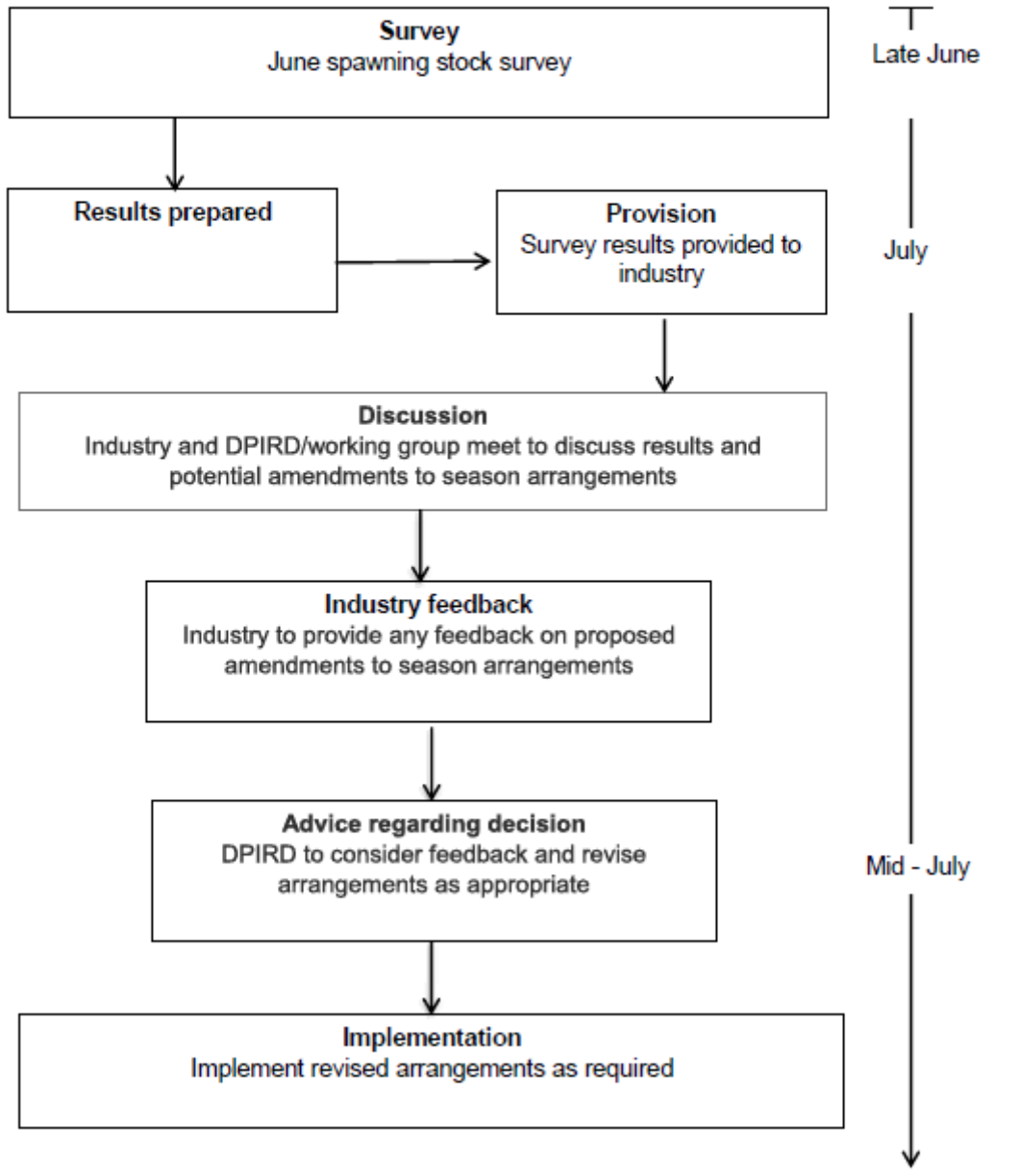


Figure 2: Shark Bay June in-season review process

Appendix 4

Shark Bay Prawn Fishery Recovery Strategy

Introduction

The status of the stocks of brown tiger and western king prawns in Shark Bay is assessed annually and the adoption of a recovery strategy would be triggered if one or both species is below the Spawning Stock Index limit reference level.

Brown tiger prawns are typically considered more vulnerable to overfishing than western king prawns because of their shorter breeding period and higher catchability (Penn & Caputi 1986). As such, management of the fishery has traditionally focused on protection for brown tiger prawns to try and maintain the spawning stock above the threshold reference level. However, since 2011 there has been a decline in the mean size of western king prawns and a declining trend in the total catch since 2015 which has required consideration of specific management for protection of western king prawns.

The management arrangements for the fishery are designed to maintain the spawning stock biomass at a level where the main factor affecting recruitment is the environment. An alternative hypothesis that recruitment for these species was only environmentally driven was effectively tested in Shark Bay by not intervening or providing additional protection of the breeding stock when it had declined to low levels in the early 1980s. This strategy was shown to be incorrect because the recovery of brown tiger prawn stocks in Shark Bay took much longer than in Exmouth Gulf where management actions were implemented immediately, and the stock recovered within the expected three to four year timeframe. The recovery in Shark Bay only occurred when the spawning stock was eventually protected.

This recovery strategy outlines the management strategies to be implemented to help rebuild the brown tiger prawn and/or western king prawn stock/s in Shark Bay, if the recovery strategy is triggered. It also includes the monitoring and assessment processes to evaluate how rebuilding is occurring. The recovery strategy is an ancillary document to be read in conjunction with the Shark Bay Prawn Resource Harvest Strategy and when triggered will remain in place until the stock is considered to have rebuilt. Due to the short generation time of prawn (~1 year), the timeframe for this recovery strategy has been set to three years, but this is dependent on environmental conditions.

Recovery Strategy

The need for the Recovery Strategy to be implemented would be triggered if the index of spawning stock abundance for either brown tiger or western king prawns falls below the limit reference point. The index of spawning stock abundance is

determined following the completion of the June and August surveys which is nearing the end of the prawn season in September (based on the current arrangements). If the limit reference point is breached, the fishery may be able to continue to operate, however, management action will be taken to provide increased protection for the spawning stock of the species that has breached the limit reference point for the remainder of the season. Arrangements for subsequent seasons while under recovery will reduce effort in a manner aimed at rebuilding the spawning stock biomass. Potential impacts from other fishing operations, such as in the Shark Bay Scallop Fishery, will also be considered as part of developing an appropriate management response.

The key management objective of this recovery strategy is to protect the spawning stock of brown tiger prawns and/or western king prawns to allow stock/s to recover to above the threshold reference level within three years, to ensure the ecological objective for these species are met.

To achieve this objective, two key steps have been identified:

- Step 1: Provide immediate protection for the stock by restricting fishing for the remainder of the season in which the limit is breached, and for the following season, set effort levels to recover the spawning stock to at least above the limit reference point in that year's index of spawning stock abundance.
- Step 2. Set effort levels and precautionary arrangements to rebuild the stock to above the threshold level as soon as possible and within three years of the recovery strategy being triggered.

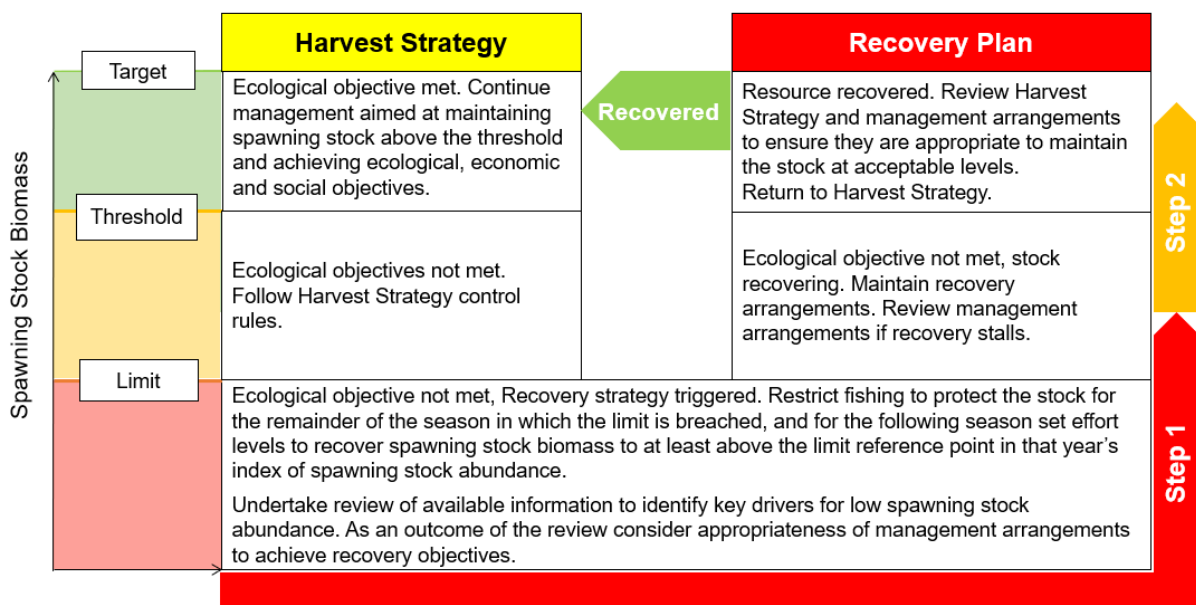


Figure 1: Schematic of Shark Bay prawn resource harvest control rules under the Harvest Strategy or Recovery Strategy.

Two key strategies have been developed to support this recovery plan:

- 1) The use of spatio-temporal closures, and
- 2) Reduction of overall effort.

Specific measures under each of these strategies will be tailored to the species that needs to be recovered due to biological differences between brown tiger and western king prawns. The goal of these strategies is to either:

- 1) Increase escapement reducing total mortality or
- 2) Provide targeted protection to spawning stock

Strategy 1 – Reduction of overall effort

Overall effort may be controlled through adjusting:

- the total number of fishing days;
- fishing hours per night;
- the length of moon closures; and
- gear controls (i.e. reduction of headrope unit value)

Strategy 2– Spatio-temporal closures

Spatio-temporal closures are a targeted form of effort control used as part of the Harvest Strategy to protect prawns at key stages of their lifecycle (See Harvest Strategy section 3.3.1). This includes permanent closures to protect nursery areas for juvenile prawns and closures to protect small recruiting prawns and key spawning areas.

For the purpose of the recovery strategy, spatio-temporal closures may be used to:

- increase proportion of mature prawns before they become available to catch;
- provide corridors to increase escapement;
- protect key spawning areas;
- protect areas of traditionally high spawning stock abundance; and
- protect areas of high abundance identified in surveys.

The primary strategy to help recover the stock/s is the management of overall effort which is primarily focused on facilitating increasing escapement. These effort reduction measures may be used in conjunction with spatio-temporal closures to help recover the stock.

Consideration of management strategies will be done in consultation with industry and based on best available science. Similarly, the effectiveness of the above strategies to recover the stock will be reviewed and discussed with industry. If the spawning stock index has not recovered to above the limit reference level after one year, or above the threshold by the following year, further reviews will be undertaken and additional measures to assist recovery will be considered.

Monitoring & Assessment

The Department undertakes spawning stock surveys to assess brown tiger and western king prawns in June, July/August and September each year which are used to develop the spawning stock index for both species (June and July/August surveys). The spawning stock index (as proxy for spawning stock biomass) is the primary performance indicator used to assess recovery. The broader weight-of-evidence assessment of stock status will also be used when reviewing recovery.

In response to strategies implemented to aid recovery, the monitoring framework may be reviewed to ensure the timing and location of surveys are appropriate to assess recovery and efficacy of strategies. Due to natural variability and a potential for ongoing environmental effects, a high degree of certainty regarding the effect of recovery measures on prawn recovery may be difficult to achieve.

Research Initiatives

An essential component of this recovery strategy is to improve the understanding of the natural and anthropogenic factors influencing prawn recovery including:

- 1) changes in the timing and key areas for spawning for both species and potential driving factors;
- 2) reassessment of MSY estimates to determine if reference levels for sustainable harvest are appropriate; and
- 3) undertake analysis of overall effort and potential increases in fleet efficiency to improve understanding of impacts of the fleet on prawn stocks.