

**BLUE SWIMMER CRAB RESOURCE OF
THE PEEL-HARVEY ESTUARY
HARVEST STRATEGY
2015 - 2020**

Version 1.0

**WEST COAST ESTUARINE MANAGED FISHERY (AREA 2)
AND THE
PEEL-HARVEY ESTUARY BLUE SWIMMER CRAB
RECREATIONAL FISHERY**

FISHERIES MANAGEMENT PAPER NO. 273

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Blue Swimmer Crab Resource of the Peel-Harvey Estuary Harvest Strategy 2015 - 2020
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Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery

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1 INTRODUCTION

Harvest strategies for aquatic resources managed by the Western Australian Department of Fisheries (the Department) are formal documents prepared to support the decision-making processes required to ensure the management of these resources are consistent with the principles of Ecologically Sustainable Development (ESD). The objectives of ESD are reflected in the objects of the *Fish Resources Management Act 1994* (FRMA), Section 3, and the draft *Aquatic Resources Management Bill 2013* (ARMB), Clause 9, which will replace the FRMA once enacted.

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

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

Harvest strategies make explicit the objectives, performance indicators, reference levels, and harvest control rules for each defined ecological asset taken into consideration by the Department when preparing advice for the Minister for Fisheries. They also indicate the scope of management actions required in relation to the status of each resource in order to meet the specific long- and short-term management objectives for the resource and the broader goals of the ESD strategy.

1.1 Review Process

It is recognised that fisheries change over time and that a review period should be built into each harvest strategy to ensure that it remains relevant. This harvest strategy will remain in place for a period of five (5) years, after which time it will be fully reviewed; however, given that this is the first harvest strategy for this resource, this document may be subject to further review and amended as appropriate within the five year period.

2 SCOPE

This harvest strategy relates to the blue swimmer crab (*Portunus armatus*) resource of the Peel-Harvey Estuary, Western Australia, together with the Murray, Serpentine, Harvey and Dandalup Rivers and all their tributaries (Figure 1) and the fishing activities that impact this resource. Within the Peel-Harvey Estuary, there are two main fisheries that target the blue swimmer crab resource; the West Coast Estuarine Managed Fishery (WCEMF) Area 2 and the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery.

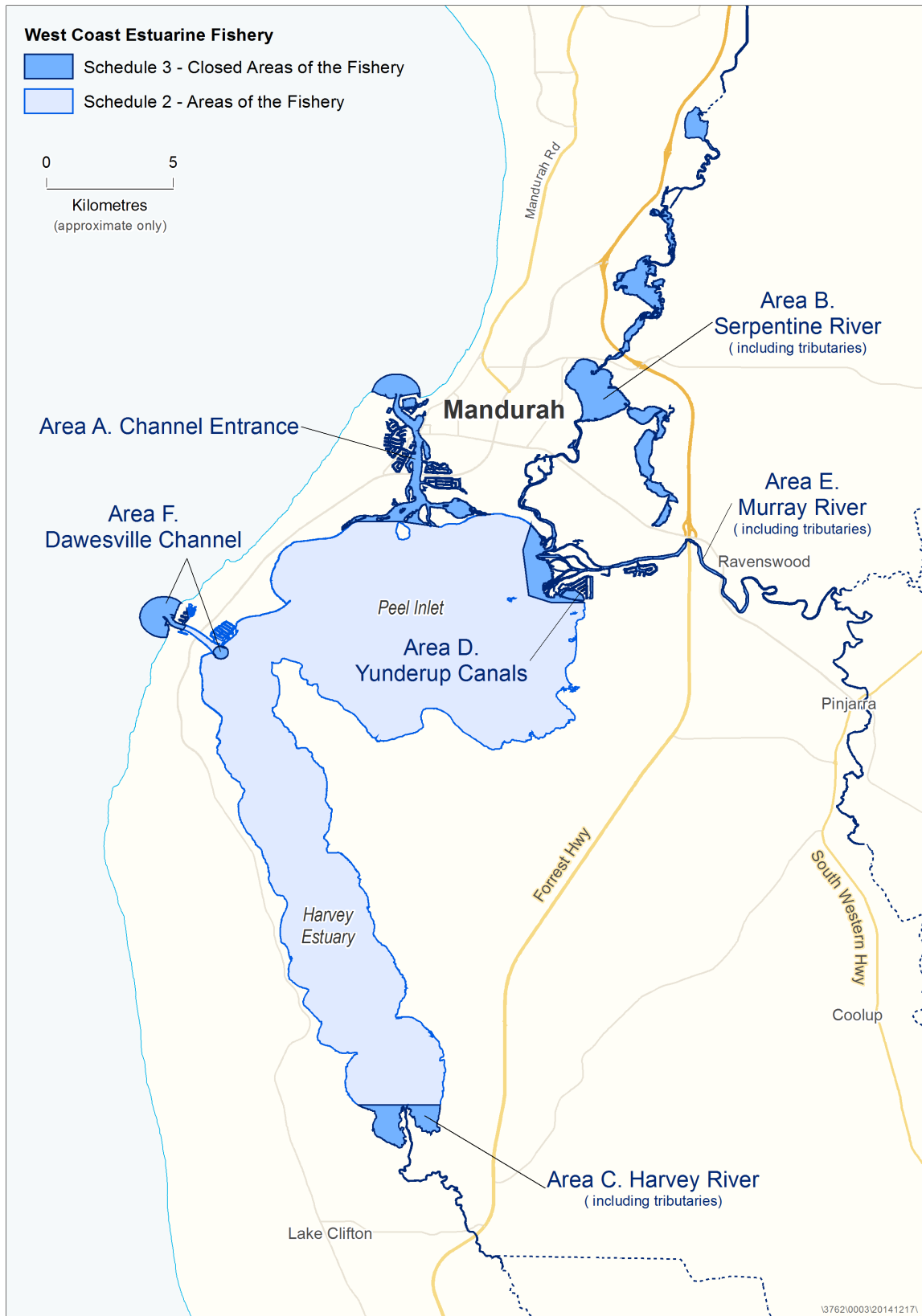


Figure 1. Key regions of the Peel-Harvey Estuary and boundaries of the West Coast Estuarine Managed Fishery: Area 2

This strategy has been developed in line with the Department's over-arching *Harvest Strategy Policy for Aquatic Resources* (Department of Fisheries in press) and relevant national policies / strategies (ESD Steering Committee 1992) and guidelines (e.g. Sloan *et al.* 2014). In addition to considering fishing impacts on the target species (i.e. blue swimmer crabs), it also considers retained non-target species, bycatch¹, endangered, threatened and protected (ETP) species, habitats and other ecological components to ensure any risks to these elements are managed effectively.

This strategy also sets out and summarises matters relevant to independent third-party certification assessment against the Marine Stewardship Council (MSC) sustainability standard and should be read in conjunction with the MSC full assessment documentation for this resource.

This document has been developed via a consultative process with industry members and has been approved by the Director General of the Department of Fisheries and the Minister for Fisheries.

2.1 Environmental Context

The Peel-Harvey Estuarine system is located 80 km south of Perth, in the south-west region of Western Australia. The estuarine system is comprised of the Peel Inlet and Harvey Estuary, which are joined together by a narrow channel through the Point Grey Sill. The system is joined to the Indian Ocean via a natural entrance channel, the Mandurah Channel, in the northern Peel Inlet and an artificial entrance channel, the Dawesville Channel, which is located in the northern part of the Harvey Estuary (see Figure 1). The shallow waters of the Peel-Harvey Estuary support extensive stands of macroalgae and seagrass. These plants, in combination with high phytoplankton productivity, support large populations of small invertebrate animals, which in turn form the basis of a food chain that supports a number of fish, other invertebrates, birds and mammals.

The estuary environment has changed dramatically over the past few decades. Increasing inputs of nutrients from surrounding agricultural land in the 1980s led to a substantial increase in algal biomass in the estuary, which resulted in the opening of an artificial entrance channel (the Dawesville Channel) in 1994. This channel has increased water exchange throughout the estuary, resulting in improved water quality; however, it has also markedly altered the ecology of the estuary, with more marine conditions favouring marine over estuarine species. In contrast with outside oceanic waters, the estuary has relatively high salinity and nutrient levels.

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

The estuary was listed as a Ramsar Wetland of International Importance in 1990, as part of the larger Peel-Yalgorup Wetland System, and is considered to be an internationally-significant habitat for waterbirds.

2.2 Target Species – Blue Swimmer Crab

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

The blue swimmer crab resource in south-western Western Australia is likely represented by a series of overlapping biological stocks, with gene flow between geographical regions largely controlled by the degree of water exchanges (Sezmiş 2004). Genetic studies have shown that the genetic compositions of the assemblages of blue swimmer crabs in Cockburn Sound and the Swan-Canning Estuary are homogenous and genetically distinct from other south-western assemblages, including crabs in the Peel-Harvey Estuary (Chaplin and Sezmiş 2008). Given the greater potential for mixing of larvae among the more closely spaced embayments south of Cockburn Sound, the blue swimmer crab assemblages in Warnbro Sound, the Peel-Harvey Estuary and in coastal waters between Mandurah to Bunbury are highly likely to be part of the same genetic stock. Consequently there is a need to integrate this strategy with harvest strategies for blue swimmer crabs in these other regions.

2.3 Fishing Activities

2.3.1 Governance

Blue swimmer crabs in the Peel-Harvey Estuary are targeted by commercial, recreational and customary fishing sectors. These fishing sectors are managed by the Department under the following legislation:

- FRMA (will be replaced by ARMB once enacted);
- *Fish Resources Management Regulations 1995 (FRMR)*;
- FRMA Part 6 – *West Coast Estuarine Managed Fishery Management Plan 2014*; and
- FRMA Section 43 Order – *Prohibition on Fishing for Crabs (Peel Inlet and Harvey Estuary) Order 2007*.

Fishers must also comply with the requirements of:

- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Western Australian Marine Act 1982*; and
- *Western Australian Wildlife Conservation Act 1950*.

2.3.2 Commercial Fishing

The commercial fishing sector operating in the Peel-Harvey Estuary is currently managed as Area 2 of the WCEMF.

Originally operating as a finfish fishery, commercial fishers in the Peel-Harvey Estuary began targeting blue swimmer crabs in the late-1950s using the same gillnets that were used to capture finfish species. In the mid-1990s, fishers started trialling crab traps to target blue swimmer crabs and by 2000/01 the majority of blue swimmer crab catch was landed using this method. A substantial proportion of the current total fishing effort in the WCEMF Area 2 is directed towards this species.

There are currently 10 commercial fishers licensed to take blue swimmer crabs in the Peel-Harvey Estuary using hourglass crab traps. Since the conversion of fishers to using traps for targeting blue swimmer crabs in 2000/01, the annual commercial catch of this species in the Peel-Harvey Estuary has ranged from 45 to 105 tonnes.

Although permitted to land other species, over 99 % of the total annual trap catch is comprised of blue swimmer crabs. The only other retained species reported in the fishery since 2000/01 has been octopus, with generally less than 0.1 tonne of octopus retained annually. Bycatch in the fishery is very low, as the traps used are purpose-designed to catch blue swimmer crabs and have escape gaps (voluntary) in place to reduce the catch of undersize and juvenile crabs. The main bycatch species recorded during on-board commercial monitoring undertaken by Departmental staff has been weeping toadfish (*Torquigener pleurogramma*, also referred to as blowfish), although this species is caught in very low numbers, is returned alive and is highly likely to have excellent post-release survival. There have been no interactions with any ETP species reported since the conversion to traps for targeting blue swimmer crabs in the fishery.

Fourteen per cent of the estuary is closed to commercial fishing activities (see Figure 1). Habitat impacts from fishing are minor due to the sand / mud substrate over which traps are primarily set, the distribution of fishing activities throughout the estuary area and the limited number of traps that are permitted to be used in the fishery (each licence is entitled to use up to 42 traps).

2.3.3 Recreational Fishing

The protected and easily-accessible waters of the Peel-Harvey Estuary are one of the most popular areas for blue swimmer crab recreational fishing in the south-west region of Western Australia. Recreational fishers are permitted to catch crabs by

- hand;
- blunt wire hook;
- drop net; and
- scoop net.

The majority of blue swimmer crab recreational fishers in the Peel-Harvey Estuary use baited drop nets, which are set (typically for ~ 10 – 15 minutes at any one time) from boats, bridges, jetties and canal houses, or scoop nets, which are predominantly used while wading or from a drifting boat in the shallow regions of the estuary to visually search for crabs.

Estimates of boat- and shore-based blue swimmer crab recreational catches in the Peel-Harvey Estuary are available from two dedicated surveys undertaken in the estuary in 1998/99 and 2007/08 (Malseed and Sumner 2001; Lai *et al.* 2014), and a state-wide survey of fishers holding a Recreational Fishing from Boat Licence (RFBL) in 2011/12 (Ryan *et al.* 2013). Due to the different methods used in the recreational fishing surveys, the catch levels reported in each survey are not directly comparable, nor do they provide complete estimates of the total recreational catch of blue swimmer crabs in the Peel-Harvey Estuary at any one time.

As part of the recent process undertaken to allocate blue swimmer crab catch shares between the commercial and recreational fishing sectors (see below), recreational catch estimates have been adjusted to account for late night and early morning fishing (1998/99 and 2007/08) and / or shore-based fishing (2011/12) (Table 1; Integrated Fisheries Allocation Advisory Committee [IFAAC] in prep.).

Table 1. Adjusted estimates of total recreational catch (tonnes, t) of blue swimmer crabs in the Peel-Harvey Estuary in 1998/99, 2007/08 and 2011/12 (IFAAC in prep.)

Year	Adjusted total catch (t)
1998/99	349
2007/08	165
2011/12	80

Drop and scoop nets, which account for ~ 99 % of the total recreational crab catch, are highly selective; thus, very few other species are caught by recreational fishers using these methods. During the 1998/99 and 2007/08 fishing surveys, fishers reported retaining very small quantities of other finfish and invertebrates, while discarded bycatch included undersize and undesirable species (Malseed and Sumner 2001; Department of Fisheries unpub. data).

There is no information currently available on the level of interactions with ETP species by blue swimmer crab recreational fishers in the Peel-Harvey Estuary; however, given the fishing gear used and the nature of the fishing methods, it is considered to be highly unlikely that the fishery is having any unacceptable impacts on ETP species.

Habitat impacts from fishers using drop nets are likely to be similar to those from the commercial trap fishery, with very limited habitat disturbance occurring during the setting and retrieval of drop nets. Habitat impacts from fishers using scoop nets most likely relate to wading by scoop-net fishers in areas of the estuary shallower than 1 m; however, the spatial extent of any such impacts are restricted by the limited access points for this type of fishing

and the relatively shallow depths at which this method of fishing can be undertaken. Furthermore, the temporal impacts of wading are limited to the period of favourable catch rates, which occur over December to May but mainly in January and February. Thus, the recreational blue swimmer crab fishery is considered to have a minor impact on the benthic habitats of the estuary.

2.3.4 Customary Fishing

There are no data on the level of customary fishing for the blue swimmer crab resource of Peel-Harvey Estuary; however, anecdotal information suggests it is very low.

2.4 Catch-Share Allocations

Historically, the blue swimmer crab resource of the Peel-Harvey Estuary has been fished by commercial and recreational sectors without any explicit catch share allocation between sectors. A formal sectoral allocation process, known as Integrated Fisheries Management (IFM), to define and assign long-term sectoral shares of the permitted catch of the blue swimmer crab resource of the lower west coast (including the Peel-Harvey Estuary) has been undertaken by IFAAC (in prep.).

Adjusted estimates of the retained catch of blue swimmer crabs from the recreational fishing surveys in 1998/99, 2007/08 and 2011/12 have been used with the monthly blue swimmer crab catch data provided by commercial fishers for the same time periods to provide an indication of the proportions of the total catch of blue swimmer crabs in the Peel-Harvey Estuary that are retained by each sector.

Forecast estimates of the annual sustainable harvest are not available to set the sectoral catch levels and estimates of recreational crab catch are not available every year. Therefore the approach adopted for this harvest strategy is to adopt an annual total allowable harvest level for blue swimmer crabs in the Peel-Harvey Estuary, based on recent historical catches, and within this total to have definitive allowable catch ranges for each sector (Department of Fisheries in prep.). The sectoral catch ranges will be reviewed in line with the final allocation determinations.

The approach provides the management flexibility required for such a highly variable stock, while acknowledging that catches anywhere within the overall catch range would be unlikely to affect the sustainability of the resource and are therefore considered acceptable. Although the catch levels for each sector can fluctuate between years within the recommended catch range, the proportional allocation remains the same in the absence of reallocation (Department of Fisheries 2010). This use of catch ranges should ensure that matters of sustainability in the short to medium term are dealt with. The likely solution to this issue in the long term lies in developing a method of abundance forecasting and setting of allowable harvests that reflect the abundance in each year.

3 HARVEST STRATEGY

3.1 Harvesting and Management Approach

The blue swimmer crab resource of the Peel-Harvey Estuary is harvested using a *constant proportion approach*, where the annual catch taken varies in proportion to variations in stock abundance.

This strategy assumes that the commercial catch rate of blue swimmer crabs in the Peel-Harvey Estuary is indicative of overall stock abundance. The development of fishery-independent recruitment and breeding stock indices will help verify whether this assumption is reasonable or not (see Section 3.5.1.3).

In line with this harvesting approach, the WCEMF Area 2 is primarily managed using input controls. Overall effort in the fishery is constrained by a cap on the number of licences / vessels (limited entry) and restrictions on fishing gear (number and size of traps). Spatial, seasonal and temporal closures within the fishery further limit the effective fishing effort. Fishers are not permitted to retain any berried² female crabs or any species smaller than the minimum legal size limits prescribed in the FRMR.

The Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery is managed through a range of adaptive regulatory controls. These include a seasonal closure, gear controls (net and mesh size, as well as limits on the number of drop nets used at any one time) and daily bag and boat limits. As with the commercial fishery, recreational fishers are not permitted to retain any berried female crabs or any species smaller than the prescribed minimum size limits.

Recreational fishers operating from a boat are required to hold a current RFBL. Unlicensed fishers on boats can fish if at least one other person on board has an RFBL, provided the total catch of everyone on board stays within the bag limits of the licenced fisher(s) (or combined boat limit).

3.2 Long-Term Objectives

In addition to ensuring the biological sustainability of all captured aquatic resources, this harvest strategy includes broader ecological objectives for each ecosystem component, as well as social and economic objectives for the fisheries. It is important to note that the social and economic objectives are applied within the context of ESD.

3.2.1 Ecological Sustainability

- 1) To maintain spawning stock biomass of the target species (i.e. blue swimmer crabs) at a level where the main factor affecting recruitment is the environment;

² With eggs attached beneath its body.

- 2) To maintain spawning stock biomass of each retained (non-target) species at a level where the main factor affecting recruitment is the environment;
- 3) To ensure fishing impacts do not result in serious or irreversible harm³ to bycatch species populations;
- 4) To ensure fishing impacts do not result in serious or irreversible harm to ETP species populations;
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function; and
- 6) To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.

3.2.2 Social and Economic Objectives

- 1) To provide flexible opportunities to ensure fishers can maintain or enhance their livelihood, within the constraints of ecological sustainability; and
- 2) To provide fishing participants with reasonable opportunities to maximise cultural, recreational and lifestyle benefits of fishing, within the constraints of ecological sustainability.

3.3 Operational Objectives

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

3.4 Performance Indicators, Reference Points and Control Rules

Suitable indicators have been selected to assess performance of the commercial and recreational fishing sectors in relation to each management objective, with a set of reference levels established to separate acceptable from unacceptable performance. Where relevant, these levels include:

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

³ Serious or irreversible harm relates to a change caused by the fishery that fundamentally alters the capacity of the component to maintain its function or to recover from the impact.

The associated control rules define what management actions should occur in relation to the value of each indicator compared to the reference levels. The extent of management actions taken (e.g. to reduce catches) will be determined by the extent to which a performance indicator has breached a threshold or limit reference point. A summary of the management objectives, performance indicators, reference levels and control rules for each component of the fisheries is provided in Table 2. The ability, and timeframe, to implement management changes depends on the legal instrument under which the management measure occurs. Further information on the management measures in place for this fishery is provided in Section 4.

3.4.1 Identifying Performance Indicators and Reference Levels

3.4.1.1 Reference Period

The reference period used for setting the reference levels for the assessment of the blue swimmer crab resource and other associated ecological assets is between 2000/01 and 2011/12⁴. This was a period of relative stability in the commercial fishing operations in WCEMF Area 2.

3.4.1.2 Blue Swimmer Crabs

The primary performance indicator used to evaluate the status of the blue swimmer crab resource in the Peel-Harvey Estuary is the annual standardised catch rate of blue swimmer crabs by commercial trap, with a secondary performance indicator of annual commercial trap catch. In the absence of direct estimates of total biomass for blue swimmer crabs, and due to the lack of regular information on total recreational effort and catch of this species in the Peel-Harvey Estuary, commercial data alone are used as an indicator of stock abundance.

Reference levels for blue swimmer crabs have been calculated from commercial catches and catch rates observed during the reference period. For each of the two indicators, the target range extends between the minimum and maximum values recorded during the reference period, which in turn represent the lower and upper threshold levels, respectively. The limit reference level is calculated as 70 % of the lower catch rate threshold value.

3.4.1.3 Other Ecological Assets

Other ecological assets incorporated in this harvest strategy include retained (non-target) species, bycatch, ETP species, habitats and ecosystem processes. The impact of fishing activities on each of these assets varies by fishing sector, with separate performance indicators and reference levels determined for the commercial WCEMF Area 2 and the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery, where required.

⁴ Note that standardised commercial catch rates are calculated by fishing season (1 November – 31 October), while annual commercial catches are reported by financial year (1 July – 30 June).

Where reliable quantitative information is available (e.g. some retained and bycatch species), reference levels have been set based on data collected on an annual or biennial basis. Alternatively, where these data are lacking, the reference levels have been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher (2014). Risk assessment outcomes are also used in a weight-of-evidence approach to support each of the assets considered within this harvest strategy.

3.4.1.4 Social and Economic Objectives

In line with the draft Harvest Strategy Policy and the principles of ESD, this harvest strategy also includes social and economic objectives and performance indicators for both the commercial and recreational fishing sectors. These objectives relate to the provision of opportunities to ensure (1) commercial fishers can maintain / enhance their livelihood and (2) that all fishers can maximise cultural, recreational and / or lifestyle benefits of fishing. It is important to note that management actions relating to these objectives are applied within the constraints of ecological sustainability.

The economic objective for this fishery does not have an explicit performance measure within the harvest strategy. Rather, it is through the formal consultation process that regulatory impediments to maintaining economic return, or opportunities for enhancing economic return, are discussed. Where possible, and in due consideration of ecological sustainability, fisheries management arrangements can be adjusted or reformed to help meet this objective.

As both fishing sectors are provided formal access rights through the setting of sectoral catch-share allocations, this provides the basis for measuring performance against the social objective. Until other more appropriate ways are developed to measure performance against social objectives, performance against this objective will be generally measured by comparing catches of each sector against their allowable catch ranges. Commercial catch is examined annually and recreational catch on a biennial basis⁵.

It is important to note that fisheries managers cannot always address the causes of constraints on access to fishing activities, as these may be due to environmental or other factors, or may compromise ecological sustainability.

⁵ The comparison is only undertaken biennially because estimates of the recreational catch of blue swimmer crabs in the Peel-Harvey Estuary are only available from fishing surveys conducted every two years.

Table 2. Summary of the harvest strategy for the Peel-Harvey Estuary blue swimmer crab resource and associated assets that may be impacted by fishing activities undertaken by commercial and recreational fishing sectors while targeting blue swimmer crabs within the Peel-Harvey Estuary

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Ecological					
Target species	To maintain spawning stock biomass of the target species at a level where the main factor affecting recruitment is the environment.	Blue swimmer crabs	<ol style="list-style-type: none"> 1. Annual standardised commercial catch rate (kg / trawlift) of blue swimmer crabs in the Peel-Harvey Estuary. 2. Annual commercial catch (tonnes) of blue swimmer crabs in the Peel-Harvey Estuary. 	<p>Target: Annual standardised catch rate is 0.7 – 1.4 kg / trawlift; and Annual commercial catch is 45 – 104 tonnes.</p> <p>Threshold: Annual standardised catch rate is < 0.7 kg / trawlift or > 1.4 kg / trawlift; or Annual commercial catch is < 45 tonnes or > 104 tonnes.</p> <p>Limit: Annual standardised catch rate is < 0.5 kg / trawlift.</p>	<p>No management action required.</p> <p>A review is triggered to investigate the reasons for the variation. Appropriate management action will be taken to return indicator(s) to the target level(s).</p> <p>Management action will be taken to protect the breeding stock (50 – 100 % reduction of total catch).</p>
Retained (non-target) species	To maintain spawning stock biomass of each retained species at a level where the main factor affecting recruitment is the environment.	All other retained species (commercial and recreational sectors)	<ol style="list-style-type: none"> 1. Annual commercial catch (tonnes) of each species in the Peel-Harvey Estuary. 2. Recreational catch (tonnes) of each species (from periodic fishing surveys) in the Peel-Harvey Estuary. 	<p>Target: Each retained (non-target) species is < 5 % of the total retained catch for each fishing sector; and</p> <p>Fishing impacts are considered to generate an acceptable level of risk to all retained (non-target) species' stocks, i.e. moderate risk or lower.</p>	No management action required.

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
			<p>3. Periodic risk assessments:</p> <ul style="list-style-type: none"> • Annual fishing effort. 	<p>Threshold: Any retained non-target species comprises $\geq 5\%$ of the total retained catch for either fishing sector; or</p> <p>Fishing impacts are considered to generate an undesirable level of risk to any retained (non-target) species' stocks, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any retained (non-target) species' stocks, i.e. severe risk.</p>	<p>A review is triggered to investigate the reasons for the variation. Appropriate management action will be taken to return indicator(s) to the target level(s).</p> <p>Appropriate management action will be taken to reduce the risk to an acceptable level.</p>
Bycatch (non-ETP) species	To ensure fishing impacts do not result in serious or irreversible harm to bycatch species populations.	All (non-ETP) bycatch species (commercial and recreational sectors)	<ol style="list-style-type: none"> 1. Commercial catch and discards (tonnes) of each species (from periodic observer monitoring). 2. Recreational catch and discards (tonnes) of each species (from periodic fishing surveys). 3. Periodic risk assessments: <ul style="list-style-type: none"> • Annual fishing effort; and • Extent of use of voluntary escape gaps in commercial traps. 	<p>Target: Each bycatch species is $< 5\%$ of the total catch for each fishing sector; and</p> <p>Fishing impacts are considered to generate an acceptable level of risk to all bycatch species' populations, i.e. moderate risk or lower.</p> <p>Threshold: Any bycatch species comprises $\geq 5\%$ of the total catch for either fishing sector; or</p> <p>Fishing impacts are considered to generate an undesirable level of risk to any bycatch species' populations, i.e. high risk.</p>	<p>No management action required.</p> <p>A review is triggered to investigate the reasons for the variation. Appropriate management action will be taken to return indicator(s) to the target level(s).</p>

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				<p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any bycatch species' populations, i.e. severe risk.</p>	Appropriate management action will be taken to reduce the risk to an acceptable level
Endangered, threatened and protected (ETP) species	To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected (ETP) species populations.	All ETP species (commercial and recreational sectors)	<p>1. Periodic risk assessments:</p> <ul style="list-style-type: none"> • Number and size of traps used; • Fishing effort; • Annual number of reported interactions in commercial fishery from statutory reporting; and • Reports of recreational fishing gear interactions. 	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to all ETP species' populations, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any ETP species' populations, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ETP species' populations, i.e. severe risk.</p>	<p>No management action required.</p> <p>A review is triggered to investigate the reason for the increased risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>Appropriate management action will be taken to reduce the risk to an acceptable level.</p>
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.	Benthic habitats (commercial trap and recreational drop net fisheries)	<p>1. Periodic risk assessments:</p> <ul style="list-style-type: none"> • Fishing effort; and • Distribution of fishing effort throughout the Peel-Harvey Estuary. 	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to benthic habitats, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any benthic habitats, i.e. high risk.</p>	<p>No management action required.</p> <p>A review is triggered to investigate the reason for the increased risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p>

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				<p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any benthic habitats, i.e. severe risk.</p>	Appropriate management action will be taken to reduce the risk to an acceptable level.
		Nearshore habitats (recreational scoop net fishery)	<p>1. Periodic risk assessments:</p> <ul style="list-style-type: none"> • Fishing effort; and • Distribution of fishing effort throughout the Peel-Harvey Estuary. 	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to nearshore habitats, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any nearshore habitats, i.e. high risk.</p>	No management action required.
				<p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any nearshore habitats, i.e. severe risk.</p>	Appropriate management action will be taken to reduce the risk to an acceptable level.
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.	All species and habitats in the Peel-Harvey Estuary (commercial and recreational sectors)	<p>1. Periodic risk assessments:</p> <ul style="list-style-type: none"> • Annual fishing effort; • Annual catch of all retained species; and • Distribution of fishing effort throughout the Peel-Harvey Estuary. 	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to ecological processes within the estuary, i.e. moderate risk or lower; and</p> <p>Fishing impacts on each ecological resource / asset impacts are considered to generate an acceptable level of risk, i.e. moderate risk or lower.</p>	No management action required.

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				<p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any ecological processes within the estuary, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ecological processes within the estuary, i.e. severe risk; or</p> <p>Fishing impacts are considered to generate an unacceptable level of risk, i.e. severe risk, to the majority of ecological resources / assets within the estuary.</p>	<p>A review is triggered to investigate the reason for the increased risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>Appropriate management action will be taken to reduce the risk to an acceptable level.</p>

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Social and Economic					
Commercial Sector	To provide flexible opportunities to ensure fishers can maintain or enhance their livelihood, within the constraints of ecological sustainability ⁶ .	Blue swimmer crabs	Allowable commercial and recreational catches (tonnes) of blue swimmer crabs in the Peel-Harvey Estuary as per formal allocations.	Target: Annual commercial catch is within the allowable range of 45 – 104 tonnes ⁷ ; and Estimated recreational catch (from biennial fishing surveys) is within the allowable range of 62 – 144 tonnes ⁷ .	No management action required.
All Fishing Sectors	To provide fishing participants with reasonable opportunities to maximise cultural, recreational and lifestyle benefits of fishing, within the constraints of ecological sustainability.			Threshold: Catch by either sector is outside of acceptable catch range by more than 10 %. Limit: Catch by either sector is outside of acceptable catch range by more than 20 %.	Review reasons for the variation in catches. Adjust management arrangements if considered necessary. Where possible, implement management actions to restore catch to allocated shares.

⁶ Note that this objective does not have an explicit performance measure within the harvest strategy and is rather discussed through the formal consultation process for the fishery (see Section 3.4.1.4)

⁷ The sectoral catch ranges may be reviewed in line with the final allocation determinations.

3.5 Monitoring and Assessment Procedures

3.5.1 Information and Monitoring

3.5.1.1 Commercial Fishing Information

3.5.1.1.1 Commercial Catch and Effort Reporting

Commercial fishers are required to report all retained species catches (kg), effort (e.g. days fished, trap lifts per day) and any ETP species interactions in statutory monthly catch and effort (CAES) returns, which have been used in the fishery since 1975. These forms provide data on the catch and catch rates of blue swimmer crabs, which are used to inform the stock assessment for this species.

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

3.5.1.1.2 Commercial (Observer) Monitoring

The first commercial catch monitoring program for blue swimmer crabs in the Peel-Harvey Estuary was conducted from December 1998 through June 2001 (Melville-Smith *et al.* 2001), with the current monitoring program established in March 2007. As part of the current program, Departmental research staff board one commercial fishing vessel operating in the Peel Inlet region and one operating in the Harvey Estuary region each month. During these surveys, research staff collect information on the catch, size, sex and condition of blue swimmer crabs caught in commercial crab traps, as well as information on fishing effort and location (using GPS). Information on any discarded species and potential interactions with ETP species are also recorded.

3.5.1.2 Recreational Fishing Information

3.5.1.2.1 Recreational Fishing Surveys

Estimates of the blue swimmer crab recreational catch in the Peel-Harvey Estuary are available from periodic fishing surveys undertaken by the Department. Some of the surveys have focused solely on the estuary, while others have been designed to provide broader-scale estimates of recreational fishing catch and effort in the whole bioregion.

To date, two dedicated recreational fishing surveys have been undertaken in the Peel-Harvey Estuary in 1998/99 and 2007/08 (Malseed and Sumner 2001; Lai *et al.* 2014). These surveys included boat- and shore-based recreational fishers, with a focus on those fishers targeting blue swimmer crabs.

More recently, an integrated system involving several survey methods has been used to survey boat-based recreational fishers in Western Australia (Ryan *et al.* 2013). Two statewide recreational fishing surveys have been completed to date using this methodology, in 2011/12 (Ryan *et al.* 2013) and 2013/14 (Ryan *et al.* in prep.). Although these surveys provide biennial

estimates of the boat-based blue swimmer crab catch in the Peel-Harvey Estuary, they do not provide estimates of the shore-based recreational catch of blue swimmer crabs, as shore-based fishers, by definition, are not included in the survey.

The abovementioned surveys have provided information on both retained and bycatch species by blue swimmer crab recreational fishers, as well as spatial distribution of fishing effort throughout the Peel-Harvey Estuary (1998/99 and 2007/08 surveys only). Ongoing monitoring of the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery is conducted as part of the integrated recreational fishing survey system, with boat-based fisher information collected every two years.

In addition, a new project aims to investigate the potential to monitor shore-based recreational fishing for blue swimmer crabs by installing cameras on the Peel-Harvey Estuary foreshore. Cameras will be running continuously at four locations around the estuary and analysis of the data will identify patterns of recreational fishing activity for blue swimmer crabs over 24-hours each day, throughout the year. The installation of cameras will commence in December 2014 and recreational fishing activity will be monitored throughout 2015. If cameras are maintained beyond 2015, they may provide an ongoing means to monitor recreational fishing activity at these four locations.

3.5.1.2.2 Other Reporting

Interactions between recreational fishers and / or their gear with ETP species are generally reported to the Western Australian Department of Parks and Wildlife via the Wildcare Helpline⁸.

3.5.1.3 Fishery-Independent Information

Since the 1980s, there have been intermittent fishery-independent research surveys of the blue swimmer crab resource in the Peel-Harvey Estuary (Potter *et al.* 1983; de Lestang 2002; Johnston *et al.* 2014). Collectively, the data highlight critical aspects of life-history traits, stock structure and changes in blue swimmer crab population dynamics over time.

Catch rate data collected during the current fishery-independent sampling program undertaken since 2007 is being used to develop indices of recruitment (sexually-immature males and females) and breeding stock (sexually-mature females) levels for blue swimmer crabs in the estuary. These indices are currently used in a weight-of-evidence approach with the commercial blue swimmer crab catch and catch rates to assess the stock status; however, there is potential in the future to include them as performance indicators in the harvest strategy when a longer time-series of information is available, the indices are shown to be reliable indicators of stock status, and the relationship between blue swimmer crab levels inside and outside the estuary is better understood.

⁸ More information about the Wildcare Helpline is available at:
<http://www.dpaw.wa.gov.au/about-us/contact-us/wildcare-helpline>

3.5.2 Assessing Fishery Impacts

3.5.2.1 Blue Swimmer Crabs

The blue swimmer crab resource in the Peel-Harvey Estuary is assessed annually through monitoring of standardised commercial catch rates (primary performance indicator used as a proxy for abundance) and commercial catch (secondary indicator) relative to reference levels based on a reference period in which these indicators have been stable (see Section 3.4.1.1). Recognising that the stock also extends outside the Peel-Harvey Estuary, this assessment approach is considered appropriate as the commercial WCEMF Area 2 lands the majority of the blue swimmer crab catches from the stock.

3.5.2.1.1 Standardised Commercial Catch Rates

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

3.5.2.1.2 Commercial Catch

In addition to standardised catch rates, the status of blue swimmer crabs in the Peel-Harvey Estuary is also assessed annually through monitoring commercial blue swimmer crab catch relative to specified reference levels.

3.5.2.1.3 Recruitment and Breeding Stock Indices

Since 2007, fishery-independent monitoring of blue swimmer crab recruitment and breeding stock levels has been undertaken in the Peel-Harvey Estuary to develop indices of abundance for this species. It is anticipated that, once fully tested, such indices could be used in conjunction with commercial catch and effort data in a higher-level assessment of blue swimmer crabs in the estuary.

3.5.2.2 Risk Assessments

The Department uses a risk-based Ecosystem Based Fisheries Management (EBFM) framework to assess the impacts of fishing on all parts of the marine environment, including the sustainability risks of target species, retained non-target species, bycatch, ETP species, habitats and the ecosystem. This framework has led the development of a periodic risk assessment process for the WCEMF Area 2 and the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery, which is used to prioritise research, data collection, monitoring needs and management actions for these fisheries and to ensure that fishing activities in the Peel-Harvey Estuary are managed both sustainably and efficiently.

In 2014 and 2015, internal risk assessments were conducted for the WCEMF Area 2 and the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery on target, other retained, bycatch and ETP species, and habitat, using the Productivity Susceptibility Analysis (PSA) and Consequence Spatial Analysis (CSA) methodologies. Eighteen species / groups were assessed, with all assessed to be at low risk. Fishery impacts from trapping, drop netting and scoop netting on benthic and nearshore habitats in the Peel-Harvey Estuary were each assessed as a low risk (Johnston *et al.* in prep.).

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

3.5.2.3 Social and Economic Objectives

The annual commercial catch and biennial estimates of recreational catch of blue swimmer crabs in the Peel-Harvey Estuary, relative to the allocated allowable catch ranges for each sector, are used to assess performance against the social objective.

4 MANAGEMENT MEASURES AND IMPLEMENTATION

4.1 Management Measures

There are a number of management measures in place for the commercial and recreational fishing sectors (Tables 3 and 4, respectively), which can be amended as needed to ensure each sector is achieving the resource objectives. These do not preclude the consideration of other options.

Table 3. Management measures and instrument of implementation for the West Coast Estuarine Managed Fishery: Area 2

Measure	Description	Instrument
Limited Entry	Ten of the commercial Managed Fishery Licences are permitted to catch blue swimmer crabs.	WCEMF Management Plan
Effort Restrictions	The capacity of the fishery is 420 traps. These may be transferred temporarily between licence holders to a maximum of 50 traps per licence.	WCEMF Management Plan
Gear Controls	Blue swimmer crabs can only be targeted using crab traps, with restrictions on size and internal volume.	WCEMF Management Plan
	Inclusion of escape gaps in crab trap.	Voluntary
Seasonal Closure	The fishery is closed to fishing between 1 September and 31 October.	WCEMF Management Plan
Spatial Closures	Parts of Peel-Harvey Estuary are permanently closed to commercial fishing activities to preserve sensitive habitats that are important for bird species.	WCEMF Management Plan

Temporal Closures	Specific weekend and daytime closures.	WCEMF Management Plan
Condition and Size Limits	Minimum size limit of 127 mm CW for blue swimmer crabs. No retention of berried female crabs.	FRMR
	Application of minimum size limit of 130 mm CW for blue swimmer crabs.	Voluntary
Reporting	Fishers are required to report all retained species catches, effort, ETP species interactions and fishing location in statutory monthly logbooks.	FRMR

Table 4. Management measures and instrument of implementation for the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery

Measure	Description	Instrument
Effort Restrictions	Maximum of 10 drop nets per person and per boat.	FRMR
Gear Controls	Blue swimmer crabs can only be caught by hand or using blunt wire hooks, drop nets or scoop nets.	FRMR
Seasonal Closure	The fishery is closed to fishing between 1 September and 31 October.	Prohibition on Fishing for Crabs (Peel Inlet and Harvey Estuary) Order 2007
Condition and Size Limits	Minimum size limit of 127 mm CW for blue swimmer crabs. No retention of berried female crabs.	FRMR
Bag and Boat Limits	Daily limit of 10 blue swimmer crabs per person and 20 blue swimmer crabs per boat (two or more Recreational Boat Fishing Licences required to take boat limit).	FRMR

4.2 Implementing Changes to the Management Arrangements

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

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

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

However, if there is an urgent issue, consultation with stakeholders may be undertaken to discuss the issue and determine appropriate management action, as needed.

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 the approval of the Minister for Fisheries. In making decisions relevant to fisheries, the Minister for Fisheries may choose to receive advice from any source, but has indicated that:

- 1) The Department is the primary source of management advice; and
- 2) Peak Bodies (Western Australian Fishing Industry Council [WAFIC] and Recfishwest) are the primary source of commercial and recreational sector advice and representation, respectively.

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

4.2.1.1 Commercial Sector Consultation

Under its SLA with the Department, WAFIC has been funded to undertake statutory consultation functions related to fisheries management plans and the facilitation of annual management meetings (AMMs) for licensed fisheries.

The FRMA requires the Minister to consult with affected parties when changes to a Part 6 management plan are being considered. In the case of the WCEMF Area 2, this includes all licence holders. AMMs between the Department, WAFIC and licence holders are used as the main forum to consult with stakeholders and licence holders on the management of the fishery. During these meetings, current and future management issues that may have arisen during the previous fishing season, and any proposed changes to the management plan, are discussed. Follow-up meetings may be held as required.

4.2.1.2 Recreational Sector Consultation

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

4.2.1.3 Consultation with Other Groups

Consultation with the public, other Government agencies, marine users, Native Title parties and NGOs is undertaken by the Department as needed.

4.3 Compliance and Enforcement

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

4.3.1 Operational Compliance Plans

Management arrangements are enforced under the Operational Compliance Plans (OCPs) for the WCEMF and the Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery. The OCPs are informed and underpinned by a compliance risk assessment conducted for each fishery. These OCPs have the following objectives:

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

These OCPs are reviewed every two (2) years.

4.3.1.1 Compliance Strategies for the Commercial Sector

The following compliance strategies are utilised in the Peel-Harvey Estuary for the commercial sector's compliance risk management:

- On-water patrols utilising Departmental vessels;
- Catch, licence and gear inspections; and
- Covert surveillance of gear / persons of interest for suspected illegal activity.

4.3.1.2 Compliance Strategies for the Recreational Sector

The following compliance strategies are utilised in the Peel-Harvey Estuary for the recreational sector's compliance risk management:

- Land patrols;
- On-water patrols;
- Catch, licence and gear inspections;
- Covert surveillance of persons of interest under approved operations;
- Road-side checkpoints; and
- Wholesale / retail inspections.

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