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Ecological Risk Assessment for the Western Rock Lobster Resource; Background Information

How J, Tuffley, E, Oliver R, Evans S, Hourston M and de Lestang S

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Enquiries:

WA Fisheries and Marine Research Laboratories,
PO Box 20,
North Beach, WA 6920

Tel: +61 8 9203 0111
Email: library@fish.wa.gov.au
Website: fish.wa.gov.au

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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

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List of Acronyms

AHL	Allowable Harvest Level
BRUVS	Baited Remote Underwater Videos
CDR	Catch Disposal Record
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CL	Carapace Length
DPIRD	Department of Primary Industries and Regional Development
EBFM	Ecosystem Based Fisheries Management
ENSO	El Niño Southern Oscillation
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERA	Ecological Risk Assessment
ERLMF	Esperance Rock Lobster Managed Fishery
ETP	Endangered, Threatened and Protected Species
FHPA	Fish Habitat Protection Areas
FRMR	*Fish Resources Management Regulations 1995*
IFM	Integrated Fisheries Management
ITQ	Individual Transferable Quota
MEY	Maximum Economic Yield
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
OCP	Operational Compliance Plans
OIMF	Octopus Interim Managed Fishery
SA	South Australian
SCCMF	South Coast Crustacean Managed Fishery
SLED	Sea Lion Exclusion Device
SWB	South Coast Bioregion
TACC	Total Allowable Commercial Catch
TARC	Total Allowable Recreational Catch
TDGDLF	Temperate Demersal Gillnet and Demersal Longline Fishery
WA	Western Australia
WCB	West Coast Bioregion
WCRLMF	West Coast Rock Lobster Managed Fishery
WHARLMF	Windy Harbour-Augusta Managed Fishery
WRL	Western Rock Lobster
WRO	Western Rock Octopus
WTO	Wildlife Trade Operation
YRA	Year Rolling Average

Executive Summary

In April 2022, the Department of Primary Industries and Regional Development (DPIRD, Department) convened an ecological risk assessment (ERA) of the fisheries that access the Western Rock Lobster Resource (Resource). ERAs are conducted by the Department as part of its Ecosystem Based Fisheries Management (EBFM) framework.

This report provides an overview of the Western Australian (WA) fisheries that access the Resource to support the ERA risk scoring process. The ERA considered the potential ecological impacts of the harvest of the Resource by all sectors, including the commercial fisheries; West Coast Rock Lobster Managed Fishery (WCRLMF) and South Coast Crustacean Managed Fishery (SCCMF), recreational (including charter) fishers and customary fishing.

The assessment focused on evaluating the impact of each fishing sector on all relevant retained and bycatch species, endangered, threatened and protected (ETP) species, habitats and the broader environment.

The ERA workshop procedures and outcomes are documented in the Ecological Risk Assessment of the Western Rock Lobster 2022 (Stoklosa, 2022).

1.0 Introduction

The Department of Primary Industries and Regional Development (DPIRD, Department) in Western Australia (WA) uses an Ecosystem-Based Fisheries Management (EBFM) approach that considers all relevant ecological, social, economic and governance issues to deliver community outcomes (Fletcher et al. 2010; 2012). Ecological risk assessments (ERA) are undertaken periodically to assess the impacts of fisheries on all the different components of the aquatic environments in which they operate. The outcomes of ERAs are used to inform EBFM-based harvest strategies and to prioritise the Department's monitoring, research and management activities (Fletcher 2015; Fletcher et al. 2016).

This report provides a cumulative description of the Western Rock Lobster Resource (Resource) and all the fishing activities that interact with the Resource.

The ERA considered the potential ecological impacts of the harvest of the Resource by all sectors, including the commercial fisheries; West Coast Rock Lobster Managed Fishery (WCRLMF) and South Coast Crustacean Managed Fishery (SCCMF), recreational (including charter) fishers and customary fishing. The ERA assessed the potential ecological impacts of these fisheries/fishing sectors on all relevant retained and bycatch species, Endangered, Threatened and Protected (ETP) species, habitats, and the broader ecosystem.

The risk assessment methodology utilised a consequence-likelihood analysis, which involves the examination of the magnitude of potential consequences from fishing activities and the likelihood that those consequences will occur given current management controls. Risk scores were determined during a stakeholder workshop held on 7 April 2022. The ERA workshop procedures and outcomes are documented in the Ecological Risk Assessment of the Western Rock Lobster 2022 (Stoklosa, 2022).

This risk assessment will help inform the review of the West Coast Rock Lobster Harvest Strategy planned for 2022-23 and development of a harvest strategy for the SCCMF. It will also assist to meet the requirements of other processes, including the WCRLMF's Marine Stewardship Council (MSC) certification.

The scope of this ERA is for the next five years (through to 2027). It is envisioned that ERAs will be undertaken periodically (approximately every five years) to reassess any current or new issues that may arise. However, a risk assessment can also be triggered if there are significant changes identified in fishery operations or management activities that may change current risk levels.

2.0 Western Rock Lobster Resource

Western rock lobster (WRL; *Panulirus cygnus*) is a decapod crustacean of the family Palinuridae (Figure 1). Palinuridae, or spiny lobsters, are found throughout tropical, sub-tropical, and temperate waters, and globally comprise of 47 species in eight genre. WRL is endemic to the waters off WA, with a distribution extending from the North West Cape in the north, to around Albany in the south (Figure 2). It is the dominant lobster throughout its range, with minimal overlap with tropical species (e.g. *P. ornatus, P. versicolor*) in the north of its range, and *Jasus edwardsii* in the south.

Figure 1. The western rock lobster, *Panulirus cygnus.* Illustration © R. Swainston.

While WRL can live up to 20 years and weigh up to 5.5 kg, they more typically live for 10-15 years and weigh less than 3 kg. Juvenile WRL predominantly inhabit the inshore shallow reefs (< 40 m) throughout their distribution (Bellchambers et al. 2012, de Lestang et al. 2016). In November/December, at approximately five years of age, juvenile lobsters undergo a synchronised moult from their usual red coloured shell to a paler pink. Over the following two to three months, these lobsters, known as “whites”, undertake a mass migration, moving from their nearshore juvenile habitats, to the deep-water (40 – 100 m) offshore reefs that form their breeding grounds (Chubb et al. 1989, de Lestang et al. 2016). Some lobsters will only migrate once, while others will migrate two or more times over subsequent migration periods. Migration movements generally occur in two phases, the first dominated by a small offshore movement, and the second associated with an extension of the offshore movement together with a strong northern movement (de Lestang 2014).

Growth in both male and female WRL is categorised by rapid juvenile growth, followed by a reduction in growth rate after sexual maturity (de Lestang 2018). In juveniles, growth rates are inversely related to carapace length, rapidly decreasing as carapace length increases (de Lestang 2018). Juvenile growth rates do not differ between sexes (Chittleborough 1975, de Lestang 2018), however, the reduction in growth rates with sexual maturity is more pronounced in females than males, and as a result, adult males have higher growth rates than adult females and therefore attain larger maximum sizes.

Figure 2 Distribution of the western rock lobster (de Lestang et al., 2016).

WRL is considered a single management unit in the West Coast Bioregion and the same genetic stock extends into the South Coast Bioregion (Figure 3). The stock structure of WRL has been examined genetically through allozyme electrophoresis with the conclusion that the western rock lobster is a single panmictic population, with ephemeral genetic patchiness between cohorts (Thompson et al.1996, Johnson 1999).

A recent study examined microsatellite and mitochondrial sequences of WRL from samples collected over a 14-year time span and 960 km of coastline found no loss of genetic variation or significant population structuring (Kennington et al., 2013). This again confirms the previous assertions of a single panmictic population (Thompson et al., 1996, Johnson and Wernham1999).

WRL is predominantly captured by commercial fishers in the WCRLMF (Section 4.1), as well as recreational fishers (Section 4.3). However, as their distribution extends onto the south coast (Figure 2), they are also captured by commercial fishers in the SCCMF (Section 4.2). Catches of WRL decline in eastern zones of the SCCMF, with the vast majority of WRL catches coming from Zone 1 (Section 4.2).

For the purposes of this report, fishery-related activities on the WRL resource are defined by those activities conducted by recreational fishers fishing for WRL as well as the commercial activities managed under the WCRLMF and Zone 1 of the SCCMF.

3.0 Aquatic Environment

The Resource is accessed by commercial, recreational and customary fishing sectors, predominantly in waters along the West Coast Bioregion (WCB) and South Coast Bioregion (SWB) (Figure 3).

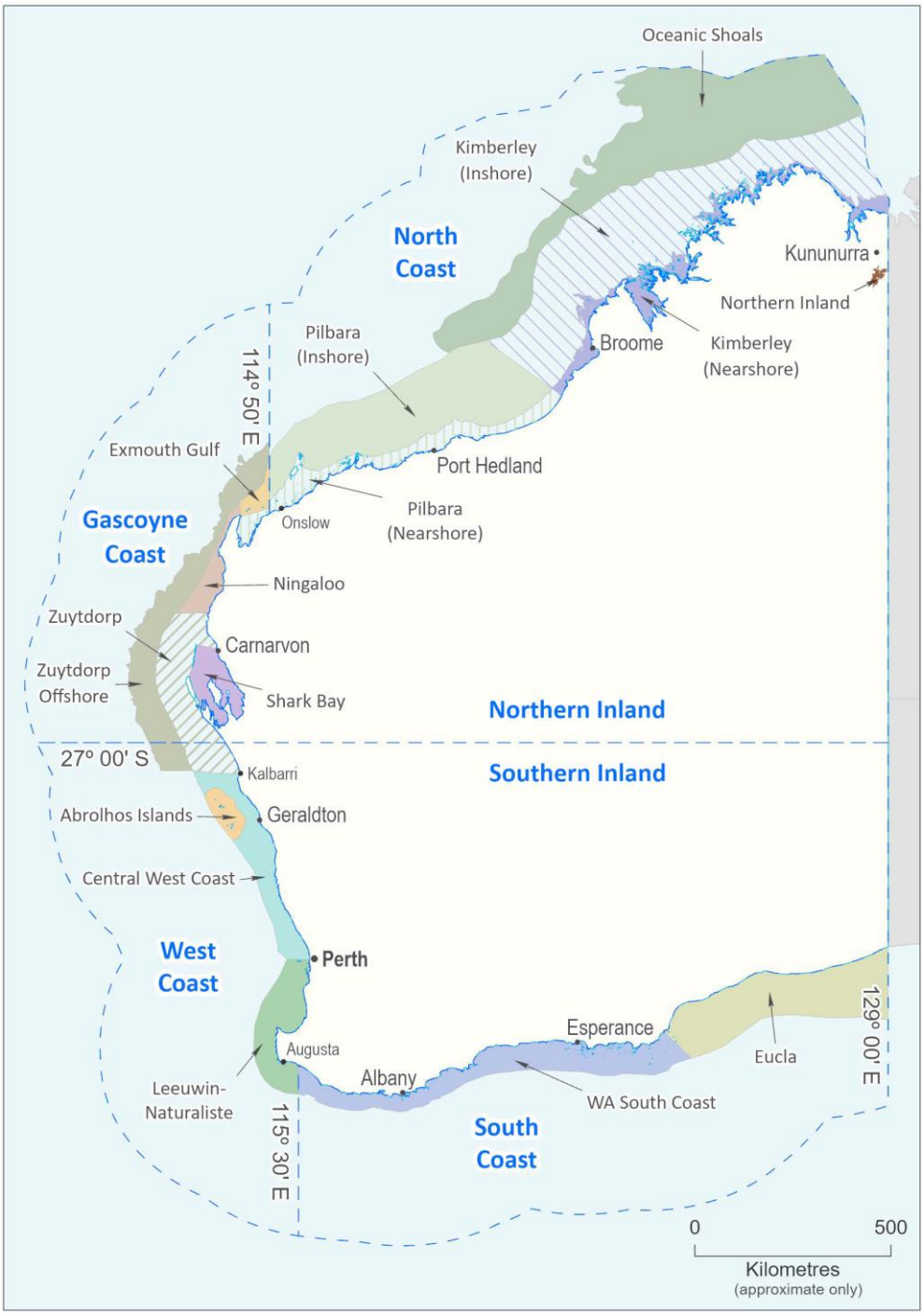

Figure 3 The Bioregions of Western Australia.

3.1 West Coast Bioregion

The marine environment of the WCB (Figure 3) between Kalbarri (27.70° S 114.16° E) and Augusta (34.31° S and 115.16° E) is predominantly a temperate oceanic zone, but it is heavily influenced by the Leeuwin Current, which transports warm tropical water southward along the edge of the continental shelf. Most fish species of the region are temperate, in keeping with the coastal water temperatures that range from 18°C to about 24°C. The Leeuwin Current is also responsible for the existence of the Abrolhos Islands coral reefs at latitude 29° S and the extended southward distribution of many tropical species along the WCB and even into the SCB.

The Leeuwin Current, which can be up to several hundred kilometres wide along the WCB, flows most strongly in autumn / winter (April to August) and has its origins in ocean flows from the Pacific through the Indonesian Archipelago (Cresswell and Golding 1980, Feng et al. 2003, Lourey et al. 2006). The current is variable in strength from year-to-year, flowing at speeds typically around 1 knot, but has been recorded at 3 knots on occasions (Cresswell and Golding 1980, Feng et al. 2003, Lourey et al. 2006). The annual variability in current strength is reflected in variations in Fremantle sea levels and is related to El Niño Southern Oscillation (ENSO) events in the Pacific Ocean. Weaker counter-currents on the continental shelf (shoreward of the Leeuwin Current), such as the Capes Current that flows northward from Cape Leeuwin as far as Shark Bay, occur during summer and influence the distribution of many of the coastal finfish species (Cresswell and Golding 1980, Feng et al. 2003, Lourey et al. 2006).

The most significant impact of the clear, warm, low-nutrient waters of the Leeuwin Current is on the growth and distribution of the temperate seagrasses. These form extensive meadows in protected coastal waters of the WCB, generally in depths of 20 m (but up to 30 m), and act as major nursery areas for many fish species.

The WCB is characterised by exposed sandy beaches and a limestone reef system that creates surface reef lines, often about 5 km off the coast. Further offshore, the continental shelf habitats are typically composed of coarse sand interspersed with low limestone reef associated with old shorelines. There are few areas of protected water along the WCB, the exceptions being within the Abrolhos Islands, the leeward sides of some small islands off the Midwest Coast, plus behind Rottnest and Garden Islands in the Perth metropolitan area.

The two significant marine embayments in the WCB are Cockburn Sound and Geographe Bay. In the WCB, there are four significant estuarine systems – the Swan-Canning, Peel-Harvey and Leschenault estuaries and Hardy Inlet (Blackwood estuary). All of these are permanently open to the sea and form an extension of the marine environment except when freshwater run-off displaces the oceanic water for a short period in winter and spring. Southward of Cape Naturaliste, the coastline changes from limestone to predominantly granite and becomes more exposed to the influences of the Southern Ocean.

3.2 South Coast Bioregion

The SCB (Figure 3) extends east from Augusta (34.310°S, 115.30°E) to the South Australian (SA) border. The continental shelf waters of the SCB are generally temperate but low in nutrients, due to the seasonal winter presence of the tail of the tropical Leeuwin Current and limited terrestrial run-off from an infertile landscape (Gaughan and Santoro 2018). Sea surface temperatures typically range from approximately 15°C to 21°C, which is warmer than would normally be expected in these latitudes due to the influence of the Leeuwin Current. The effect of the Leeuwin Current, particularly west of Albany, limits winter minimum temperatures (away from terrestrial effects along the beaches) to about 16°C to 17°C. Fish stocks in this region are predominantly temperate, with many species' distributions extending right across southern Australia. Tropical species are occasionally found, which are thought to be brought into the area as larvae as they are unlikely to form breeding populations.

The SCB is a high-energy environment, heavily influenced by large swells generated in the Southern Ocean. The coastline from Cape Leeuwin to Israelite Bay is characterised by white sand beaches separated by high granite headlands. East of Israelite Bay, there are long sandy beaches backed by large sand dunes, until replaced by high limestone cliffs at the SA border. There are few large areas of protected water in the SCB, the exceptions being around Albany and in the Recherche Archipelago off Esperance.

The western section of the coastline receives significant winter rainfall and hosts numerous estuaries fed by winter-flowing rivers. Several of these, such as Walpole/Nornalup Inlet and Oyster Harbour, are permanently open, but most are closed by sandbars and open only seasonally after heavy winter rains. The number of rivers and estuaries decreases to the east as the coastline becomes more arid. While these estuaries are influenced by terrestrial run-off and have relatively high nutrient levels (and some, such as Oyster Harbour and Wilson Inlet, are suffering eutrophication), their outflow to the ocean does not significantly influence the low nutrient status of coastal waters.

The marine habitats of the SCB are similar to the coastline, having fine, clear sand sea floors interspersed with occasional granite outcrops and limestone shoreline platforms and sub-surface reefs. A mixture of seagrass and kelp habitats occurs along the coast, with seagrass more abundant in protected waters and some of the more marine estuaries. The kelp habitats are diverse but dominated by the relatively small *Ecklonia radiata*, rather than the larger kelps expected in these latitudes where waters are typically colder and have higher nutrient levels.

4.0 Fisheries/Sectors Accessing the Resource

The Resource is accessed by two commercial fisheries; the WCRLMF (Section 4.1) and the SCCMF (Section 4.2) which are responsible for approximately 92% and 1%, respectively, of total annual landings (averaged over the past five years) (Figure 4). The Resource also supports a highly valued recreational and charter fishery which takes approximately 7% of all WRL landings (averaged over the past five years) (Figure 4).

Under the Integrated Fisheries Management (IFM) allocation decision, the recreational fishing sector has been formally allocated 5% of the western rock lobster Allowable Harvest Level (AHL), and 95% has been allocated to the WCRLMF. The AHL is determined annually in accordance with the sustainability and harvest (economic) objectives outlined in the *West Coast Rock Lobster Harvest Strategy and Control Rules 2014-2019*. To date, the recreational sector has not exceeded its 5% allocation under IFM.

A notional allocation exists for customary fishing of 1 tonne annually. If this allocation was fully accessed, it would account for less than 0.02% of total annual landings.

Harvest by the SCCMF is currently not considered within the IFM allocation decision.

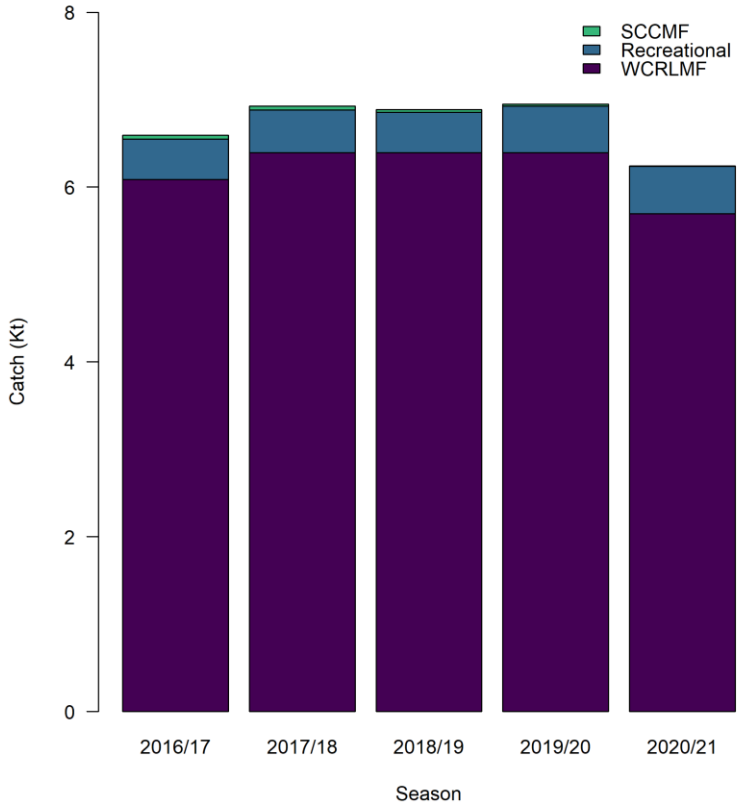

Figure 4 Catches of WRL by sector. Season refers to the year in which the season started. Note variations in season start dates mean that for WCRLMF the season begins in January of the year, and ends in January the following year, while for Recreational and SCCMF the season begins on 1st July of the year and ends on 30th of June the following year.

4.1 West Coast Rock Lobster Managed Fishery

4.1.1 *History of Development*

A full description of the history of the WCRLMF can be found in de Lestang et al. (2016).

The WCRLMF was one of the first managed fisheries in Australia, and the world, with management regulations implemented for harvesting of WRL in 1897 (de Lestang et al 2012). The WCRLMF captures WRL along the state's west coast, with its boundaries extending from Cape Leeuwin to North West Cape and comprising three fishing zones (Figure 5).

The fishery was declared limited entry in March 1963 when licence and pot numbers were capped. Since 1963, boat numbers have declined from 836 to approximately 235 (2021) due to management changes (pot reductions etc.) and consolidation for economic efficiencies (Figure 6). There was a significant drop in vessel numbers in 2008/09 and 2009/10 associated with the effort reductions. In recent seasons vessel numbers have remained at ~230 vessels, which typically pull around of 100 pots per trip.

From the 1980s to the mid-2000s, the annual catch averaged approximately 11,000 t, although it varied from 5,800 to 14,000 t based on levels of recruitment (Figure 6). Initially an input-controlled fishery, the fishery transitioned to an output managed fishery in 2009/10 with a Total Allowable Commercial Catch (TACC) limit of 5,500 t (± 10%). This TACC was maintained for the 2010/11 season using individual transferable quotas (ITQs). The transition of the fishery from effort-based management controls to an ITQ management framework was finalised in 2012 with the implementation of the *West Coast Rock Lobster Managed Fishery Management Plan 2012.*

This transition was in response to a historically low recruitment period from 2007 which necessitated a marked reduction in total annual catch, from averages of ~11,000 t under effort controls, to around ~5,500 t under quota. Since then, recruitment has improved and there has been a marked increase in biomass. However, catches have remained at ~ 6,000 t for commercial marketing and economic reasons.

The improved biomass and limited catch have seen a marked reduction in effort. From the 1970s through to the mid-2000s, the WCRLMF had in excess of 9 million pot lifts per season. This dramatically declined through the late 2000s with the series of effort controls and transition to quota. This has resulted in less than 3 million pot lifts in recent seasons (Figure 6).

Traditionally, the fishing seasons for Zones B and C of the WCRLMF operated from 15 November to 30 June annually, while Zone A, the Abrolhos Island zone, operated from 15 March to 30 June. From the 2010/11 fishing season, there was a progressive increase in season length, until year-round fishing occurred in 2013. Since then, fishing in every zone has commenced on 15 January and finished on 14 January the following year, with seasons referred to by the year in which they began. The exceptions were two extended "18 month" seasons which were implemented to address COVID-19 and market closure impacts on the fishery. These seasons ran

from 15 January 2020 to 30 June 2021 and 1 July 2021 to 14 January 2023 (current season), with a pro-rata quota equivalent to ~ 6,600 t.

The WCRLMF was first declared an approved Wildlife Trade Operation (WTO) in August 2002, in accordance with Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The WCRLMF has since been reassessed several times, most recently in 2018. This accreditation allows continued export of product from the fishery. As a result of the development and implementation of effective whale mitigation measures (Section 5.2.1), the requirement for three yearly assessments was removed and the fishery was moved to a 10-year assessment schedule. The next WTO assessment is due to occur in May 2025.

The WCRLMF was the first fishery in the world to receive MSC certification as a sustainable fishery in 2000 and was recertified in 2006, 2012 and 2017. The fishery is currently undergoing assessment for its fourth re-certification.

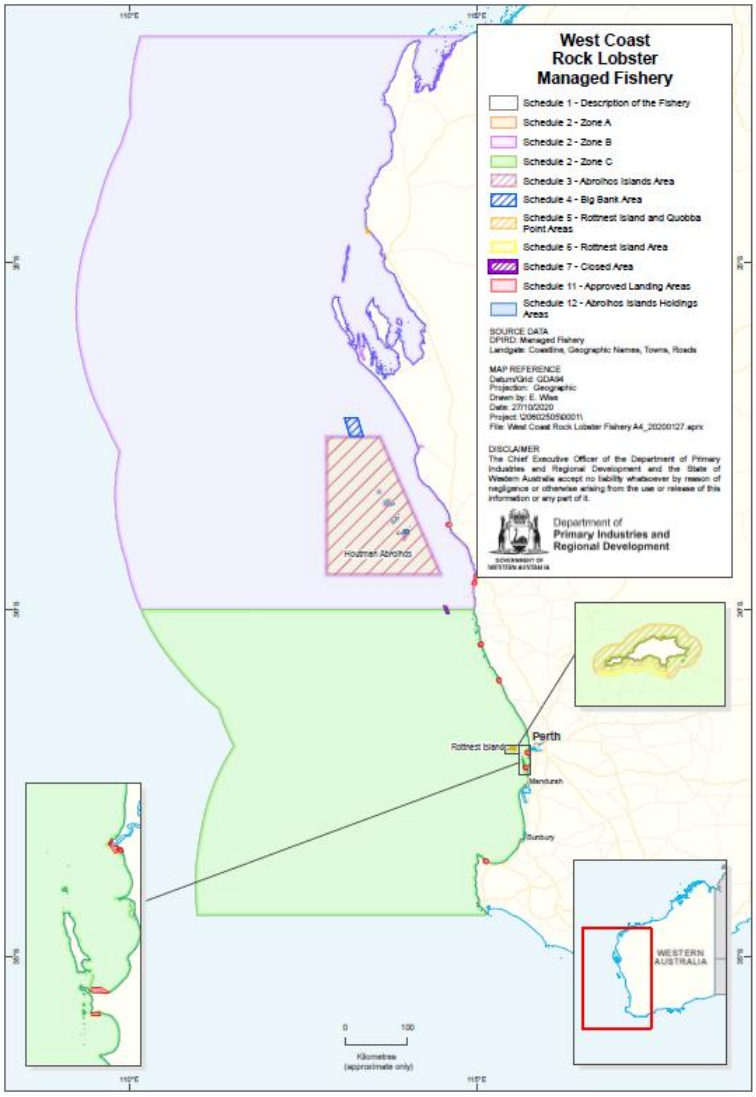

Figure 5. Management boundaries of the West Coast Rock Lobster Managed Fishery.

Figure 6 Seasonal catch, effort and number of vessels in the West Coast Rock Lobster Managed Fishery.

4.1.2 *Current Fishing Activities*

For full description of the current fishing activities can be found in de Lestang et al. (2016).

The WCRLMF is regulated by the *West Coast Rock Lobster Managed Fishery Management Plan 2012.* There are currently 720 licences in the fishery, with ~ 235 boats actively fishing.

The WCRLMF is primarily managed via output controls by way of a ITQ management system which limits the amount (kg) of WRL that can be harvested within the TACC limit. The management framework also limits the number of pots which may be used under each licence, calculated based on the number of ITQ units. WCRLMF entitlement units are conferred as kilograms within one of the three zones.

The WCRLMF is managed in three zones: within the Abrolhos Islands zone (Zone A), north of latitude 30° S (Zone B), and south of latitude 30° S (Zone C) (Figure 5). This zoning arrangement distributes effort relatively evenly across the entire fishery and allows for the implementation of management controls aimed at addressing zone-specific issues, which has previously included different maximum size restrictions in the northern and southern regions of the fishery.

Rock lobsters are totally protected at some stages in their lifecycle. When lobsters are protected, fishers must not take them or have them in their possession. Fishers are required to immediately return undersize, berried and/or tarspot lobsters to the water from which they were taken, before the next pot is pulled and before taking another lobster when diving.

For the commercial sector, rock lobster with setose (fine hair-like filaments underneath the tail) are commercially protected between 1 November and 30 April the following year.

Fishers are required to report all catches to DPIRD in a Catch Disposal Record (CDR) and any interactions with ETP species.

Until recently, almost all product was “live” and shipped predominantly to China. The outbreak of COVID-19 resulted in the effective closure of the live lobster trade to Asia in late January 2020. As a result of this dramatic reduction in demand, operators in the WCRLMF essentially stopped fishing from late January until the end of March 2020.

To account for these major perturbations to the industry, a TACC (9,000 t) was recently allowed to be caught over two extended (18 month) seasons: 15 January 2020 to 30 June 2021, and 1 July 2021 to 14 January 2023. The fishery is currently discussing alternative start dates, but once this has been decided and transitioned to, seasons will return to a 12-month season.

4.1.3 *Fishing Gear and Methods*

All lobsters are captured using baited pots. These are typically a wooden batten pot which formerly had very specific restrictions on their dimensions (Figure 7). The majority of pots used by fishers are still made to these dimensions despite a change to the regulations in 2016. In an attempt to provide greater flexibility for fishers and reduce regulation, the specified dimensions of a pot were changed to specify that a rock lobster pot must not exceed 1000 mm in diameter (width) and 500 mm in height (Schedule 13 of the *Fish Resources Management Regulations 1995* (FRMR)).

Pots are set on or adjacent to limestone reef or on sand-dominated migratory pathways of rock lobsters at certain times of the year. They are marked by surface floats which are attached to the pots through lines (plastic rope). These lines are used to haul the pots which are set mainly between 1 – 7 days.

Additional alterations to fishing gear have been specifically implemented at certain locations or times of the year to reduce interactions with ETP species. These specific modifications to fishing gear are explained in Section 5.2.

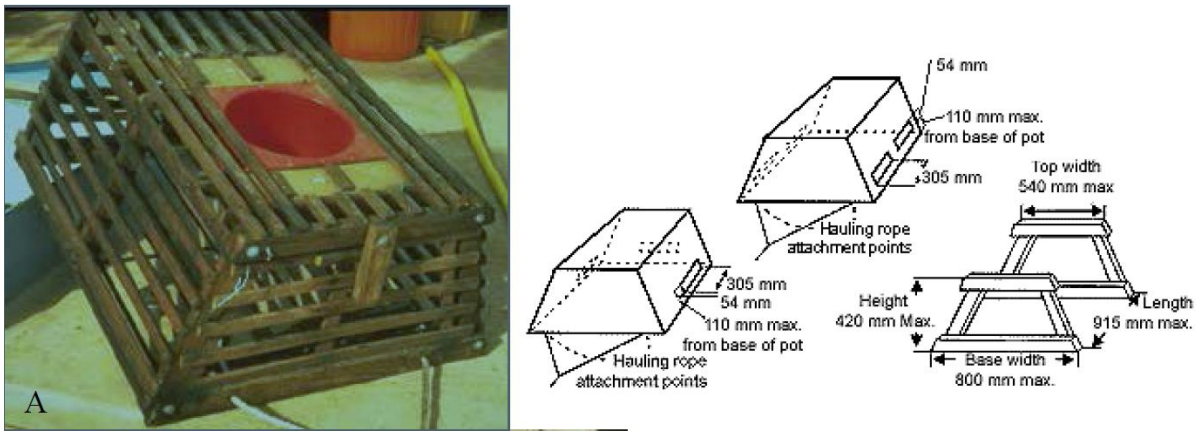

Figure 7. Image of a western rock lobster pot (left) and the previous specified dimensions of pots (right) which are the size of most pots in the fishery.

4.1.4 *Captured species*[1]

4.1.4.1 *Western rock lobster*

The primary captured species of the WCRLMF is the western rock lobster (*Panulirus cygnus*). The fishery operates throughout the majority of the WRL's geographic range, and fishing behaviour tends to reflect and target the behaviours of this species, i.e., fishing in deeper waters to capture migrating animals during the "whites" migration.

The WRL makes up over 99% of the total catch of the WCRLMF. Catches over the past 5 years have been relatively stable, with only a moderate decrease in 2020 as a result of COVID-19 (Figure 8). Catches for 2021 (Jan 15 2021 – Jan 14 2022) are not yet available.

[1] This refers to any species which is captured by the fishery, be it targeted, non-targeted, discarded or retained (for recreational or commercial purposes)

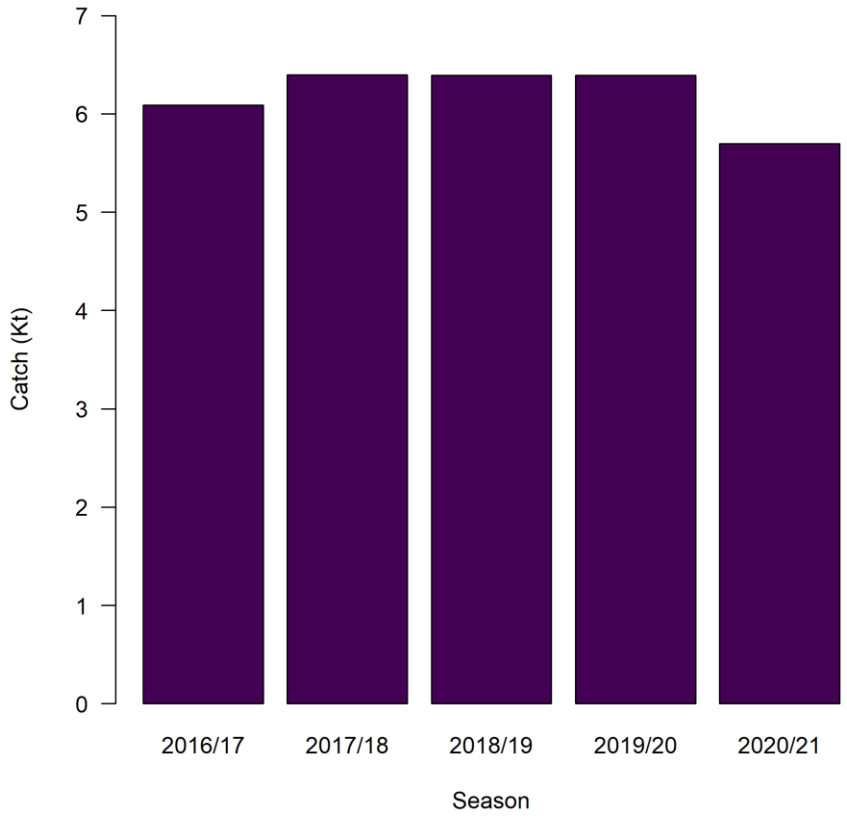

Figure 8 Catches of WRL (kilo tonnes) in the WCRLMF over the past five seasons.

4.1.4.2 *Squid*

Squid (*O: Oegopsida* and *Myopsida*) are an open access resource in Western Australia and can be targeted and retained by any commercially license fishing boat. WCRLMF fishers are not permitted hooks and lines on board their vessel to eliminate the targeting of finfish, though they are permitted a squid jig. During the past 5 years there have been three instances of WCRLMF fishers targeting and landing squid. One vessel in 2016 recorded 1.4 kg of squid, while a separate vessel in 2020 landed squid on two occasions totalling 36.5 kg.

4.1.4.3 *Western rock octopus*

WCRLMF fishers are also able to retain and sell western rock octopus (WRO) (*Octopus djinda*) that are caught while fishing for WRL. All catch of this species must be detailed on their CDR and this data is included in the stock assessment for the MSC certified Octopus Interim Managed Fishery (see Hart et al. 2021). Catches of WRO in the WCRLMF have been relatively stable, around 12,500 kg, with only a slight increase to 15,000 kg in the 2019 season (Table 1).

4.1.4.4 *Champagne crabs*

WCRLMF fishers are also able to retain and sell champagne crabs (*Hypothalassia acerba*) that are caught while fishing for WRL. Captures occur when WCRLMF are targeting migrating deep-water “whites” lobsters. All catch of this species must be detailed on their CDR and this data is included in the stock assessments of this species (How and Baudains 2021). Two commercial fisheries actively target this species, the MSC certified West Coast Deep Sea Crustacean Managed Fishery and the South Coast Crustacean Managed Fishery.

Catch of champagne crabs in the WCRLMF have been relatively stable, around 1,500 kg, with only a slight increase in recent seasons to around to 3,000 kg in 2019 and just over 2,000 kg in the 2020/21 season (Table 1).

4.1.4.5 *Finfish and Elasmobranchs*

A range of finfish species are captured inadvertently in WCRLMF pots. This suite of demersal species includes prized recreational species (e.g. WA dhufish, pink snapper) which are able to be retained by fishers for personal consumption within recreational limits (e.g. bag and size limits), while other species (e.g. morwong and moray eels) are discarded upon capture.

The retention of finfish by WCRLMF is incorporated as commercial take (despite not being sold) in the stock assessment of the West Coast Demersal Scalefish Resource (Fairclough and Walters 2021). Catch of finfish and elasmobranchs by WCRLMF is dominated by baldchin grouper (*Choerodon rubescens*), with approximately 2,200 kg landed annually. The remaining finfish and elasmobranch species caught by the WCRLMF all contribute to ~ 500 kg or less per species annually (Table 1).

Table 1 Quantity (kg) for the 2016 – 2020 fishing seasons and five-year average catch of bycatch species from the West Coast Rock Lobster Managed Fishery. Grey shading indicates those species which can be sold commercially. *2020/21 figures relate to an 18-month season (15 January 2020 - 30 June 2021).

	Catch (kg)					Ave annual
Species	2016/17	2017/18	2018/19	2019/20	2020/21*	catch
Western Rock Lobster	6,087,083	6,394,630	6,392,448	6,392,328	5,696,323	6,192,562
Octopus	12,434	12,328.5	12,438	15,052	12,764	13,003
Champagne crab	1,3534	1,582	1,170	2,929	2,182	1,843
Cuttlefish	192	142	168	402	405	262
Southern Rock Lobster	9	30	17	0	30	17
Tropical Rock Lobster	0	3	0	0	4	2
Slipper lobster	2	0	0	0	0	0
Baldchin groper	1908	1515	2355	2183	3130	2218
Pink snapper	208	252	623	613	919	523
Redthroat emperor	121	193	238	391	286	246
Wobbegong shark	161	169	254	216	83	177
Breaksea cod	194	76	193	179	183	165
West Australian dhufish	93	41	99	78	58	74
Crabs	51	37	88	22	5	41
Leatherjacket	10	4	18	20	56	22
Spangled emperor	51	24	20	0	0	19
Rockcods	5	1	2	36	9	11
Other fishes	6	22	0	0	0	6
Scorpionfishes	1	2	1	5	1	2
Mud crab	0	0	0	10	0	2
Flatheads	2	2	1	1	1	1
Foxfish	4	2	0	0	1	1
Common Coral trout	5	0	0	0	0	1
Goldspotted rockcod	2	0	0	0	3	1
Parrotfishes	1	1	1	0	0	1
Unidentified	0	0	0	3	0	1
Morwong	0	2	0	0	0	1
Grass emperor	2	0	0	0	0	0
Western wirrah	1	0	1	0	0	0
Moray eel	1	1	0	1	0	0

4.2 South Coast Crustacean Managed Fishery

4.2.1 *History of Development*

Fishing for offshore crustaceans (i.e. rock lobsters and deep sea crabs) on WA's south coast began in the late 1960s, with the Windy-Harbour Augusta region (subsequently the Windy Harbour-Augusta Managed Fishery [WHARLMF]) being fished by full-time and part-time fishers since the late 1970s. The fishery primarily landed rock lobsters (WRL and southern rock lobster), with landings of deep-sea crabs (champagne, giant and even small amounts of crystal crab) not reported until early 1990s.

Fishing for WRL on the south coast began under formal management with the establishment of the WHARLMF and the Esperance Rock Lobster Managed Fishery (ERLMF). Access to the WRL resource outside these managed fisheries was through a pot regulation (Regulation 95) to take WRL and a condition attached to a fishing boat licence (Condition 105) which permitted the take of deep-sea crabs. This regulation and condition permitted access in both the Albany and Bight regions and the retention of deep-sea crabs outside of the lobster season (15 November – 30 June) in the WHARLMF.

To meet the need to bring all WA fisheries under a managed fishery framework, the establishment of a South Coast Crustacean Managed Fishery (SCCMF) was proposed, by combining the pot regulation (Regulation 95) and Condition 105 with the two existing managed fisheries (WHARLMF and ERLMF). On 1 July 2015, the SCCMF was formally established, with four coastal zones reflecting the historical fishing arrangements and an additional an offshore zone which was open to all license holders in the SCCMF (Figure 9).

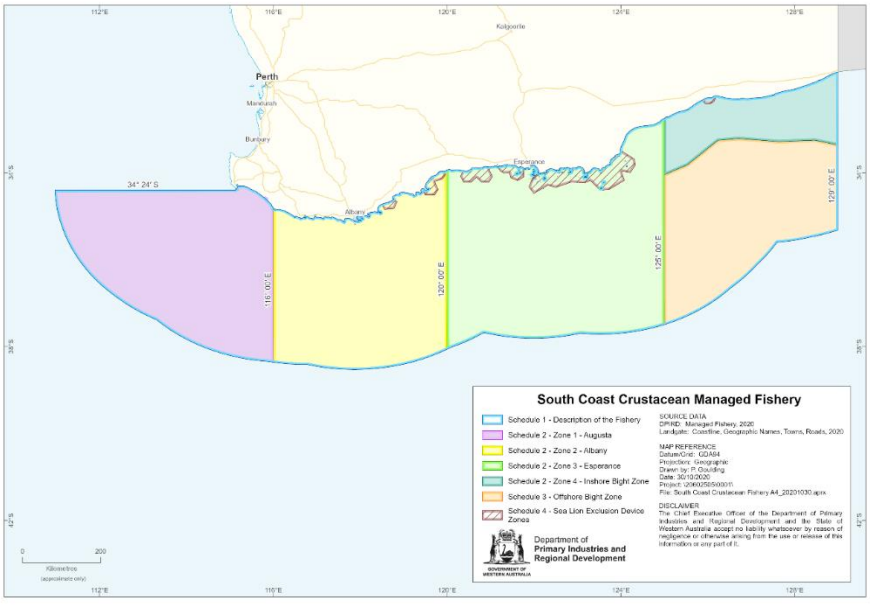

Figure 9 Management boundaries of the South Coast Crustacean Managed Fishery. Zone 1 shown in purple.

4.2.2 *Current Fishing Activities*

WRL is almost exclusively landed in Zone 1 and is accessed by two vessels that currently operate in Zone 1 of the SCCMF. Their combined capacity is 350 pots, and they are able to fish for rock lobster (primarily WRL) from 15 November to 30 June each year. Outside of this period, they are able to continue to fish for other crustaceans (e.g. deep sea crabs) but they are unable to retain rock lobster.

Like the WCRLMF, fishers are required to immediately return undersize, berried and/or tarspot lobsters to the water from which they were taken (see Section 4.1.2). Rock lobster with setose (fine hair-like filaments underneath the tail) are commercially protected between 1 November and 30 April the following year, in Zone 1 of the SCCMF.

DPIRD is currently consulting on a range of management plan amendments which is focused on transitioning the SCCMF to an output managed fishery. Currently, the proposed amendments will confirm units of catch (kg) for each species in the zone. There will be no change to fisher allocations, but capacity will be expressed as weight of a species as opposed to pots. There is no proposed changed to the amount of pots fishers can use, though it is proposed that fishers will be able to retain all species year-round. It is anticipated that these changes will be implemented for 1 July 2022.

4.2.3 *Fishing Gear and Methods*

Given the primary captured species (see Section 4.2.4) in Zone 1 is WRL, fishers use very similar fishing gear to those in the WCRLMF (see Section 4.1.3). As there are no specified sea-lion exclusion zones in Zone 1, fishers are not required to modify their gear to meet these requirements. Additionally, there are currently no modifications to fishing gear required for SCCMF fishers to mitigate whale entanglements. However, as part of the proposed management amendment, which is due to take effect 1 July 2022, modifications will be required. For more detail see Section 5.2.1.

4.2.4 *Captured species*[2]

A range of species are captured in Zone 1 of the SCCMF. Catches are dominated by WRL in most years, however all captured species exhibited extreme inter-annual fluctuations in landings, due in part to abundance and market forces (Figure 10).

[2] This refers to any species which is captured by the fishery, be it targeted, non-targeted, discarded or retained (for recreational or commercial purposes)

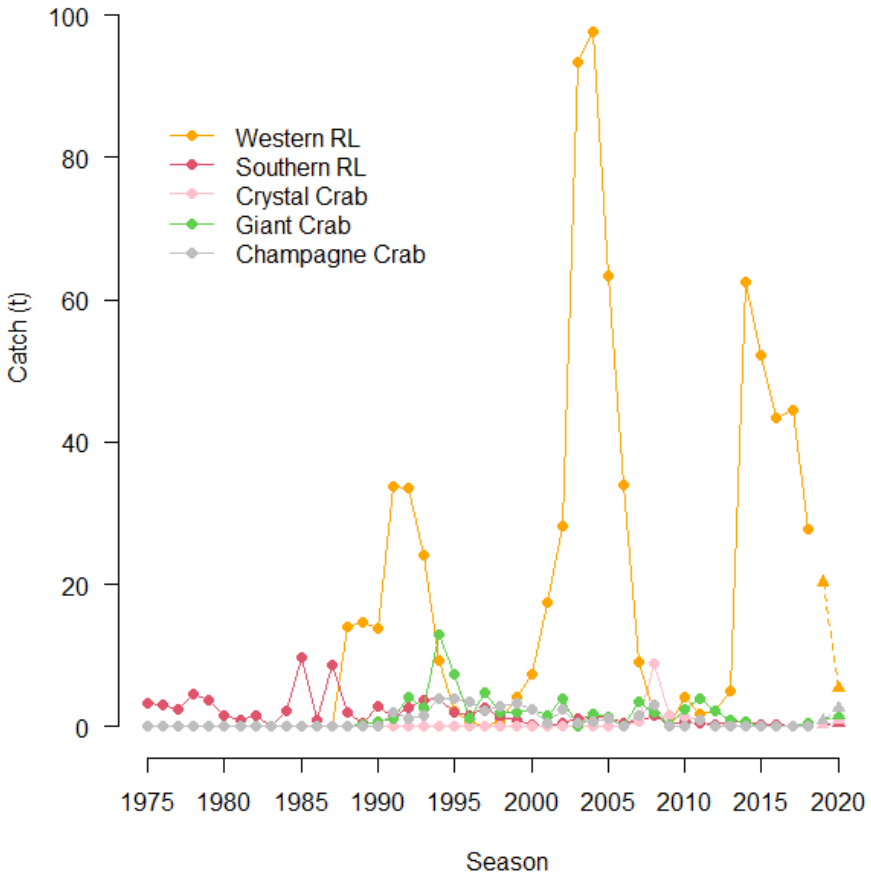

Figure 10 Seasonal (year indicates first year of season, e.g. 1975 = 1975-76 season) catches of five retained species in Zone 1. Triangles and dashed lines denote the period where trip returns were used compared to the preceding period where monthly returns were used.

4.2.4.1 *Western rock lobster*

Zone 1 accesses WRL in the southern extent of their distribution (Figure 2), and only comprise a small component (1%) of total annual landings of the resource (Figure 4). Catches of this resource within Zone 1 have been highly variable and have correlated well with puerulus settlement averaged four to five years previously at Cape Mentelle. This puerulus site is located ~ 40 km north of the Zone 1 boundary, in the West Coast Rock Lobster Managed Fishery. Strong Leeuwin Currents have been shown to influence puerulus settlement at Cape Mentelle, thus it appears that these currents also impact the biomass of WRL located in Zone 1, with stronger currents leading to greater biomass.

4.2.4.2 *Southern rock lobster*

Southern rock lobster (*Jasus edwardsii*) is an intermittently targeted species in Zone 1, with the zone accessing southern rock lobster at the western extent of their distribution. Catches have remained reasonably consistent over ten years, ranging from 99 – 731 kg, with an average of 352 kg.

4.2.4.3 *Crystal crab*

Crystal crab (*Chaceon albus*) is an intermittently targeted species in Zone 1 (in some years is has been targeted but in others, when western rock lobster catches are high, it has not). Catches of this species have varied markedly over the past ten years, ranging from 0 – 907 kg, with landings only occurring in four years. In the four years when crystal crabs were landed, catches were either ~250 kg or ~ 850 kg with an average of 566 kg.

4.2.4.4 *Champagne crab*

Champagne crab (*Hypothalassia acerba*) is an intermittently targeted species in Zone 1. Catches varied markedly ranging from 0 – 2,504 kg, with landings only occurring in six of the last 10 years. When champagne crabs were landed, catches were either ~30 kg or > 850 kg. Last season (2020/21) there was a 10-fold increase in targeted effort, which coincides with an emerging market for this species.

4.2.4.5 *Giant crab*

Giant crab (*Pseudocarcinu gigas*) is considered an intermittently targeted species in Zone 1 (in some years is has been targeted but in others, when western rock lobster catches are high, it has not). Catches varied markedly ranging from 0 – 3,872 kg, with landings occurring in seven of the last 10 years. There has been a decline in the catches of giant crabs with decline from 3,872 – 0 kg from 2011/12 to 2015/16, before increasing again from 0 in 2017/18 to 1,464 kg in 2020/21. This is likely due to shifts in targeting other species, while also noting that giant crab in Zone 1 are at the western extent of their distribution.

4.2.4.6 *Minor species*

Prior to the 2019/20 season, the statutory return of the SCCMF was a monthly catch and effort return (CAES return). This did not necessitate the recording of some species which were discarded or retained for personal consumption. Since the 2019/20 season, fishers have been required to compete a trip return where all species and quantities are recorded. Therefore, the time series of bycatch in Zone 1 is restricted to the last two seasons.

Table 2 Number of retained or discarded bycatch species from Zone 1 of the South Coast Crustacean Managed Fishery from statutory trip returns

Species	2019/20		2020/21	
	Retained	Discarded	Retained	Discarded
Octopus	30	1		
Cuttlefish	5	5		
Spear lobster				1
Pink slipper lobster				3
Conway fish				1
Knife Jaw		3		
Pink snapper		1		
Ling			1	
Eel				1
Spur dog shark				1
Green-eye shark				1
7 Gill Shark				2
Deepwater shark				1

4.3 Recreational Fishery

4.3.1 *History of Development*

Recreational fishing for WRL in WA occurs state-wide with an annual licence giving fishers access to four species: WRL, southern rock lobster (*J. edwardsii*) and tropical lobsters (*P. ornatus* and *P. versicolour*). A general amateur licence was introduced in 1932, but was replaced in 1986 with the current fishery-specific recreational rock lobster licence (Melville-Smith and Anderton 2000). An umbrella licence, which collectively endorsed fishing for lobster, abalone, netting, marron and freshwater angling, was also in effect from 1986 to 2010.

The recreational fishery is managed by gear restrictions, size limits, protection of reproductive females, seasonal closures, daily bag and boat limits and possession limits (for the latest arrangements see: http://www.fish.wa.gov.au/Documents/recreational_fishing/licences/rec_licence_rock_lobster.pdf).

Recreational rock lobster catches have been monitored by a variety of survey methodologies since the mid-1980's. The initial use of a mail recall survey has been gradually replaced with phone diary and recall surveys in recent years.

Prior to 2008/09, when recreational catches were not limited by allocation between sectors, the recreational catch varied from year to year, but remained below 4% of the commercial catch. This estimates of recreational catch, and the potential for long-term growth in catch from the recreational sector, was considered in determining allocation of 95% to the commercial and 5% to the recreational sectors (Department of Fisheries 2005). Implementation of the *West Coast Rock Lobster Managed Fishery Management Plan 2012* saw determination of the TACC and Total Allowable Recreational Catch (TARC) for monitoring resource allocations between the commercial and recreational sectors, respectively (de Lestang et al. 2012, Reid et al. 2013). The annual Allowable Harvest Level was set according to Maximum Economic Yield (MEY) with a TARC based on 5% of the upper limit of MEY.

The recreational fishing season was previously a 9-month period from 16 October to 30 June the following year but has been increased to a 12 month season since 2018 to align with the WCRLMF. Recreational fishing is concentrated in inshore regions from Exmouth (latitude 21°47´S) to Augusta (latitude 34°24´S), with the majority of recreational fishing occurring in waters off Perth (31°57´S) and Geraldton (28°46´S). Recreational fishing activity is highest during November–January (Christmas holidays) when 'whites' are easily accessible.

The total catch and effort from charter boat-based recreational fishers has been monitored with mandatory Tour Operator Returns (charter logbooks) since 2001. Charter fishing effort is mainly directed at scale-fish and catches of lobster are minimal.

A 3-year rock lobster charter trial commenced in November 2019 and includes increases to the number of pots allowed per vessel (from six to 12) as well as increased boat limits (from 24 up to 40 for vessels licensed for six to 10 passengers). New catch reporting requirements are currently being implemented to evaluate the

success of this trial and will provide an understanding of the effect of these new regulations on catches from tour operator vessels.

4.3.2 *Current Fishing Activities*

For the 2020/21 recreational season (1 February 2020 - 31 January 2021), there were 56,064 licensed recreational fishers (11.6 per cent increase from the previous season) who retained an estimated 526 tonnes of rock lobster taken by potting and diving, plus a charter catch estimated to be 16 tonnes.

The total recreational and charter catch for the 2020/21 season was estimated to be 542 t, and is the highest catch on record. While the total estimated recreational catch exceeds the 2020/21 TARC (533 t), using the 5-Year Rolling Average (YRA) model, the 5-YRA catch was 498 t and the 5–YRA of the TARC was 503 t. This represents 4.9 per cent of the AHL.

The increasing trend in catches was expected due to the easing of management regulations, and the conservative level of fishing by the commercial sector which has resulted in increased abundance and size of western rock lobster.

4.3.3 *Fishing Gear and Methods*

Recreational fishing for WRL can occur from a boat and from the shore. Recreational fishers can target WRL with pots (limit of two pots per licence), by diving (using a loop, shepherds hook, or blunt hook and dive gear such as scuba, snorkelling or hookah), and by hand collecting in the intertidal zone. Fishing for WRL from charter vessels can occur using pots and by diving. Pots have size and shape restrictions and require escape gaps, consistent with the requirements of rock lobster pots used by the commercial sector (see Section 4.1.3).

4.3.4 *Captured species*[3]

4.3.4.1 *Western Rock Lobster*

Catches of WRL in the recreational fishery increased from around 150 t in the early 2000s to around 500 t in the late 2010s and were at a record level of 542 t in the 2020/21 fishing season (Figure 11).

All recreational catches of WRL are accounted for in the stock assessment of the WCRLMF, see Section 4.1.4.1.

[3] This refers to any species which is captured by the sector, be it targeted, non-targeted, discarded or retained for recreational purposes

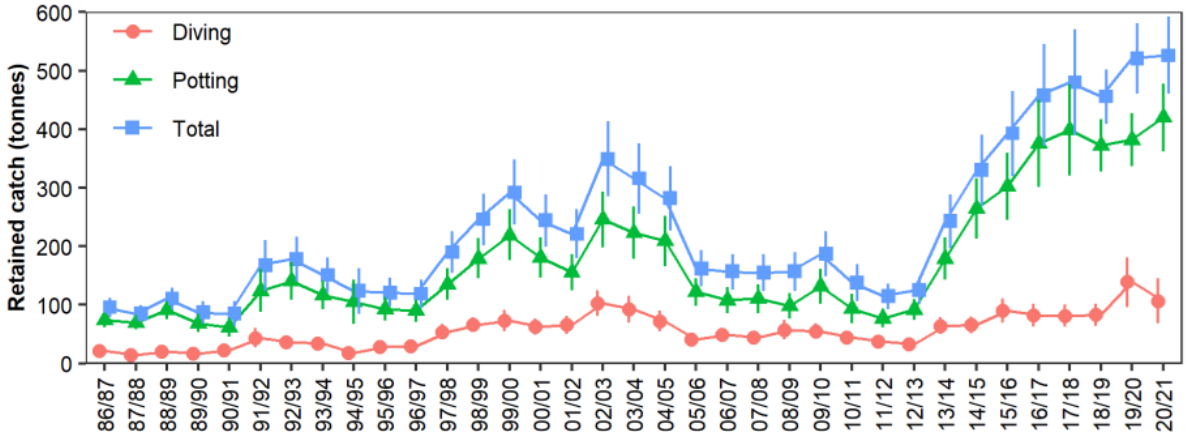

Figure 11 Time series of retained catch (95% Confidence Intervals) of Western Rock Lobster by licensed fishers by potting (green), diving (red) and total (blue) from 1986/87–2020/21. Estimates for 1986/87–2017/18 from Trinnie et al. (2021). Note: A RL licence was required to fish from a charter boat prior to 2016/17 and these catches are included in the retained catch from 1986/87–2016/17.

4.3.4.2 *Other species*

There are no data on species other than WRL which are captured (retained or discarded) by recreational fishers. Diving for lobsters is highly targeted with no bycatch anticipated other than infrequent captures of southern rock lobsters which would also be “looped” by divers. Given the similar nature of the pot fishing gear, it is suspected that bycatch species would be similar to those of commercial pots (Section 4.1.3).

4.4 Customary fishing

Under Section 6 of the *Fish Resources Management Act 1994*, Aboriginal people, who have traditionally used the resources of an area of land or water in a traditional manner, are entitled to continue using those resources in that manner. An Aboriginal person is not required to hold a recreational fishing licence to the extent that the person takes fish from any waters in accordance with continuing Aboriginal tradition if the fish are taken for the purposes of the person or his or her family and not for a commercial purpose.

Although there are no records required for indigenous fishers taking WRL under customary take, the catch is thought to be very low (less than one tonne). In the assessment of the fishery, customary take is arbitrarily assigned as one tonne. This is in line with the integrated fisheries management (IFM) of the stock.

4.5 Compliance

Operational Compliance Plans (OCP) guide the enforcement of management arrangements for each sector which accesses the Resource. OCPs are informed and underpinned by a compliance risk assessment and are reviewed every 1-2 years. OCPs have the following objectives:

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

Compliance strategies and activities that are used to protect the Resource include:

- land and sea patrols;
- catch validation against managed fishery licences for the WCRLMF and SCCMF, and recreational rock lobster fishing licences for the recreational sector;
- inspections at wholesale and retail outlets, and processing facilities;
- inspections of fishing vessels in port and at-sea;
- entitlement monitoring of the WCRLMF via FishEye; and
- aerial surveillance.

5.0 Ecological Impacts

The ecological impacts of fishing for the Western Rock Lobster Resource are initially assessed based on the following component tree (Figure 12).

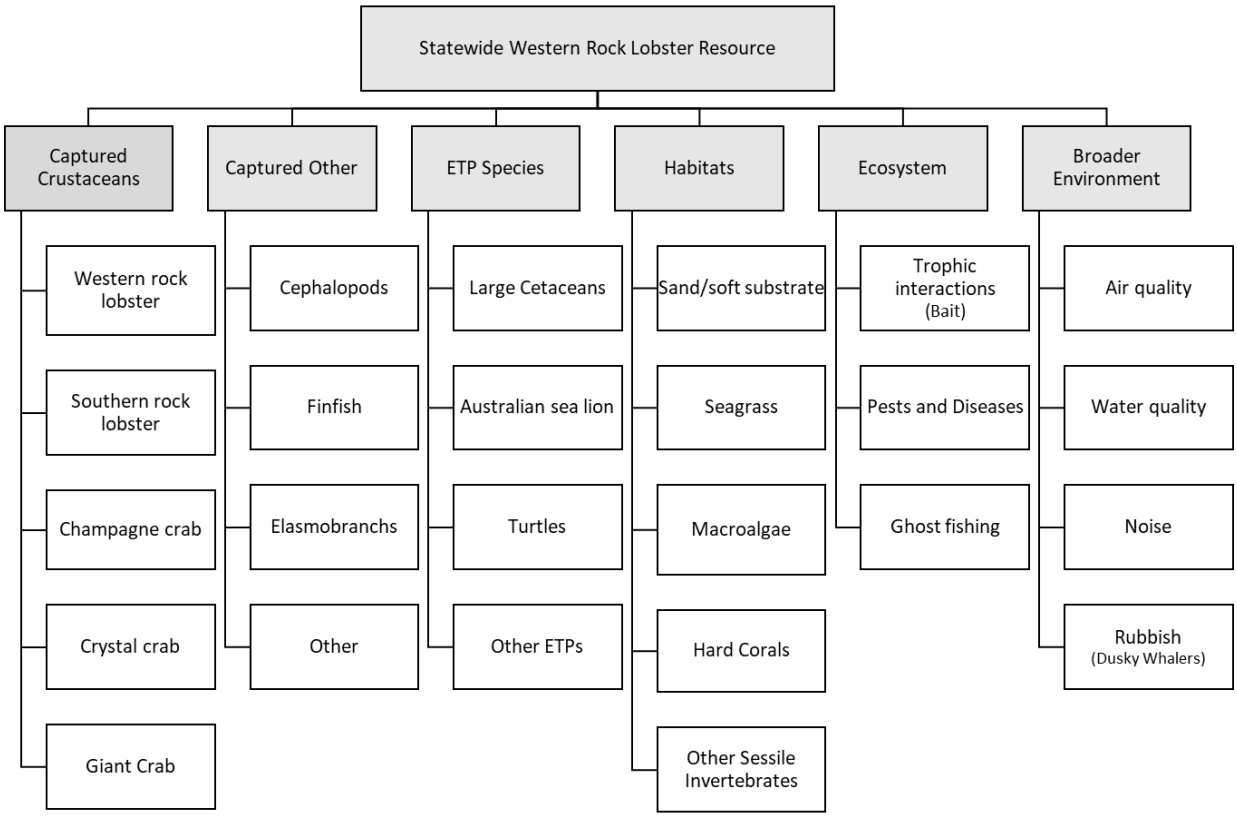

Figure 12 Component tree for the assessment of the effect of fishing for the western rock lobster resource on the marine ecosystem

5.1 Captured species

5.1.1 *Western Rock Lobster*

Of the four fisheries accessing the WRL resource, the WCRLMF has the greatest impact, accounting for 92% of all catch of WRL. Stock assessment and management of this fishery also accounts for the recreational catches, 7% of total landings, and therefore acocunts for 99% of all landings.

Management of the WCRLMF is based on maintaining an acceptable status of zone-specific breeding stocks relative to their threshold Biological Reference Points (BRP), which are designed to:

"Ensure that the egg production in each Zone of the fishery remains above its threshold level and the probability of still being above this level in five years' time is at least 75%." (de Lestang et al. 2012)

DPIRD has an ongoing program to monitor settlement of puerulus, catches of the commercial fleet (through on-board sampling and catch returns), the breeding stock, recreational catches, and environmental conditions. This information is used to assess

changes in the western rock lobster stock and input into an integrated population model which forms the basis of advice for management decisions.

Stock assessment for WRL in the WCRLMF is based on a number of empirical and modelled indices that are considered collectively in a “weight-of-evidence” approach and used to inform a risk assessment on the sustainability of the fishery. The maximum risk score for the Western Rock Lobster resource in the West Coast Bioregion was 4, which was generated by the combination of a high likelihood (4) of minimal stock depletion (1). This constitutes a **LOW** risk which is the minimum acceptable risk level (de Lestang et al. 2021).

As part of a recent assessment of the component of the WRL resource in Zone 1 of the SCCMF, an examination of the impacts of variable catch limits (20 – 100 t) within Zone 1 for western rock lobster was undertaken using the integrated population model. This did not indicate and any variation in the sustainability of the fishery that that reported above for the bulk of the resource.

5.1.2 *Southern Rock Lobster*

Southern rock lobster (*J. edwardsii*) is actively targeted by fishers of the SCCMF but is a bycatch of the WCRLMF. These fisheries are at the western edge of the species distribution, with catches in Western Australia being dominated by eastern zones (Zones 3 & 4) of the SCCMF. Consisting of a single genetic stock, the total WA take of southern rock lobster however is small compared to take throughout the rest of its geographic range which includes South Australia, Victoria, Tasmania and New Zealand.

There is some concern over the stock status of southern rock lobster. Australia-wide, southern rock lobster egg production has increased in recent years, but stocks in several jurisdictions remain close to their limit reference points (Linnane et al 2021). Juvenile and commercial catch rates in many jurisdictions have continued to remain low. In Western Australia, commercial catches and catch rates of southern rock lobster have been at very low levels over the past few seasons (How and Baudain 2021). Furthermore, it remains unknown what contribution egg production in Western Australia contributes to the overall larval pool and to recruitment in WA (Linnane et al 2021). The assessment of southern rock lobster in the SCCMF indicates a **MODERATE – HIGH** sustainability risk, with management actions implemented to address risk (How and Baudains 2021).

The catches of southern rock lobster from fishers accessing the WRL resource are very low, with ~ 500 kg taken during the 2020 season, which represents < 3% of the take of the species in Western Australia (Table 3).

5.1.3 *Champagne Crab*

Champagne crab (*H. acerba*) is a bycatch species of deep water fishing for migrating WRL in the WCRLMF, and a targeted species for fishers in the SCCMF. An assessment of champagne crab indicated the stock to be sustainable and at a **LOW** risk of depletion. Catches from fishers accessing the WRL resource accounted for 71% of a take of champagne crab in WA (Table 3). The remaining take occurred in the West

Coast Deep Sea Crustacean Managed Fishery (WCDSCMF) which has an annual TAC of ~ 20 t, though this has yet to be fully exploited due to continued market development (How and Baudains 2021b).

5.1.4 *Crystal Crab*

Due to the depth crystal crabs (*C. albus*) inhabit, they are not captured by the WCRLMF. However, fishers in the SCCMF actively target this species, with ~ 900 kg retained in 2020 (Table 3). This is the major species for the WCDSCMF which has a TAC of 154 t in 2020. This fishery was assessed as having a **MEDIUM** risk of stock depletion in 2020 and remains as a MSC certified fishery (How and Baudains 2021 b). Therefore, the catches of fishers accessing the WRL resource account for <1% of the take of crystal crabs in WA (Table 3).

5.1.5 *Giant Crab*

Giant crab (*P. gigas*), while a single genetic stock throughout its geographic range, is assessed nationally at a jurisdictional level. Length-based modelling indicates that the Tasmanian giant crab fishery is depleted and likely recruitment impaired (Hartmann et al. 2021). By contrast, the Victorian and South Australian assessments of giant crabs are assessed through catch rates to inform jurisdictional TACs. Victoria's TAC was reduced from 25 t in 2011 to 10.5 t in 2014 where it has remained since. However, there continues to be a decline in the catch rates though they are still above the limit reference point. Catches in South Australia have remained relatively stable between 15 and 20 t since 2010 and catch rates remain above their trigger level for TAC reductions. In Western Australia catches have remained between 6 – 14 t since 2010 and are accessed across a wide geographic area (Fremantle – Esperance), indicating that the current level of fishing is unlikely to cause recruitment impairment.

The national variation in stock status indicates that the stock is at a **MEDIUM** risk of stock depletion. However, due to the WRL fishers accessing the western most component of the stock, their captures are low, with < 1.5 t retained in 2020, which represents ~ 20 % of the take in WA (Table 3).

5.1.6 *Cephalopods*

5.1.6.1 *Octopus*

Octopus (*Octopus djinda*) are caught as by-catch in the pots of all sectors accessing the WRL resource. In the WCRLMF and SSCMF octopus can be retained and sold commercially. In the recreational fishery octopus can be retained within recreational fishing regulations (daily bag and boat limits).

Octopus are the target species of the Octopus Managed Fishery, and therefore retained captures as part of accessing WRL resource are accounted for in the stock assessment of this fishery. The stock status of this fishery is currently sustainable**,** and the risk rating **LOW** (Hart et al. 2021) (Table 3).

5.1.6.2 *Squid*

There were reported catches of squid (O: Oegopsida and Myopsida) by fishers on three occasions over the last 5 years from the WCRLMF. Fishers are able to target squid as they can possess a squid jig onboard a vessel, and it is an open access fishery.

Assessed at the bioregional level, the West Coast Bioregion stock of squid was a **MEDIUM** risk (Yeoh et al. 2021). The catch of 36 kg in 2020 by WCRLMF fishers was the largest catch in the last 5 years, with < 40 kg reported over this 5-year period. The catch of <10 kg per season represents <1 % of the catch of squid by commercial and recreational fishers from 2019 and 2017/18 respectively (Table 3).

5.1.6.3 *Cuttlefish*

Cuttlefish (*Sepia* sp.) were retained in both the WCRLMF and SCCMF though take predominantly came from the WCRLMF, with a total take of ~ 400 kg of cuttlefish in 2020 (Table 3). Assessed at a state-wide level, the stock was at a **LOW** risk of unacceptable stock depletion with a catch of 55 t commercially reported in 2019 (Yeoh et al. 2021). This resulted in the take of cuttlefish from fishers accessing the WRL resource being <1 % of the total state's landings (Table 3).

5.1.7 *Finfish*

Fishers accessing WRL can retain finfish captured within their pots as part of lobster fishing, but only for personal consumption and are not able to sell them. The retention of these species must be in line with recreational size and possession limits. Fishers in the WCRLMF are required to report retained finfish on their CDR, while fishers in the SCCMF report all bycatch (retained / discarded) on Trip Returns which were introduced in 2019.

The WCRLMF is responsible for most of the finfish by-catch of the WRL resource. The main species captured are baldchin groper, pink snapper, red throat emperor, breaksea cod, and WA dhufish. All of these species are assessed as part of the West Coast Demersal Scalefish Resource. The most recent assessment of these species demonstrated that the current risk to sustainability for the two indicator species of pink snapper and dhufish were **SEVERE** and **HIGH,** respectively (Fairclough and Walters 2021). As an indicator approach is used to assess the West Coast Demersal Scalefish Resource, all other species captured by this resource are deemed to have the same risk rating (Table 3).

Even if all bycatch of demersal species from the WCRLMF are considered as mortalities, then the catches would be < 5 t which contribute to ~ 2% of the 247 t of retained catches of all demersal species by commercial fisheries and <1% of the total take of all demersal species in the West Coast Bioregion (Fairclough and Walters 2021; Table 3).

5.1.8 *Elasmobranchs*

Sharks are the only reported elasmobranchs captured by fishers accessing the WRL resource. The WCRLMF captures between 80 – 250 kg of wobbegong sharks. Four

species of sharks were also reported captured in the SCCMF (Table 2). Sharks and rays are commercially protected under the FRMR and are therefore returned to the sea upon capture.

Wobbegong (*F. Orectolobidae*) are part of the suite of shark species assessed under the Temperate Demersal Gillnet and Demersal Longline Fishery Resource (TDGDLF). Using an indicator approach for this resource, the four indicator species (Gummy, Dusky, Whiskery and Sandbar sharks) were all above their threshold levels (Braccini & Watt 2021). The total commercial catch of the TDGDLF in 2019/20 was 774 t of sharks and rays. The bycatch by the WRL resource equates to <1 % of this commercial catch (Table 3)

5.1.9 *Other*

A small number of crabs and eels are captured in the WCRLMF and SCCMF. These are discarded and are usually alive.

Table 3 Species captured by fishers accessing the WRL resource and their retained catch in 2020. The fishery for which that species is assessed and its associate stock status (relative to reference points) or risk rating, catches for 2020 (unless specified) and the percentage of total catch from the WRL resource fishers compared to that of the assessed fishery are also presented.

Species	Catch	Assessed Fishery	Status	Total catch			
			Risk	Commercial	Recreational	% of total	Reference
Western rock lobster	6244 t	WCRLMF	**LOW**	5.702 t	0.542 t	100	De Lestang et al. 2021
Western rock octopus	12.8 t	OIMF	Above target	254 t	1 t	5.01	Hart et al 2021
Southern rock lobster	0.566 t	SCCMF	**MEDIUM – HIGH**	19.23 t	NA	2.94	How & Baudains 2021
Crystal crab	0.907 t	WCDSCMF	Below threshold, above limit	155.6 t	NA	0.58	How & Baudains 2021 b
Champagne crab	4.685 t	National	Above threshold	6.58 t	NA	71.2	How 2021
Giant crab	1.464 t	National	Jurisdictional variation	7.1 t	NA	20.6	Hartmann et al. 2021
Cuttlefish	405 kg	WA (statewide)	**LOW**	54.7 t (2019)	4,234 animals (2017/18)	< 0.7 (2019)	Yeoh et al 2021
Squid	36.5 kg	WCB resource	**MEDIUM**	49 t (2019)	34 t (2017/18)	0 (2019)	Yeoh et al. 2021
Tropical Rock Lobster	4.5 kg	National	Not Assessed	Negligible	~500 animals	~ 0.09	Saunders et al. 2021
Finfish (inc. Baldchin grouper and pink snapper)	4576 kg	WCDSR	**HIGH – SEVERE**	247 t	210-253 rec (95%CI 2017/18) 61 charter (2017/18)	< 1%	Fairclough and Walters 2021
Elasmobranchs	83 kg	TDGDLF	**LOW-MEDIUM**	774 t	<10% commercial	0 (2019)	Braccini & Watt 2021

WCRLMF – West Coast Rock Lobster Managed Fishery; SCCMF – South Coast Crustacean Managed Fishery; WCDSCMF – West Coast Deep Sea Crustacean Managed Fishery; WCDSR – West Coast Demersal Scalefish Resource; TDGDLF – Temperate Demersal Gillnet and Demersal Longline Fisheries; OIMF – Octopus Interim Managed Fishery

5.2 Endangered, Threatened and Protected (ETP) Species

All commercial fisheries in Western Australia, including the WCRLMF and SCCMF, are required to report any interaction with ETP species in their statutory fishing returns. The Department is responsible for reporting these interactions in the publicly available annual State of the Fisheries reports. Some ETP interactions, such as entangled whales may move gear away from the fishers' operations, and hence are not observed and therefore unable to be reported by commercial fishers. Reported entanglements from all sources are collated and provided to government agencies (state and commonwealth) as well as industry bodies annually.

Compliance checks are undertaken by government officials to ensure ongoing adherence to the management measures implemented to mitigate ETP interactions (e.g. SLEDs, gear modifications). The number of checks and associated non-compliances associated with these regulations are reported annually as part of on-going MSC Certification. It should be noted that not all checks are random in nature and hence a comparison on checks with levels of non-compliance does not indicate a broader non-compliance rate. For more details on compliance activities please refer to Section 4.5.

There were no reported ETP interactions in the SCCMF over the last two seasons from statutory trip returns. Reported protected species interactions for the WCRLMF included five groups (Table 4), and none of the interactions reported mortalities of ETPs. All of these 303 reported interactions were from 15 unique vessels across the WCRLMF fleet. While reported as interactions, those where comments on the interaction were provided indicated that most were observations. For example, the 15 reported bottlenose dolphin interactions in 2021 (Table 4) were accompanied with the following comment "Playing alongside vessel. One baby!". Similarly, 20 humpback whales reportedly interacted by one vessel with in 2017 were accompanied with the comment; "They were jumping in the air and having so much fun. I'm sure they were practicing their cannonballs".

Therefore, it is difficult to ascribe all of these interactions as deleterious interactions between the WCRLMF fleet and ETP species. There were five comments which indicated negative interactions with ETP species. One involved a "possible collision with whale" in 2017. The remaining four indicated entanglements of humpback whales. All of these were cross-referenced with reported entanglements (Section 5.2.1), with all having detailed records as part of the entanglement database.

Table 4 Reported protected species interactions by season in the West Coast Rock Lobster Managed Fishery. Note, these do not represent a physical interaction between the WCRLMF and ETPs (see text above)

Common Name	Season				
	2017	2018	2019	2020	2021
Bottlenose Dolphin				5	15
Humpback Whale	46	25	22	79	106
Sharks	2			1	
Turtle, Leatherback	1				
Whales	1				

5.2.1 *Large Cetaceans*

The largest population of humpback whales (*Megaptera novaeangliae*) in the southern hemisphere (Leaper et al. 2008) migrates along the West Australian coast annually. Traditionally this population has had a small interaction with the fishers accessing the WRL resource, with few entanglements. Entanglements between 1990 and 2010 ranged from 0 to 6, averaging just over 1 entanglement annually. However, in 2011 there was an increase in whale entanglements which ultimately peaked with 17 in 2013 as a result of increased fishing during the whale migration period when the season was extended to 12 months.

The ecological risk of whale entanglements was deemed **LOW** in the 2013 ERA, despite the high reported level of entanglements, noting the entanglements did not represent a threat to the whale population or its recovery. However, to address potential negative public perception and conditions on the fishery from federal and state governments, a suite of management measures was introduced to mitigate whale entanglements. In July 2014 gear modifications were introduced during the whale migration period (May-October) each year since for the WCRLMF. There have been minor modifications to these mitigation measures (see Bellchambers et al. 2017) but the major focus has remained consistent which is around limits on rope length and float numbers.

In 2020, the following arrangements were implemented, and continue to be in place:

- Modified gear is now required from 1 April to 31 October
- A requirement that the top third of the pot line is held as close to vertical as possible, by using weighted rope or by attaching a weight to the pot line.
- A maximum limit on the number of floats permitting no more than:
    - 3 surface floats, when used in waters greater than 54.9 meters in depth; or
    - 2 surface floats, when used in waters less than or equal to 54.9 meters in depth.

    - the line must have a weight attached, or weighted rope must be used
- all pots must be pulled at least once every 7 days regardless of depth of water in which they are set.
- Fishers can only fish with 50% of their pot entitlement between 1 May and 31 October
- Requirement for fishers to report the number of pots left in the water at the end of a trip (this applies year round)

A recent assessment of the effectiveness of these modifications indicated that they had a median effect of reducing entanglements by 64% (How et al. 2021). In 2021 there were 10 entanglements of humpback whales reported off Western Australia with only one of those being confirmed in WCRLMF gear.

Recreational fishers are required to adhere to similar management measures to those of the WCRLMF. There have been two reported entanglements in recreational WRL gear, one in 2019 and another in 2020. Measures for recreational fishers were implemented in 2018 and have remained reasonably consistent since their inception. The only notable change was a shift from a year-round requirement (initially implemented to reduce recreational fishers having ropes and floats cut off or entangled in vessel propellors) to only being required from 1 April to 31 October. In 2020, the following management measures were in place when fishing with rope (including the float rig) more than 20 m long;

- Top half of the rope is held vertical in the water column
- A maximum limit of 2 surface floats

Fishers in the SCCMF are currently not required to have modified gear to mitigate whale entanglements. There have only been two reported entanglements in SCCMF gear, with only one from fishers in Zone 1. This occurred in 2018 with a partial disentanglement completed. With a shift to year-round fishing in the SCCMF (see Section 4.2.2), a range of gear modifications have been proposed for the fishery. These include

- A requirement that the top third of the pot line is held as close to vertical as possible, by using weighted rope or by attaching a weight to the pot line.
- An active fishing requirement to ensure gear is actively fished and maintained by requiring that all gear is pulled at least once every 10 days.
- A maximum limit on the number of floats permitting no more than:
    - 3 surface floats, when used in waters greater than 54.9 meters in depth; or
    - 2 surface floats, when used in waters less than or equal to 54.9 meters in depth.

These are proposed to be in place for the period 1 April to 30 November. The longer duration on the south coast is due to the greater potential for interaction with southern

right whales (*Eubalaena australis*), which are resident on the south coast, where they mate and calve, for a longer than humpback whales (Burnell and Bryden 1997).

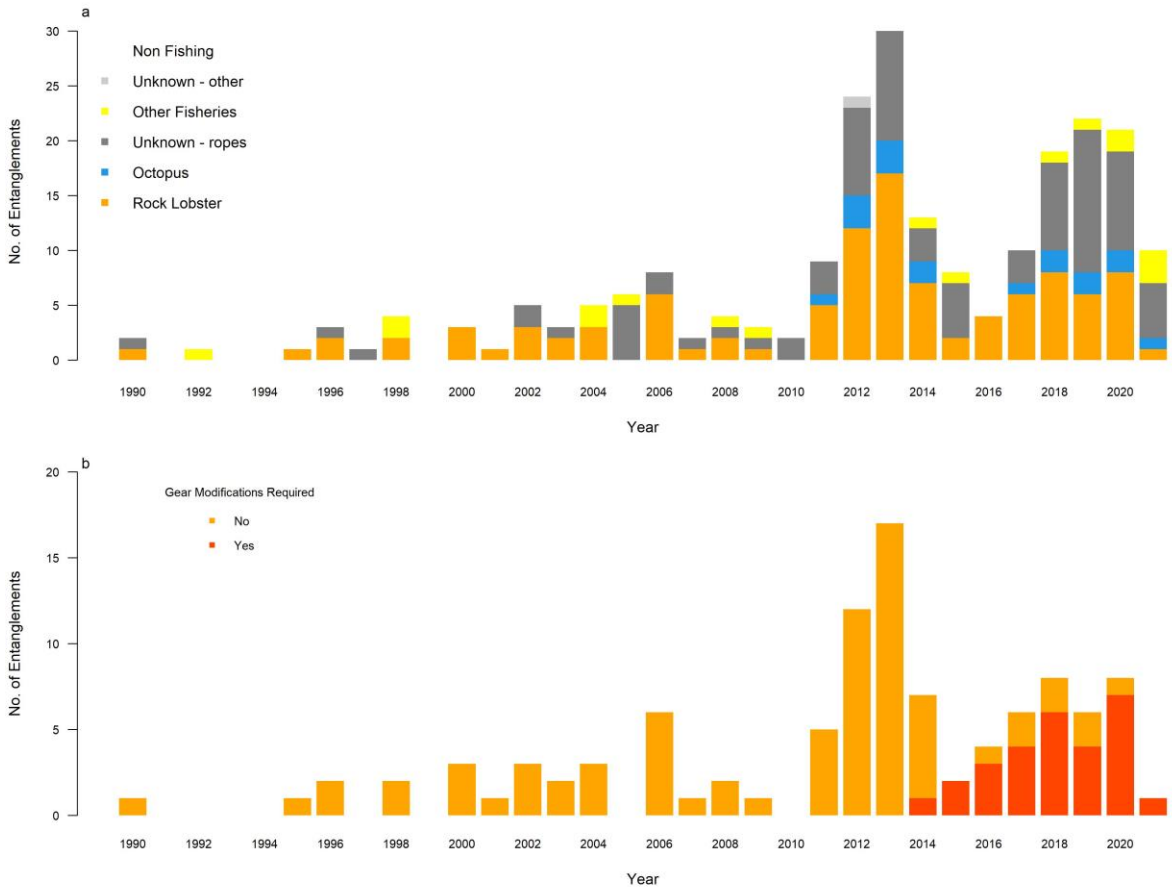

Figure 13 Annual entanglement rates a) by fishery / gear type, and b) for the West Coast Rock Lobster Managed Fishery, highlighting when seasonal gear modifications were required.

Fishers are subject to ongoing compliance checks for adherence to whale mitigation management measures and these indicate low levels of non-compliance (Table 5).

Table 5 Non-compliance notifications issued regarding gear modifications for whale entanglement mitigation for the last 5 years

Sector	Type	2016	2017	2018	2019	2020
	Warning	14	3	2	2	6
Commercial	Infringement			5	3	2
	Brief				5	
Recreational	Brief				1	

5.2.2 *Australian sea lions*

Historically, interactions with WCRLMF gear and ASLs have been reported through accidental drowning of ASL pups in pots while attempting to forage for bait / WRLs (de Lestang et al 2010). These interactions were adjacent (<= 30km) to mainland breeding colonies on the states' mid-west coast and in shallow water (<20 m). Additionally, while no reported interactions were recorded at the Abrolhos Islands, a dead ASL pup reported on a fishing jetty was revealed to have drowned through post-mortem. Subsequent research indicated that ASL pups at the Abrolhos Islands do enter pots at the Abrolhos Island.

To mitigate the risk to juvenile Australian sea lions (ASL) all pots fished within designated sea lion areas are now fitted with sea lion exclusion devices (SLEDs) to stop the accidental drowning of ASL. These are required when fishing, either commercially or recreationally in specific areas off the mid-west coast and Abrolhos Islands. For full details of requirements and locations of SLED zones see Bellchambers et al. 2017. There are additional SLED zones which have been implemented for the SCCMF, however these are in Zones 2 – 4 of the fishery (Figure 9) and hence are not applicable to the WRL resource.

In the 2013 ERA, the risk to Australian sea lions with management was deemed **NEGLIGIBLE** as the implementation of SLEDs virtually eliminate capture of pups. However, it was noted that the loss of a single individual is considered important in the Abrolhos Islands (Stoklosa 2013). Despite the negligible risk, there is continued compliance checks on fishers' adherence to the SLED requirements, with low levels of non-compliance (Table 6).

Table 6 Non-compliance notifications issued regarding SLED use for the last 5 years

Sector	Type	2016	2017	2018	2019	2020
Commercial	Warning	1		3		
	Infringement	3	1	1	2	
Recreational	Warning	13	8	2		
	Infringement	6	1	1		

5.2.3 *Turtles*

In the 2013 ERA the risk of collision of leatherback turtles with WRL fishing vessels or entanglement in WRL pot lines was deemed **LOW.** Mortality of individuals were noted to be 1-2 annually (Stoklosa 2013). Since 2013, there has been only two reported entanglement of leatherback turtles in gear accessing the western rock lobster resource.

Changes to fishing practices and gear modifications to mitigate whale entanglements further serve to mitigate the risk to turtles from accessing the lobster resource. Longer pull times and a reduction in effort (Figure 6) results in less vessel fishing time and hence reducing the risk of vessel strike. Further, the modification to reduce whale entanglements through the lessening of line, floats would also serve to mitigate turtle entanglements.

5.2.4 *Other ETP species*

The WRL resource overlaps with the distribution of a number of other ETP species. However, other than the interactions highlighted above, there are no other reported interactions between fishers accessing the WRL resource and ETP species. This includes no reported interactions of sea birds, protected sharks and rays, sea snakes or syngnthids.

5.3 Habitats

A substantial component of the benthic habitats throughout the distribution of WRL have been mapped to describe both the physical substratum and the broad biological communities. A detailed summary of historical benthic habitat information and habitat associations of WRL, specifically for the WCRLMF, can be found in Bellchambers et al. (2012) and Bellchambers et al. (2017). While WRL may utilise a range of habitats throughout their life, including seagrass beds as juveniles or sand / soft substrate during their migratory phase ('whites'), the macroalgae dominated reefs throughout the west coast bioregion form the habitat for the majority of the population. In the 2013 ERA, the risk across all habitat components was considered **LOW** or **NEGLIGIBLE** based on the significant reduction of effort within the WCRLMF following the introduction of ITQ. This effort reduction has been sustained in subsequent years. In addition, it was remarked that fishers do not target coral habitats to avoid damage to gear and the 12-month fishing season also decreased fishing effort in these shallow water locations.

The information in this section outlines the available habitat to inform the distribution of key benthic habitats within the WRL relating to those classes defined the component tree:

- Sand/soft substrate
- Seagrass
- Macroalgae
- Hard Coral
- Other Sessile Invertebrates

5.3.1 *Broad Scale Habitat*

A large (~54,000km^2) area of the nearshore benthic environment of the WRL is described based on predictive habitat species distribution modelling (Hovey et al., *in prep*) (Figure 14). The broad scale predictive habitat map was developed using the 250m x 250m national bathymetry grid, clipped to the 100m depth contour between Augusta and Shark Bay. The map utilises a range of geo-referenced underwater imagery (e.g., BRUVS, Tow Video, Pot BOTS) to train and test with a classification correction rate of higher than 75% for all defined categories. Based on the broad scale habitat map (Figure 13), the nearshore (<100m depth) benthic environment of the WRL is comprised of 32.4% No Biota (e.g., sand / soft substrate), 30.4% Sessile Invertebrates (Other Sessile Invertebrates), 12.2% Kelp (Macroalgae), 7.7% Macroalgae and Sessile Invertebrates, 6.2% Rhodoliths, 5.0% Macroalgae (Macroalgae), 3.6% Mixed Assemblage with Seagrass, 2.4% Seagrass (Seagrass), 0.15% Mixed Assemblage with Hard Coral and 0.1% Hard Coral (Hard Coral) (Figure 14). Macroalgae, mixed assemblage and kelp dominate nearshore habitats, particularly in the southern most region of the fishery, while sessile invertebrates tend to dominate in the northern regions and hard coral observed around the Houtman Abrolhos Islands (Figure 14).

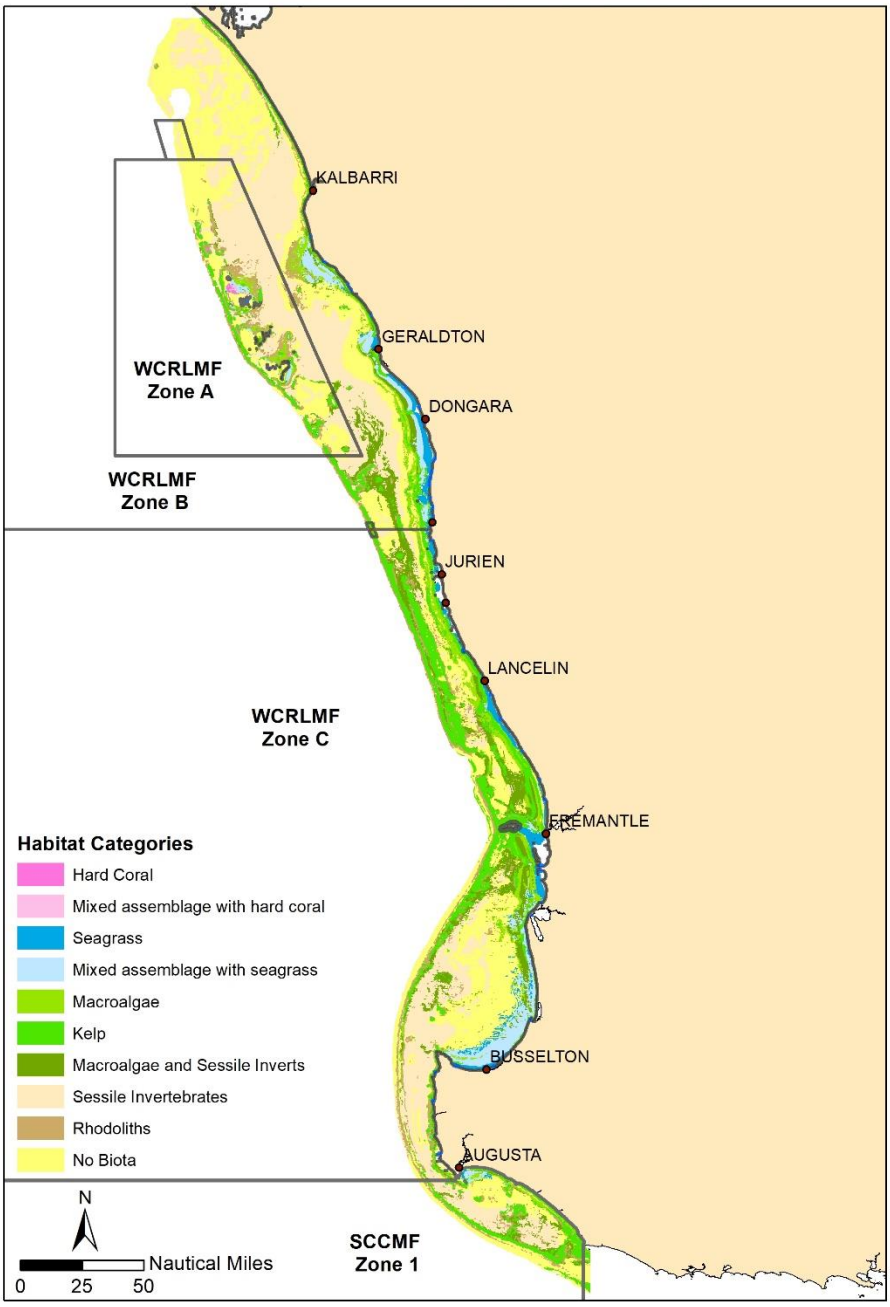

Figure 14. Broad Scale Habitats of the WRL (Hovey et al. *in prep*)

For the WCRLMF, CDRs have been reported since 2010/11 and provide a 10 x 10 nautical mile spatial resolution of effort (pot lifts) within the WRL. Between 2015-19, cumulatively, ~75% of the WCRLMF effort occurred within the broad scale benthic environment map and ~85% of the total mapped area had an association with the WCRLMF (Figure 15). Based on the 2015-2019 cumulative CDR effort data the WCRLMF effort primarily occurs on sand or soft substrate (No Biota) at ~33% and Other Sessile Invertebrate at ~30% (Figure 15). The remaining proportion of WCRLMF effort is distributed amongst the Macroalgae, including Kelp (~17%), Macroalgae and Sessile Invertebrate assemblage (~8%), Rhodoliths (6%), Mixed Assemblage and

Seagrass (~3%), Seagrass (~2%), Mixed Assemblage with Hard Coral (~0.2%) and Hard Coral (~0.1%) (Figure 15).

The SCCMF effort data has only been reported by 10 x 10 nautical mile blocks since 2020 and therefore a five-year cumulative effort estimate is not yet available to assess against the benthic habitat map. There is also no detailed spatial effort data of the recreational WRL fishing. However, given the known habitat preferences of WRL described in Bellchambers et al. (2012) and Bellchambers et al. (2017), it is probable the benthic environment associations described for the WCRLMF are representative for both the SCCMF and WRL recreational fishing effort.

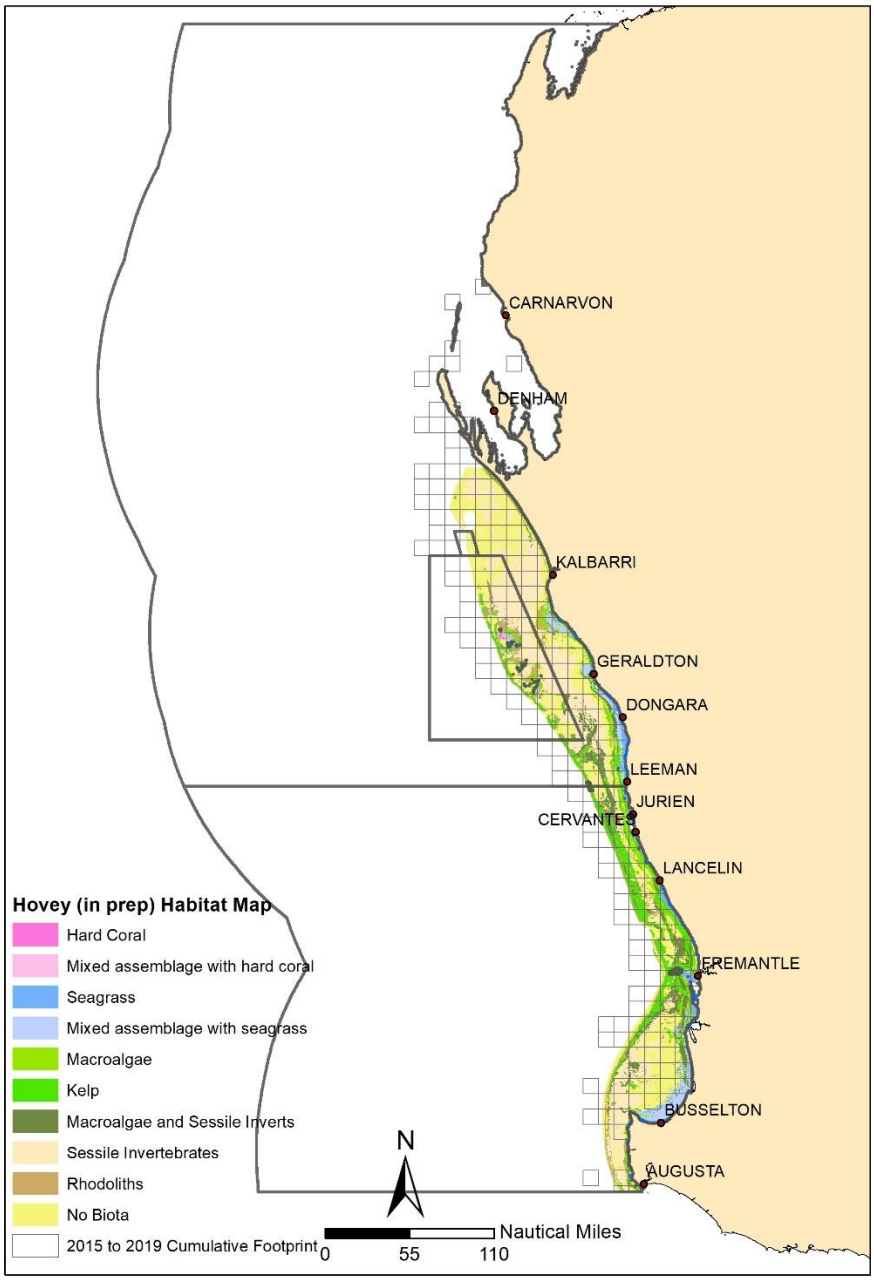

Figure 15. WCRLMF 2015-2019 Cumulative Effort

5.3.2 *Houtman Abrolhos Islands Fish Habitat Protection Area*

The Houtman Abrolhos Islands (Abrolhos) Fish Habitat Protection Areas (FHPA), although a small spatial component for the WRL, is important not only for the high proportional contribution of WCRLMF catch and effort but also as a significant source of WRL breeding stock and egg production that contributes to the ongoing sustainability of the WRL. The Abrolhos FHPA accounts for ~9.4 % (~2494 km^2) of the spatial area of the WCRLMF A zone (~26,550 km^2) and ~0.4% of the entire WCRLMF (~605,065 km^2). The WCRLMF and WRL recreational fishing have access to the Abrolhos FHPA and detailed summaries of their association to the Abrolhos FHPA can be found in Evans et al. (2022). Summarising the information provided in Evans et al. (2022) suggests that there is likely minimal recreational fishing effort for the WRL at the Abrolhos FHPA compared to both the WCRLMF and nearshore areas along the west coast, noting that in 2020 a total of 1134 vessels notified to enter the Abrolhos FHPA for recreational purposes. In addition, given the distance (~60km) from the mainland coast, it is not likely all these vessels undertook fishing activity for the WRL.

Therefore, the WCRLMF is the largest fishery targeting the WRL within the Abrolhos FHPA, operating in these waters since the 1890's. Following the transition of the WCRLMF to ITQ in 2010, fishing effort on the WRL in the Abrolhos FHPA has reduced by ~81% from ~ 811,000 pot lifts per year to ~152,000 pot lift per year (Figure 16).

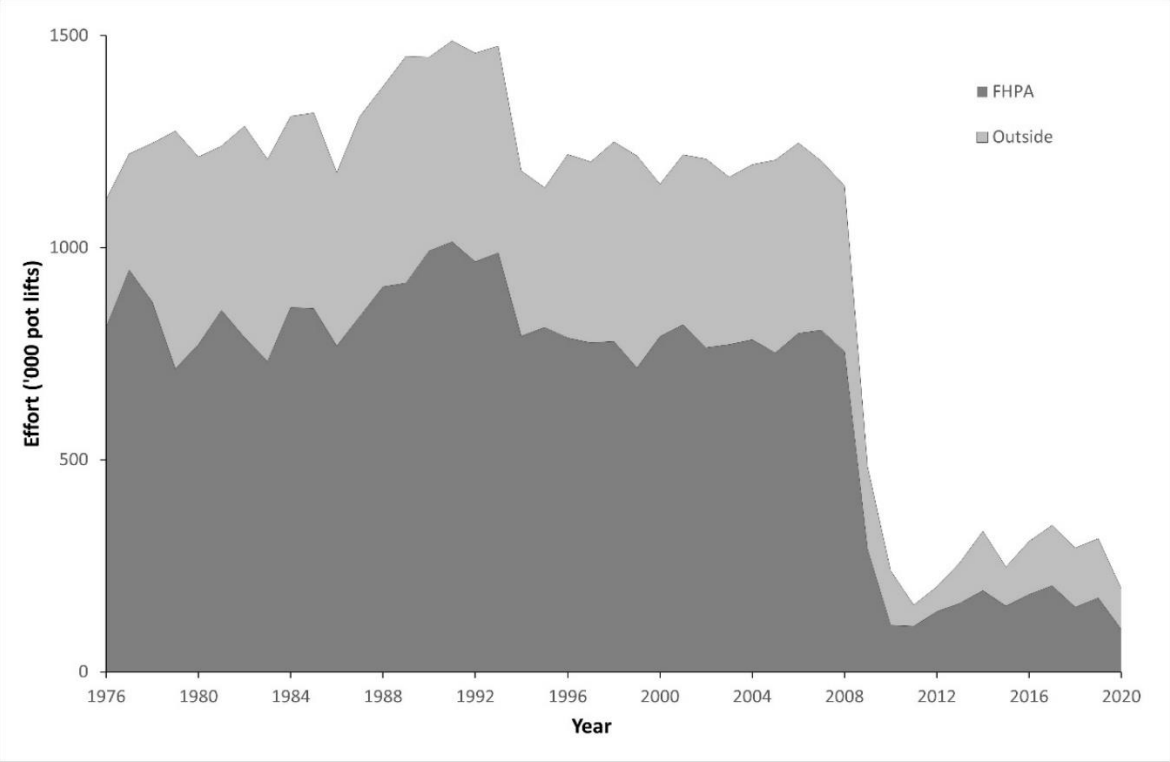

Figure 16. Annual WCRLMF Zone A total fishing effort (pot lifts) proportioned into estimates of effort inside (bottom) and outside (top) of the Abrolhos FHPA

As with the overall reduction in WCRLMF effort following the introduction of ITQ, Evans et al. (2022) observed that the spatial extent of fishing activity across the Abrolhos FHPA habitats also reduced. This was highlighted by overlaying finer-scale aerial pot count survey grids (1630m x 1000m) on the Evans et al. (2012) remote sensing habitat map for the shallow water environment of the Wallabi Group (Figure 17). Over the four

survey periods (2006, 2011, 2014, 2019) the spatial extent of fishing activity in the Wallabi Group showed a decreasing trend (Table 7). In 2006 (pre ITQ), all four individual biota classes defined in Evans et al. (2012) observed fishery associations of between 61.0% (seagrass) and 68.4% (hard coral) of their respective total areas mapped (Table 7). Comparing 2006 and 2019, three of the four individual biota classes observed decreases in the spatial extent of fishing activity to the total area of the habitat class mapped, with a ~50% reduction in the hard coral environment, ~30% reduction in macroalgae and ~40% reduction in abiotic (sand/soft substrate) (Table 7).

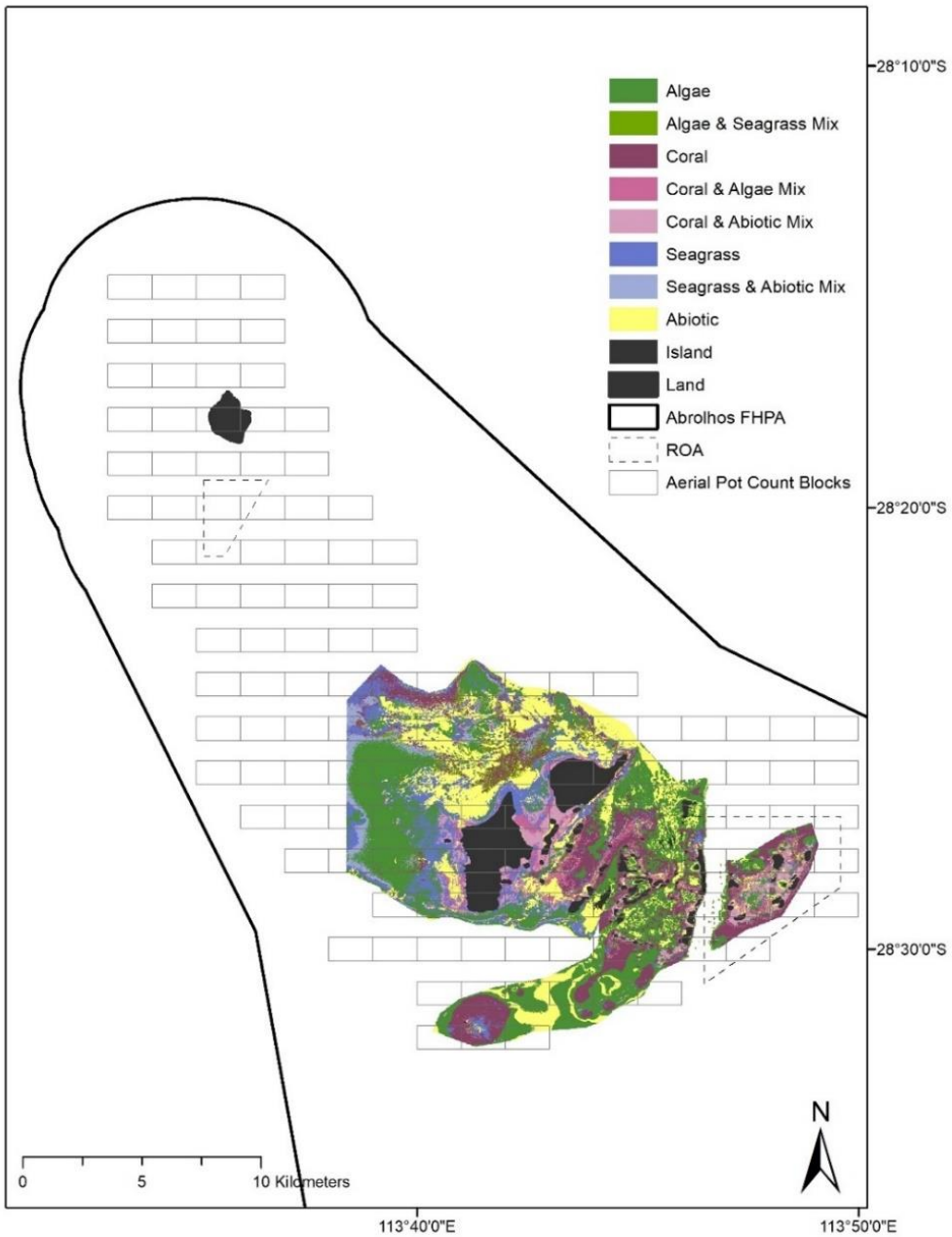

Figure 17. Biota classes of the Abrolhos FHPA Wallabi Islands area shallow (<20m) waters (Evans et al., 2012) with WCRLMF aerial pot count survey grid overlay.

Table 7. Proportion (%) of the differing biological (biota) classes (Evans et al., 2012) with observed WCRLMF fishing activity from the aerial pot count surveys.

Biota class	2006	2011	2014	2019
Abiotic	64.9	65.2	20.0	40.0
Macroalgae	66.3	62.2	18.0	46.8
Macroalgae and Seagrass Mix	96.3	84.5	39.8	40.0
Coral	68.4	48.4	18.5	37.4
Coral and Abiotic Mix	43.1	38.8	20.4	35.9
Coral and macroalgae Mix	46.7	34.7	21.4	32.1
Seagrass	61.0	74.1	29.1	61.6
Seagrass and Abiotic Mix	86.3	94.0	13.4	68.8

5.4 Ecosystems

5.4.1 *Trophic interactions*

WRL are an omnivorous species that consumes an extremely wide range of benthic food items and are therefore classified as generalist consumers (Joll & Phillips 1984). Common dietary items include mobile invertebrates, such as crabs and gastropods, sessile filter feeds (e.g. mussels), coralline algae, and seagrass (Edgar 1990, MacArthur et al. 2011, Dumas et al. 2013).The diet and feeding strategies of juvenile WRL vary greatly between seasons and locations, and is reflective of the abundance of available benthic macrofauna (Edgar 1990). For adult WRL in deep-water habitats, diets are primarily carnivorous, consisting of crabs, amphipods and isopods, and supplemented by bait from pots and discards from fishing vessels (Waddington et al. 2008, Waddington & Meeuwig, 2009). There is no evidence that size (65-120 mm CL) or sex affects the WRL's diet or trophic position in deep-water ecosystems (Waddington et al. 2008).

Due to the high number of WRL inhabiting coastal reefs in WA, it is likely that they play an important role in regulating benthic communities in these areas (Joll and Phillips 1984; Edgar 1990a; b). A study by Edgar (1990a) showed rapid declines in large > 2 mm gastropods, such as *Cantharidus lepidus*, *Stenochiton cymodocealis* and *Asteracmaea stowae*, when WRL made a dietary shift from an algae to a mollusc-dominated diet.

WRL act as secondary consumers in shallow and deep-water habitats as they derive much of their growth from benthic animal prey that feed on primary producers (Joll and Phillips 1984; Edgar 1990a; b; Jernakoff et al. 1993; Waddington et al. 2008; MacArthur 2009). Qualitative modelling of WRL in deep-water habitats has predicted that decreased abundance and changes to population size structure due to fishing, would increase the abundance of common macroinvertebrate prey species, including small-bodied crabs and polychaetes, as well as small fish species such as old wife and king wrasse (Metcalf et al. 2011).

To investigate the ecological effects of WRL removal on deep-water habitats, a 12 nm^2 area located in the middle of the WCRLMF, was closed to WRL fishing in 2011 (Bellchambers et al. 2017). Before it's closure, baseline assessments of the benthic habitat were extensively mapped using multibeam hydroacoustic techniques and validated by towed and drop videos. A research program to monitor habitat (e.g., autonomous underwater video, tow and drop video), indirect ecosystem indictors (e.g. small fish from Baited Remote Underwater Videos) and target species (WRL potting) was initiated in 2011 and is ongoing. Benthic habitats data has been collected via autonomous underwater video in 2011, 2012, 2013 and 2021 and tow video in 2015 and scheduled for 2022 to allow for the detection of long-term changes in benthic habitat structure and associated trophic impacts of fishing. A total of 110 Baited Remote Underwater Video drops (22 sites x 5 replicates) which target both macroalgae and sessile invertebrate dominated habitats have been surveyed in 2011, 2014, 2018 and are scheduled to be resurveyed in 2022 to assess impacts on indictor fish species. Preliminary data from 2014 showed there were no significant spatial or temporal trends in indicator fish species, with the 3-year timeline likely too short to detect significant changes in fish structure (Bellchambers et al. 2017). Information on the target species, WRL, is captured through a potting survey of 300 commercial pot set on the same location throughout and immediately adjacent to the closure. This survey was undertaken annual between 2008 and 2017 and then in 2019 and 2021. These data indicate that the abundance of WRL inside the closure, especially of large males, has increased since the prohibition of fishing in 2011, relative to adjacent reference sites (Bellchambers et al. 2017). An assessment of the status and trends of the trophic interactions of the closure, ten years following implementation, is currently in process.

There are no known predators that rely on western rock lobsters as their main prey item (Waddington et al., 2008, de Lestang et al., 2015, MacArthur 2007). Juvenile WRL are eaten by a number of fish species, with predation rates highest in smaller lobsters, especially is the first year following settlement (Howard 1988, Phillips et al. 2003). Larger lobsters are predated on by several larger fish species, e.g. Dhufish and Baldchin groper, however lobster only forms a small part of the diets of these species (Lek 2044, Walker 1983, Robinson 1987, Marr 1980). Several shark species are known to predate on WRL, however again rates are low, with lobster making up only a small portion of their diets (McAuley et al. 2005, Simpfendorfer et al. 2001). While octopus are highly effective predators of lobster trapped in pots, with predation rates as high as ~40 per 1000 pots (depths < 10 m) (Hart et al. 2016), there is no evidence of octopus predating on lobsters in the wild. The Australian selion (*Neophoca cinerea*) is a known predator of WRL, with remnants of lobster shell identified in gut contents analyses (Richardson and Gales 1987, Berry et al. 2017). The level of natural predation of WRL by sea lions is not known, however, their ability to dive to depths of ~ 137 m (Lowther et al. 2013), means they can potentially prey on both juvenile and adult lobster populations (Costa and Gales 2003).

5.4.1.1 *Bait*

Fishers use a range of fish bait species, with pig fat / flare also used as a “holding” bait. The fishery used 2496 t of bait in the 2020 season which were sourced either locally or from New Zealand (Table 8).

Bait may be an important source of nutrition for lobsters in areas where fishing occurs, with studies finding that bait can contribute up to ~30% of lobster nutrition in typical juvenile shallow-water habitats (< 20 m) (MacArthur et al. 2011), and 30-80% of lobster nutrition in deep-water habitats (35 - 60 m) (Waddington et al. 2008). Both of these studies were conducted prior to a significant decline in effort (Figure 6) and subsequently bait usage (Figure 18). Coupled with this decline has been a considerable increase in the biomass of WRL (legal sized biomass has increased from ~12 000 t in 2000 to 26 000 t in 2021). Therefore, provisioning of bait from WRL fishing is likely to be considerably reduced from these previous estimates.

Table 8 ***Identity, origin, type and amount of bait (kg) used during the 2020 fishing season, and its percentage by weight of all catch including bait.***

Bait	Origin	Type	Amount (kg)
Blue Mackerel	New Zealand	Whole	633,915
Salmon	Western Australia	Cutlets	49,868
Kahawai	New Zealand	Whole	12,400
Hoki	New Zealand	Heads	1,017,556
Orange Roughy	New Zealand	Heads	521,065
Pork Flare	Western Australia		117,625
Alfonsino	New Zealand	Heads	93,700
Orange Roughy	Australia	Heads	13,440
Blue Mackerel	New Zealand	Tails	12,000
Salmon	Western Australia	Heads	11,420
Pork Fat	Western Australia		7,500
Silver Warehou	New Zealand	Heads	5,020
Blue Mackerel	New Zealand	Heads	40

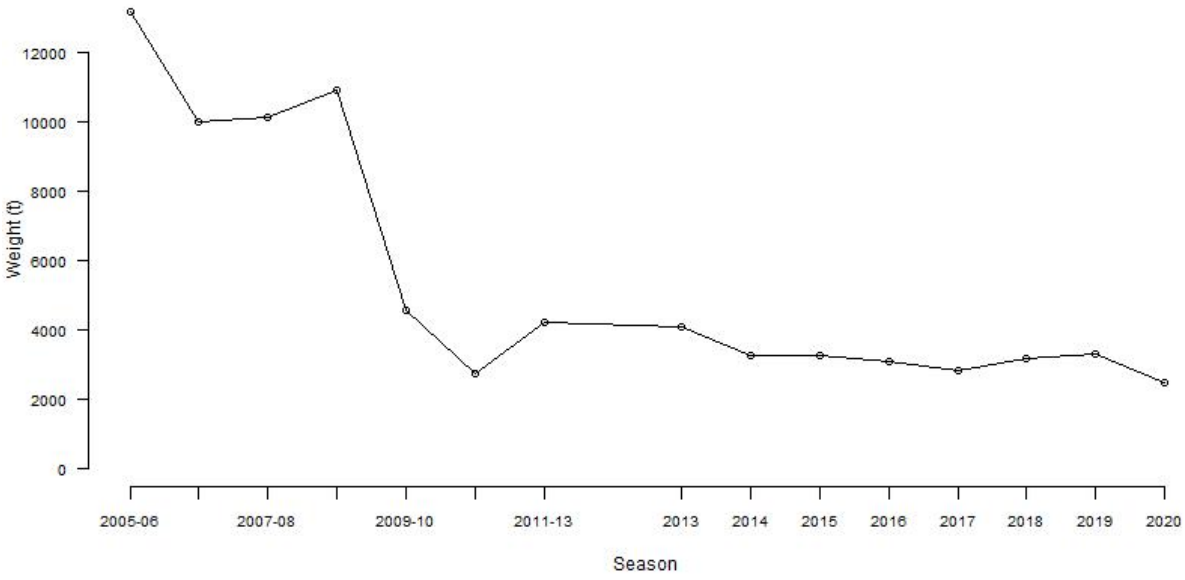

Figure 18 Total seasonal bait usage by the West Coast Rock Lobster Managed Fishery

5.4.2 *Translocation (pests and disease)*

Pests and diseases may be transferred via vessels in wet areas such as bilges, decks, anchor wells and sea chests and in niche area of the hull. Fishing vessels may present additional areas including on wet fishing gear or holding tanks. Overall, fishing vessels are typically rated very low risk in terms of translocation of marine pests and diseases at an international scale but examples of local transmission of pest species such as *Undaria pinnatifida* can be identified (Bridgwood and McDonald 2014).

Given that commercial fishers are not permitted to use their boats or gear outside of Australian waters, the risk of international transmission of introduced marine pests and diseases is effectively zero. At a local level, the vessels operating in the WCRLMF and SCCMF have low susceptibility to inoculation from pests and diseases because they typically work in remote ocean locations and from a limited number of predominantly low-risk ports. Over half of all vessels fished exclusively from one port, with 95% of the fleet using 3 or less landing areas throughout a season. The two commercial vessels in Zone 1 of the SCCMF only ever fished out of the port of Augusta while accessing the WRL. This suggests a negligible risk of translocation of pests and diseases due the activity of this fishery.

Table 9 Number of WCRLMF vessels and the number of unique landing areas used by year. The total number of vessels fishing in each year is also presented along with the five-year average proportion of vessels using landings areas.

	Number of Landing Areas							# Vessels
Year	1	2	3	4	5	6	7	
2017	110	76	30	13	2	3		234
2018	116	76	37	7	1		1	238
2019	123	67	39	8			1	238
2020	128	67	33	8	2			238
2021	127	65	33	8	1			234
Mean Proportion	0.51	0.3	0.15	0.04	0.01	0	0	

5.4.3 *Ghost fishing*

The potential for ghost fishing in the fishery is very low as both commercial and recreational pots are designed with mandatory escape gaps. Lobster have been shown to exit an intact lobster pot. Commercial fishers use wooden baton pots, and those pots which are lost eventually breakdown as the wood decays rapidly in the marine environment. In addition, the use of fish derived bait means it disintegrates and less like to attract species into the pots. These factors suggest that ghost fishing does not occur.

The loss of commercial gear is also likely to be low, however, to quantify this, DPIRD are currently undertaking a survey of fishers as part of an audit on plastic use within the fishery. As part of that survey information on the number of pots lost by fishers is being collected. Fishers aren't required to report lost pots, but it is understood that they make an attempt to retrieve lost gear that may be unable to be retrieved due to tides or if the floats are chopped off. There is a financial incentive (~$250 per pot) for them to retrieve lost gear and they often do successfully.

5.5 Broader Environment

5.5.1 *Air quality*

Commercial fishing vessels operating in the WCRLMF and SCCMF use fuel and emit greenhouse gases. Currently, there are 235 vessels actively fishing in the WCRLMF and 2 vessels operating in Zone 1 of the SCCMF, with an average annual effort of less 90 fishing days per vessel per year, with vessels in the WCRLMF averaging 71 fishing days in 2021. This fleet operates over a large geographical area and the impact of vessel emissions on air quality over this area is expected to be minor.

5.5.2 *Water quality*

Fishing vessels operating in WCRLMF and Zone 1 of the SCCMF have the potential to reduce water quality through discarding of debris and litter (see below) as well as by accidental oil and fuel spills. The WCRLMF and SCCMF operate over large geographical areas and the impact of accidental spills on water quality over this area is expected to be negligible.

Marine pollution due to sewage and sullage is regulated at the international, national and state levels. Recreational and commercial vessels are required to operate in accordance with the Department of Transport's Strategy for Management of Sewage Discharge from Vessels into the Marine Environment. The strategy provides guidance for managing the discharge of sewage from vessels into the marine environment.

Some of the Abrolhos Islands provide land-based camps used by the WCRLMF to support its operations. To meet water and health requirements, users of the Abrolhos Islands Reserve must dispose of sewage by use of a saltwater flushing outfall pipe feeding directly into the sea; through a septic tank disposal system; or by use of an approved sewage disposal system at an approved site.

5.5.3 *Noise pollution*

Water is an efficient medium for transporting sound waves. In the marine environment sound transmission is highly variable and can be dependent on the acoustic properties of the seabed and surface, variations in sound speed and the temperature and salinity of the water (Richardson et al. 1995).

For most marine animals, sound is important for communication; for locating particular features, prey and peers; and for short-range and long-range navigation (Evans et al. 2016, Erbe et al. 2015). Sounds from anthropogenic sources can mask vocal communication, disrupt normal behaviours, and cause temporary or permanent threshold shifts in hearing (Evans et al. 2016, Hazel et al. 2009).

Currently, little is known regarding the effects of noise pollution for most marine species in Australia. The main anthropogenic activities producing high levels of noise are seismic surveys of sub-bottom strata, active sonars, explosions, pile driving, vessels, dredging and drill rig activities (Evans et al. 2016).

The size of vessels and low-density nature of fishing mean any impact of noise pollution from WCRLMF and SCCMF vessels is expected to be minor. In addition, due to an increase in soak times and a reduction in effort (Figure 6), the time vessels are

on water is likely to have deceased in the last decade. This will have reduced the noise pollution from vessels accessing the western rock lobster resource.

With regard to noise on the Abrolhos Islands, fishers residing on the islands must ensure that the noise emissions from premises or motors in the reserve (other than boats), do not exceed specified levels (outlined under Part 9 of the FRMR).

5.5.4 *Rubbish*

Commercial and recreational fishers are likely to generate some waste/rubbish while fishing (e.g. bait packaging, food wrappers, drink containers, rope cut-offs). The dumping of waste at sea is prohibited under the *Western Australian Marine (Sea Dumping) Act 1981*. Fishers are encouraged to store waste and rubbish on the vessel and disposal of it appropriately when back on land. While difficult to quantify, there is thought to be a high level of stewardship amongst fishers with a low level of intentional littering. However, there is evidence of floats and rope which wash up on shores, some of which may be from boat strikes on gear or rough weather.

As mentioned under section 4.7.3.3, DPIRD is currently undertaking a study of plastic use within the fishery, including information on the number of pots lost by fishers. Preliminary results indicate that the rate of gear loss is very low by international standards, though this work is yet to be finalised.

In response to concerns of discarded bait bands from the fishery, a state-wide ban on bait bands on fishing vessels was implemented on the 15 November 2011 (de Lestang et al. 2021). Compliance checks are undertaken on the adherence of fishers to bait band regulations. In 2020 there were 89 vessels checked for bait band compliance. No compliance issues were identified.

At the Abrolhos Islands, fishers using the islands to support their operations must meet a suite of requirements around waste management and disposal, including campsite and food waste and disposal of oil, fuel and batteries.

5.5.4.1 *Dusky Whalers*

Concerns were raised regarding entanglement of the Dusky shark (*Carcharhinus obscurus*) population from discarded bait bands as part of an ERA which was conducted in 2005. A resultant state-wide ban on bait bands on fishing vessels was implemented on the 15 November 2011 and is on-going. An ecological risk assessment (ERA) re-assessed this issue after the implementation of the state-wide ban as a **NEGLIGIBLE** risk (Stoklosa 2013). Despite this risk reduction, there is continued compliance checks on fishers' adherence to the bait band ban, with low levels of non-compliance (Table 10).

Table 10 Non-compliance notifications issued for bait bands on fishing vessels for the last 5 years

Sector	Type	2016	2017	2018	2019	2020
Commercial	Warning					
	Infringement	2	1	2		
Recreational	Warning			3		
	Infringement					

6.0 External Factors

While a number of external influences and activities (e.g. urban developments, dredging and climate change), have the potential to impact on the productivity and sustainability of the fisheries, the Resource and the broader ecosystem in the future, these were not explicitly assessed within the scope of this ERA.

The impacts of external factors on species and their habitats will be reflected in the data collected for each fishery - for example, age and length composition, catch and effort distribution, rates of recruitment and mortality, and biomass trends. Current and future impacts of external factors, such as climate change, are considered in the risk-based weight-of-evidence stock assessments conducted for primary species. The risks posed by external factors are then managed through the harvest strategy for the Resource.

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