Policy for the Management of the South Australian Commercial Giant Crab Fishery

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Government of South Australia
Department of Primary Industries and Regions

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1 Table of Contents

1 Purpose and scope of this policy

The purpose of this document is to provide administrative guidance as to how the Department of Primary Industries and Regions (PIRSA) will manage the commercial harvesting of Giant Crab (*Pseudocarcinus gigas*) in South Australia. Commercial fishing for Giant Crabs is not formally identified as a discrete fishery under the *Fisheries Management Act 2007* and is, therefore, referred to as a fishing activity through this document. The activity is formally regulated by the *Fisheries Management (Miscellaneous Fishery) Regulations 2015* and the *Fisheries Management (Rock Lobster Fishery) Regulations 2017*.

This policy applies to the commercial harvest of Giant Crabs only. The area of the activity covered under the policy includes marine waters of South Australia except within Aquatic Reserves, Marine Park sanctuary zones, restricted access zones (unless otherwise authorised under the *Marine Parks Act 2007*) and waters landward of the line of Mean High Water Springs to a depth of 2 metres.

The policy does not apply to broodstock and seedstock collection or stock enhancement activities.

2 Description of the fishery

2.1 Commercial fishing history

Targeted commercial fishing for Giant Crab was initiated in Tasmanian waters in 1990/91. Commercial fishing for Giant Crabs began in South Australian waters in 1992 as a by-product of Rock Lobster fishing operations. Initially the activity in South Australia was jointly managed by the Commonwealth and South Australia. In 1992, two dedicated Giant Crab fishers began fishing under Commonwealth licences in South Australian waters and, Rock Lobster Fishery (RLF) licence holders were permitted to take Giant Crab in Commonwealth waters. In 1997, management related to fishing for Giant Crab was separated into two zones, the Southern Zone and Northern Zone, consistent with zones designated for the RLF (see PIRSA 2013 and PIRSA 2014 for description of these zones).

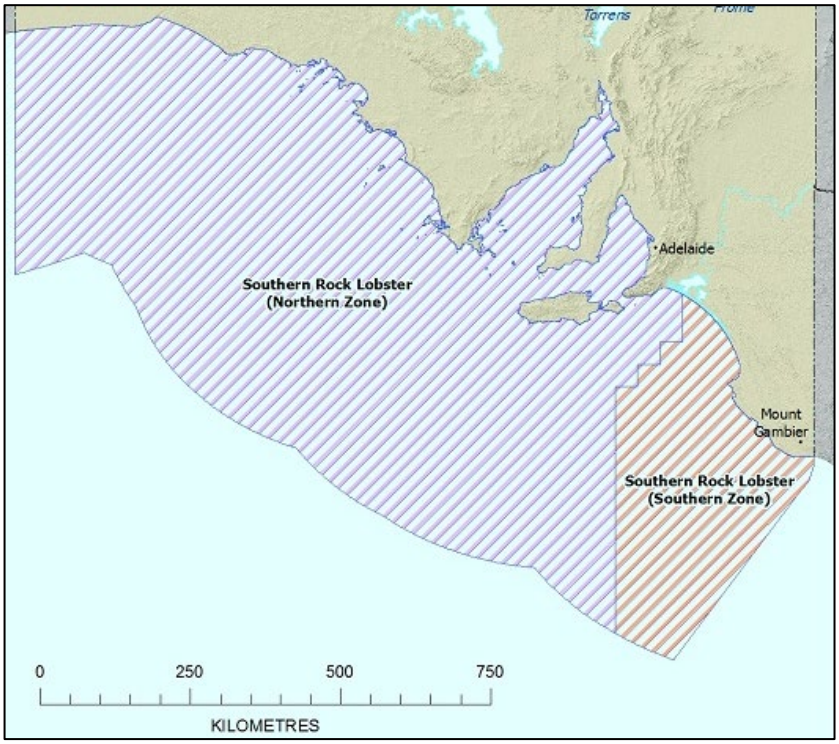

Figure 1: Southern and Northern management zones consistent with the Giant Crab Fishery

In 1997, an Offshore Constitutional Settlement (OCS) arrangement was made between the South Australian and Commonwealth Governments that transferred management responsibility for Giant Crab to the South Australian Government. The two Commonwealth Giant Crab licence holders were issued with South Australian Miscellaneous Fishery licences with access to Giant Crabs. Initially their access was limited to the waters of the Southern Zone but was subsequently extended to include the Northern Zone. Rock Lobster fishers who had previously held a Commonwealth permit with Giant Crab access were provided with unrestricted access to Giant Crab under their South Australian licence. Licence holders without any access to Giant Crab under a Commonwealth permit were permitted a by-catch limit of five Giant Crabs per trip under their South Australian RLF licence.

An annual Total Allowable Commercial Catch (TACC) of 26 tonnes (t) was introduced for commercial harvest of Giant Crab in 1999 as a competitive TACC. In 2000, the TACC was reduced to 22.1 t. The TACC remained at this level since that time until the 2023/24 season when it was reduced to 9.61 t (6.7 t in the Northern Zone and 2.61 t in the Southern Zone). In 2002, quota became individually transferable with 1000 quota units in each zone allocated to licence holders with 60.6% of the quota provided to the Northern Zone and the remainder provided to the Southern Zone. These initial allocations between zones were based on historical average annual catches in each zone between 1997/98 and 1999/2000 (Sloan 2002).

Management arrangements for the commercial fishing activity are described in a report prepared by PIRSA for the (then) Commonwealth Environment Australia on the management of the South Australian Giant Crab (*Pseudocarcinus gigas)* Fishery for the purposes of section 303FN (Approved Wildlife Trade Operation) of the *Environment Protection and Biodiversity Conservation Act 1999* (Sloan 2002).

A review of the performance indicators described in the EPBC report (Sloan 2002) was conducted in 2017 (SARDI internal document). The review recommended new performance indicators for measuring the performance of the fishing activity which continue to be monitored.

In August 2023, the South Australian Research and Development Institute (SARDI) classified the status of the Giant Crab stock as “depleting” for the first time. Prior to this the stock was defined as either “undefined” or “sustainable”. The depleting classification was the result of a weight of evidence approach, noting the primary performance indicator (in place at this time) of 5-year average catch per unit effort (CPUE) was below the Trigger Reference Point, the declining trend in CPUE and the historical lows in catch and recruitment.

2.2 Management arrangements

Regulatory arrangements for the commercial fishing activity are contained in the *Fisheries Management (Miscellaneous Fishery) Regulations 2015*, the *Fisheries Management (Rock Lobster Fisheries) Regulations 2017* and the *Fisheries Management (General) Regulations 2017*. Any amendments to these regulations could change the regulatory arrangements described in this section. Appropriate consultation will be undertaken should any changes to regulation be required. Management arrangements may also be implemented through licence conditions. The Minister reserves the right to amend licence conditions for commercial fishing of Giant Crabs if required to meet the sustainability objectives of the *Fisheries Management Act 2007*.

Commercial fishing for Giant Crab in South Australia is managed through a mix of input and output controls summarized in Table 1. These controls are aimed at matching harvesting capacity with resource availability.

Commercial access to the Giant Crab resource in South Australia is limited to 245 licence holders in the RLF and the Miscellaneous Fishery. One licence holder in the Miscellaneous Fishery has access to both

zones and all licence holders in the RLF with Giant Crab Quota can access Giant Crab for commercial purposes, or for non-quota holders in the RLF through an allowance of up to five individual Giant Crabs per fishing trip as by-product. There are 17 licence holders who hold Giant Crab quota units: 2 in the South Australian Miscellaneous Fishery and 15 in the RLF. A total of 228 RLF licence holders can retain Giant Crab as by-product (See Table 1).

The TACC is allocated among licence holders who hold Giant Crab quota units with 5% of quota in each fishing zone held aside to account for Giant Crab taken as by-product by RLF licence holders that do not hold Giant Crab quota units. The TACC is set by a determination of a value in kilograms for each giant crab unit in each fishing zone. Quota units may be transferred between Rock Lobster and Miscellaneous Fishery licences with access to harvest Giant Crab in the fishing zone to which the quota unit relates. All harvest of Giant Crab must be consigned to a registered fish processor to support the quota monitoring system and reported to PIRSA and the research provider, SARDI.

Fishing in each zone is subject to a seasonal closure. The fishing season in the Southern Zone is between 1 October and 30 April, while in the Northern Zone the fishing season is between 1 November and 31 May.

Vessels and masters must be registered on a fishery licence when commercially accessing Giant Crab in South Australia. Vessels operating with a Northern Zone RLF licence or under a Miscellaneous Fishery licence are required to operate a Vessel Monitoring System (VMS).

Fishers use steel-framed pots similar to (or the same as) rock lobster pots, fitted with a molded plastic neck and covered in mesh. All pots must comply with regulations specifying maximum dimensions, weight, escape gaps, etc. The number of pots that each licence may use to commercially harvest Giant Crab is regulated to limit effort expended in the fishing activity and limit incidental impacts on non-target species.

A minimum legal size limit of 150 mm carapace length is in place for both commercial and recreational fishers to maximize the opportunity for individual Giant Crab to reproduce at least once before being available to fishing. Females with external eggs are also protected and must be returned to the water as soon as possible.

Table 1: Management arrangements for commercial fishing of Giant Crab

Management Arrangements	**Northern Zone**	**Southern Zone**
Limited entry (number of licences with access to the commercial fishing activity)	Miscellaneous – 1 Rock Lobster (with quota) – 6 Rock Lobster (by-catch) – 57	Miscellaneous – 1 Rock Lobster (with quota) – 9 Rock Lobster (by-catch) – 171
Minimum legal size limit	150 mm carapace length	
Commercial gear	Pots Limit on number of pots Escape gaps Sea lion exclusion devices in waters <100 m	Pots Limit on number of pots Escape gaps (optional)
TACC 2000/01 – 2022/23	13.4 t	8.7 t
TACC 2023/24	6.7 t	2.61 t
Spatial closures	Yes	Yes
Fishing season	1200 hrs 1 November to 1800 hrs 31 May of the following year	0600 hrs 1 October to 1800 hrs 30 April of the following year
Catch and effort reporting	Yes	Yes
Catch and disposal reporting	Yes	Yes

2.3 Co-management

There was no organisation formally representing licence holders with access to the Giant Crab resource at the time this policy was developed. Consultation on issues related to the activity are conducted directly with the relevant Miscellaneous and RLF licence holders with Giant Crab quota units endorsed on their licences. Consultation with Rock Lobster fishers, taking Giant Crab with quota entitlements and as by-product was referred to the associations for the RLF being the South Eastern Professional Rock Lobster Fishermen's Association and the South Australian Northern Zone Rock Lobster Fishermen's Association.

2.4 Cost-recovery

South Australian commercial fisheries operate in accordance with the Government's cost recovery policy which provides that costs attributed to the management of a commercial fishing activity are recovered from industry. The costs of policy development, research and compliance programs are fully cost recovered through legislated licence fees. An annual plan for service delivery for commercial fishing for Giant Crabs and the costs associated with delivery of these services is developed each year considering the long-term objectives for the activity and the work programs required to meet these objectives. Licence fees are collected through a base licence fee and an additional fee per unit of quota endorsed on individual licences.

2.5 Export approval

Commercial fishing for Giant Crab in South Australia was assessed under Part 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* in 2015 and is currently approved as a wildlife trade operation until 2025.
(see https://www.dcceew.gov.au/environment/marine/fisheries/sa/giant-crab)

2.6 Recreational fishing

Recreational fishers are permitted to take Giant Crabs in South Australian waters; however, due to the depth in which this species is found, recreational take of Giant Crabs is minor (Giri and Hall 2015). Management arrangements for recreational fishers include minimum size limits, closed seasons and gear restrictions. There are no recreational bag or boat limits.

2.7 Traditional fishing

While it is known Aboriginal People have fished the coastal waters of South Australia since long before European settlement (Cann et al. 1991) there are no documented records of harvest of Giant Crab by traditional fishers. Any further information on Aboriginal traditional harvest of Giant Crabs that becomes available in the future will be included in reviews of this policy.

2.8 By-catch

No formal monitoring of by-catch in the Giant Grab Fishery (GCF) has occurred in South Australia in the past, however, by-catch is understood to be low due to the targeting nature of the Rock Lobster pots and Giant Crab traps which also have escape gaps to remove by-catch. PIRSA is currently in the process of digitising logbook returns which will require by-catch species to be included. The most common species of by-catch are considered to be Banded Morwong, Leatherjacket spp., Slimy Cod (Bearded Cod), Conger Eel, Knifejaw and Octopus.

Non-quota holders in the RLF can take up to five individual Giant Crabs per fishing trip that are taken as by-product when fishing for Southern Rock Lobster.

3 Current status of the Giant Crab resource

Giant Crab is considered to be a single biological stock from Western Australia to Tasmania because the species occurs in a continuous distribution across this range. The most recent classification of the status of the South Australian Giant Crab resource was for the 2022-23 season in which it was classified as "depleting" (McLeay 2024). This classification was the result of a weight of evidence approach, noting the primary performance indicator (in place at the time) of 5-year average CPUE had declined to below the Trigger Reference Point, as well as the historical lows in catch and recruitment. It is noted that due to data confidentiality constraints that have since been resolved, Giant Crab stock status reports to date have not provided a separate stock status for the Southern Zone and for the Northern Zone. The new harvest strategy that forms part of this management policy considers available data of each zone separately in determining TACCs.

Recent stock status reports are available on the Miscellaneous Fishery Page of the PIRSA website at: https://pir.sa.gov.au/primary_industry/commercial_fishing/commercial_fisheries/miscellaneous_fishery

Historical stock status reports are available on the reports and publications page of the SARDI website: https://pir.sa.gov.au/research/publications

4 Ecosystem impacts

The *Fisheries Management Act 2007* requires that fishing activities are managed to protect, use and develop the aquatic resources of the state in a manner consistent with ecologically sustainable development (ESD). In particular, that aquatic habitats are protected and conserved and ecosystems and genetic diversity is maintained and enhanced. Consistent with this requirement, management of commercial fishing for Giant Crab in South Australia is considered as part of the broader ecosystem using an ecosystem-based fisheries management approach.

The ecological impacts associated with the fishing activity considered in development of this policy have been identified and assessed through the process of conducting an ESD risk assessment for the activity, using the National Ecologically Sustainable Development Reporting Framework for Australian Fisheries (Fletcher et al. 2002) to guide the assessment. In accordance with the ESD object in the Act, this approach was used to identify and prioritise important ecological, social and economic factors that affect the management of the activity. Full details about the risks identified and their relevant priority are provided in the report entitled *Ecologically Sustainable Development Risk Assessment of Commercial Fishing for Giant Crabs in South Australia* (PIRSA, 2018). A summary of this report is described in section 10.

A 'High' risk rating was identified for climate change impacting on the performance of the activity. Risk ratings of 'Moderate' were identified for the Giant Crab resource, as well as external factors effecting the performance of the activity including oceanographic influences, economic, mining and other activities and other commercial fisheries. Specific management objectives and strategies listed in Table 2 have been developed to address risks identified as 'Moderate' from the ESD risk assessment. Development of objectives and management strategies that directly mitigate the effects of climate change is limited and, therefore, this risk is not referred to in objectives and strategies.

Since the completion and publishing of the ESD Risk Assessment in 2018, industry has noted that the impact or consequence of demersal trawl fishing on the Southern Zone of the GCF should be considered greater that 'Moderate'. This is specifically in the area in which the GCF overlaps with the Commonwealth Southeast Trawl Fishery. This is due to concerns on the longer-term impacts from

demersal trawling upon the benthic environment along the continental shelf and due to the loss of fishing gear through interactions with trawlers.

5 Goals and Objectives

Section 7 of the *Fisheries Management Act 2007* sets out objects for the Act including principles to protect, manage, use and develop the aquatic resources in a manner that is consistent with ESD. Management of South Australia's fisheries and fishing activities must be consistent with these objects. A number of biological, social and economic factors are identified in the objects of the Act that must be balanced in pursuing ESD. The principle of avoiding over-exploitation of resources and ensuring that those resources are not endangered is specified as the primary consideration.

Four key goals have been identified for commercial fishing for Giant Crab linked to operational objectives for the activity. Performance indicators and reference points for each objective are provided to allow future assessment of this policy in meeting the identified goals as described in Table 2.

Goal 1 – The Giant Crab resource is maintained at ecologically sustainable levels

This goal relates to the sustainability of the target stock. The objectives of this policy in relation to sustainability are:

- Giant Crab stocks are maintained at sustainable levels based on performance indicators in the harvest strategy.
- Information collected is sufficient to manage the fishing activity to sustainable levels.

These objectives aim to ensure that Giant Crab resources in South Australia are harvested within sustainable limits as defined by performance indicators relative to reference points described in the harvest strategy at Section 7.

Goal 2 – Enable optimum utilisation and equitable distribution

This goal relates to the economic and social benefits derived from the activity and aims to optimise the economic benefits of the commercial activity. Optimising the use of the activity focuses on allowing for economic efficiency of fishing operations. The objectives of this policy in relation to optimum utilisation are:

- Optimise economic performance within biologically sustainable limits.
- Manage the resource to allow for equitable distribution within biologically sustainable limits.

It is noted that fishing for Giant Crabs is predominately a commercial activity by virtue of the depth that Giant Crabs inhabit. The objectives in this policy allows for access of the resource in line with requirements under the *Fisheries Management Act 2007*.

Goal 3 – Protect and conserve aquatic resources, habitats and ecosystems

This goal relates to the management of the activity using an ecosystem-based fisheries management approach. The objectives of this policy to achieve this goal are:

- Fishing impacts on by-catch, by-product and Threatened, Endangered and Protected Species (TEPS) are within sustainable levels.
- Fishing impacts on benthic habitat and associated biological communities are within ecologically sustainable levels.

Goal 4 – Enable cost effective and participative management of the fishing activity

This goal relates to co-management of the activity, planning of management activities and the recovery of the costs of management of the activity. The overall objectives of this goal are to ensure that stakeholders and government fisheries administration share responsibility and have involvement in the decision-making processes for developing and implementing management arrangements, and to ensure that management arrangements are complied with. The cost effectiveness of these arrangements also needs to be considered in the development process as the management costs are recovered from fishers in accordance with the Government‘s cost recovery policy.

The operational objectives of this policy are:

- Industry participation in management through the appropriate consultation with licence holders with access to the Giant Crab resource.
- Maximise stewardship of fisheries resources.
- Management costs of the activity are funded by relevant licence holders.

Table 2: Goals, Objectives and strategies for commercial fishing for Giant Crab

Objective	Strategies	ESD risk addressed	Performance indicator	Description	Reference point
Goal 1: The Giant Crab resource is maintained at ecologically sustainable levels					
1a Giant Crab stocks are maintained at sustainable levels based on performance indicators in the harvest strategy	1ai. TACC set annually informed by the harvest strategy 1aii. Set input and output controls that support sustainable use of the resource 1aiii. Controls on number of licences	Impacts on Giant Crab	3-year average commercial catch rate (CPUE)	3-year average commercial catch rate (CPUE) calculated from the average of the current and previous four fishing seasons. Commercial catch rate is weight (kilograms) of legal sized Giant Crabs/potlift	3-year average standardised Catch Per Unit Effort (CPUE) above 2.03 kg per potlift in the Northern Zone and above 1.85 kg per potlift in the Southern Zone
1b: Information is collected sufficient to manage commercial harvest operations to sustainable levels.	1bi. Fishery-dependent information collected through commercial catch and effort logbooks (periodic returns) and catch disposal records		Provision of periodic returns and catch disposal records	Spatial and temporal catch and effort data provided by all commercial operators	Total catch and effort in the GCF are reported and monitored
Goal 2: Enable optimum utilisation and equitable distribution					
2a Economic performance is optimised within biologically sustainable limits	2ai. TACC set annually informed by the harvest strategy 2aii. Management arrangements allows for commercial activities that take into account sustainability objectives	Economics	TACC set annually informed by the harvest strategy		TACC set annually informed by the harvest strategy
Goal 3: Impacts on aquatic resources, habitats and ecosystems are sustainable.					
3a Fishing impacts on by-catch, by-product, threatened, endangered and protected species (TEPS) are within sustainable levels	3ai. Control of the number of licences with access to Giant Crab 3aii. Escape gaps are fitted to pots where required 3aiii. Interactions with TEPS are reported and monitored		Number of fishing licences with access to Giant Crab Number of interactions with TEPS reported in the Wildlife Interaction Logbook		Number of fishing licences with access to Giant Crab does not exceed the number of licences when this policy was implemented Interactions with TEPS is monitored

Objective	Strategies	ESD risk addressed	Performance indicator	Description	Reference point
3b Fishing impacts on benthic habitat and associated biological communities are within ecologically sustainable levels	3bi. Total number of pots in the fishing activity is not increased		Number of pots that can be used to harvest Giant Crabs		Number of pots that can be used to harvest Giant Crab does not exceed the number of pots when this policy was implemented
Goal 4: Enable effective and participative management of the fishing activity.					
4a Industry participation in management through the appropriate consultation with licence holders with access to the Giant Crab resource	4ai. Stakeholder have input to the management of the commercial fishing activity through appropriate consultative processes 4aii. Arrangements are communicated to the wider community	External factors affecting fishing	Consultation with relevant industry members where appropriate Management information is available on PIRSA website	Information related to management of the activity is correct and relevant on PIRSA website	Consultation with relevant industry members where appropriate is conducted to provide input into management decisions PIRSA website information is updated as required
4b Maximise stewardship of fisheries resources	4bi. Cost-effective compliance and monitoring program implemented to address identified risks 4bii. Management arrangements are communicated to the wider community		Number of prosecutions. Management information is available on PIRSA website.	Number of prosecutions related to the fishing activity Information related to management of the fishing activity is correct and relevant on PIRSA website	Number of prosecutions over three years does not increase significantly. PIRSA website information is updated as required
4c Management costs of the activity are funded by relevant licence holders	Recover licence fees from relevant commercial licence holders in accordance with the Government's cost recovery policy		Costs attributed to managing commercial fishing for Giant Crab are recovered through licence fees		Costs attributed to managing commercial fishing for Giant Crab are recovered through licence fees

6 Research and monitoring

PIRSA Fisheries and Aquaculture contracts research services for each fishing activity. SARDI is currently the primary research provider for core scientific stock status assessment and reporting for commercial fishing for Giant Crabs. Costs of the annual research program for the activity are recovered through licence fees in accordance with the Government's cost recovery policy. External funding sources, such as the Fisheries Research and Development Corporation (FRDC) may also provide funding for specific research projects.

6.1 Data collection and analysis

To achieve the research and monitoring needs for the activity, a variety of fishery-dependent data are collected and analysed (McLeay 2016):

- Commercial catch and effort logbook data.
- Wildlife interaction logbook data.
- Catch disposal records.

There are currently no fishery-independent data available for commercial fishing for Giant Crabs.

6.2 Fishery dependent monitoring

Licence holders are required to complete a daily catch and effort logbook report detailing their fishing activities and harvest. The data from these logbooks are entered into a database maintained by PIRSA and validated (McLeay 2016). Fishers are also required to complete catch disposal records on each offload of Giant Crab from commercial vessels. The data from these records are entered and maintained by PIRSA Fisheries and Aquaculture in order to monitor the quota for the fishing activity.

PIRSA Fisheries and Aquaculture implemented a generic data recording logbook in 2007 for recording wildlife interactions (including TEPS) for all South Australian commercial fisheries. The wildlife interaction logbook was implemented to ensure consistent reporting practices for interactions with TEPS. SARDI collate and archive the data from the wildlife logbooks and summarise these in an annual report (see Mackay et al. 2017).

6.3 Reporting

SARDI provide stock status reports for commercial fishing for Giant Crabs annually. The stock status synthesises information available for the fishing activity, assesses the status of the resource, and evaluates the performance of the activity with respect to performance indicators and reference points described in the harvest strategy (section 7). Stock status reports are available on the Miscellaneous Fishery Page of the PIRSA website at:
https://pir.sa.gov.au/primary_industry/commercial_fishing/commercial_fisheries/miscellaneous_fishery

7 Harvest Strategy

7.1 Background

The primary aim of this harvest strategy is the sustainability of the Giant Crab resource in South Australia consistent with goal 1 described at section 3 of this policy. This harvest strategy has been developed using the best available information. The operational objective of this harvest strategy is to maintain the 3-year average standardised Catch Per Unit Effort (CPUE) above 2.03 kg per potlift in the Northern Zone and above 1.85 kg per potlift in the Southern Zone.

The harvest strategy was developed following feedback from industry that the previous harvest strategy contained within the 2018 management policy required substantial improvement to better respond to changes in Performance Indicators and further graduate changes in the Total Allowable Commercial Catch (TACC) settings to reduce the severity of TACC changes. This harvest strategy was developed by PIRSA Fisheries and Aquaculture in collaboration with industry, with scientific advice to inform the harvest strategy provided by SARDI and an independent scientific reviewer. The changes in this harvest strategy from the 2018 version include: 1) a separate harvest strategy for the Northern Zone and Southern Zone; 2) the use of statistical standardisation procedures applied to CPUE; and 3) the use of 3-year average standardised CPUE as an index of relative Giant Crab abundance and the primary performance indicator used in each management zone.

7.2 Framework for the annual decision making process

This harvest strategy provides a structured framework for decision making in terms of setting TACC levels that aim to maintain the Giant Crab resource at a sustainable stock status classification.

This decision-making framework involves the following steps to be undertaken prior to the commencement of the new fishing season each year on 1 October in the Southern Zone and 1 November in the Northern Zone:

Step 1: Obtain fisheries logbook data to determine 3-year average standardised Catch Per Unit Effort (CPUE) for the Northern Zone and for the Southern Zone inclusive of the most recent fishing season.

Step 2: Use the Harvest Strategy Decision Rules and Meta Rules to determine the TACC and stock status for the Northern Zone and for the Southern Zone, respectively.

Step 3: Provide licence holders and industry representatives the opportunity to provide PIRSA Fisheries and Aquaculture feedback on the proposed TACCs determined under the Harvest Strategy Decision Rules and Meta Rules prior to the commencement of the season.

Step 4: The results of steps 1-3 will be considered by the Minister or their delegate to set the quota unit for the upcoming fishing season.

The Minister or their delegate then has responsibility for determining the value of a quota unit on an annual basis for the Northern Zone and for the Southern Zone of the GCF under the *Fisheries Management (Rock Lobster Fisheries) Regulations 2017* and the Fisheries *Management (Miscellaneous Fishery) Regulations 2015* by dividing the TACC for the fishery by the total number of Giant Crab quota units in the fishery.

7.3 Performance Indicators

The primary performance indicator used in this harvest strategy is the 3-year average standardised Catch Per Unit Effort (CPUE) that is applied separately for the Southern Zone and Northern Zone. The indicator is an index of relative Giant Crab abundance and derived from the number of kilograms of legal sized Giant Crabs per potlift.

Following a review by SARDI in 2024 and with the support of industry, statistical procedures were applied to CPUE data to control the factors potentially influencing CPUE to construct a standardised index of relative Giant Crab abundance (see e.g., Kimura 1981). The standardised index was calculated for each zone using the yearly season effects (or regression coefficients) estimated from a lognormal regression model that controlled for month, licence, Marine Fishing Area and depth. The standardised index was then scaled relative to the initial season's (2000) CPUE value and is called the "standardised CPUE". Technical details of the standardisation methodology are in Appendix 10.2.

In reviewing factors to control for in the creation of the standardisation model for this harvest strategy, soak time was also considered. Soak time has not been used in this harvest strategy as data was only available for the most recent 6 seasons and thus could not provide information on the relative abundance trends for the entire time series. Furthermore, soak time was unlikely to affect the trend in a standardised index of abundance (McLeay, unpublished data). Soak time will continue to be recorded for potential incorporation into future harvest strategies.

Although not factored into the decision rule contained in this Harvest Strategy, an additional performance indicator of pre-recruit index (PRI) will continue to be monitored. Pre-recruit index (PRI) is a performance indicator for monitoring recruitment predicted to enter the GCF in the following years. PRI will be published and reviewed each year to provide industry with the option of taking a lower TACC for the upcoming season as per Decision Rule 2.

7.4 Reference Points

The Target Reference Point (RP targ) for each zone is set at the average standardised CPUE of the years 2000-2012. These years were considered to represent a stable and sustainable period of fishing in respect of nominal CPUE, landed catch and the number of potlifts. Consistent with the National Harvest Strategy Policy (Sloan et al. 2014) the Limit Reference Point (RP lim) is set at 50% of RP targ and the Trigger Reference Point (RP trig) is set at 75% of RP targ.

The blue, green, orange and red 'zones' in the harvest strategy tables are aimed to respond to changes in stock abundance by using a gradual approach that provides for greater reductions in TACC when CPUE is below the relevant Trigger Reference Point.

For both zones, the TACC at the RP targ is based on average catch landed in the years 2000-2012. In line with a gradual management response, reductions in TACC are more stringent when the TACC is below RP trig. When TACC is above RP trig, the bands are set at approximately 15% whilst when TACC is below TRP, the bands are set at approximately 20%. Following consultation with industry, an additional upper 'blue zone' band has been included in both decision tables with maximum TACCs of 13.4 tonnes (t) in the Northern Zone and 8.7 t in the Southern Zone (Tables 3 and 4). These maximum TACCs levels are consistent with historical TACCs in the GCF.

7.5 Monitoring strategy

Commercial CPUE is derived from catch and effort data reported in the commercial GCF catch and effort logbooks from commercial licences endorsed with Giant Crab quota units throughout the fishing season.

SARDI reports commercial catch rate data and the 3-year average standardised (previously 5-year) CPUE in the annual stock status report or Advice Note prior to the commencement of the next fishing season. Further details about the reporting of commercial catch and effort are provided in section 6.

7.6 Stock status classification

A consistent national reporting framework for the status of fish stocks has been developed and applied in all jurisdictions across Australia. The reporting framework provides stock status classifications to assess whether the current abundance/biomass of fish in a stock is at an adequate level and whether the level of fishing pressure is adequately controlled through management measures or regulation (Piddocke et al 2020).

Biological reference points provide guidance on determining whether stock abundance/biomass is too low or fishing pressure is too high. The SAFS provides guidance on the definition of stock status classification and the management actions to be taken for each status (Table 1). The SAFS guidelines have been incorporated into the decision-making matrices for the respective zones in the GCF (Tables 4 and 5).

Table 3: SAFS stock status classifications

	Stock status	Description	Potential implications for management of the stock
	Sustainable	Biomass (or proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (recruitment is not impaired) and for which fishing mortality (or proxy) is adequately controlled to avoid the stock becoming recruitment impaired (overfishing is not occurring).	Appropriate management is in place.
	Depleting	Biomass (or proxy) is not yet depleted and recruitment is not yet impaired, but fishing mortality (or proxy) is too high (overfishing is occurring) and moving the stock in the direction of becoming recruitment impaired.	Management is needed to reduce fishing mortality and ensure that the biomass does not become depleted.
	Recovering	Biomass (or proxy) is depleted and recruitment is impaired, but management measures are in place to promote stock recovery, and recovery is occurring.	Appropriate management is in place, and there is evidence that the biomass is recovering.
	Depleted	Biomass (or proxy) has been reduced through catch and/or non-fishing effects, such that recruitment is impaired. Current management is not adequate to recover the stock, or adequate management measures have been put in place but have not yet resulted in measurable improvements.	Management is needed to recover this stock; if adequate management measures are already in place, more time may be required for them to take effect.
	Undefined	Not enough information exists to determine stock status.	Data required to assess stock status are needed.
	Negligible	Catches are so low as to be considered negligible and inadequate information exists to determine stock status.	Assessment will not be conducted unless catches and information increase.

7.7 Decision Rules for setting the TACC

In determining the TACCs for the respective zones of the GCF, the following decisions rules apply:

1. The maximum recommended TACC that applies to the GCF for each zone is in accordance with the relevant band that corresponds to the 3-year average standardised index of relative abundance in Tables 4 and 5.
2. The relevant zone of the GCF will be closed when the 3-year average standardised index of relative abundance falls into the classification corresponding to having a 'Depleted' stock status for the respective zone.
3. Industry can opt to take a lower value of TACC than that corresponding to the most recent standardised index of relative abundance, or close a zone of the GCF, if there are additional concerns not highlighted by the Performance Indicator.

Table 4: Decision matrix for the Northern Zone of the GCF for 3-year average standardised index of relative abundance

Standardised Index of Relative Abundance Bands	**TACC (t)**	**Stock status**	
>2.92 +	13.4	Sustainable	
>2.70 to 2.92	10	Sustainable	Target Reference Point (2.70)
>2.48 to 2.70	8.5	Sustainable	
>2.26 to 2.48	7.2	Sustainable	
>2.03 to 2.26	6.1	Sustainable	Trigger Reference Point (2.03)
>1.80 to 2.03	4.9	Depleting / Recovering*	
>1.57 to 1.80	3.9	Depleting / Recovering*	
>1.35 to 1.57	3.1	Depleting / Recovering*	Limit Reference Point (1.35)
0 to 1.35	0	Depleted (fishery closed)	

* classified as "Recovering" when 3-year average standardised index of relative abundance is higher than the previous year

Table 5: Decision matrix for the Southern Zone of the GCF for 3-year average standardised index of relative abundance

Standardised Index of Relative Abundance Bands	**TACC (t)**	**Stock status**	
>2.68 +	8.7	Sustainable	
>2.46 to 2.68	7.6	Sustainable	Target Reference Point (2.46)
>2.26 to 2.46	6.5	Sustainable	
>2.06 to 2.26	5.5	Sustainable	
>1.85 to 2.06	4.7	Sustainable	Trigger Reference Point (1.85)
>1.64 to 1.85	3.7	Depleting / Recovering*	
>1.43 to 1.64	3.0	Depleting / Recovering*	
>1.23 to 1.43	2.4	Depleting / Recovering*	Limit Reference Point (1.23)
0 to 1.23	0	Depleted (fishery closed)	

* classified as "Recovering" when 3-year average standardised index of relative abundance is higher than the previous year

7.8 Meta Rule

1. The TACC in any one year can only be increased by a maximum of one band from the previous year, regardless of the actual 3-year average standardised index of relative abundance reported.

7.9 Re-opening Strategy

In the event of the closure of either zone of the GCF as a result of a 'depleted' stock status classification in Table 4 or 5 or at the request of industry in accordance with Decision Rule 3, a zone can only be opened following the implementation of the following points:

1. A survey overseen by SARDI is undertaken to assess stock status and if possible, set a TACC for the relevant zone(s).
2. A working group that includes members from PIRSA, SARDI and industry is established to determine the parameters of the survey, including but not limited to:
    a. The location(s) and duration of the survey.
    b. Industry members and vessels who will conduct the survey.
    c. The number of pot sets to be undertaken in the survey.
    d. Observer coverage during the survey.

Following the application of the above-mentioned steps:

- A zone can only be reopened for non-survey fishing after it has been closed for at least one season.
- The observed CPUE derived from the survey will be used as a substitute for the catch and effort data that would have normally been obtained had the fishery not been closed.
- PIRSA Fisheries and Aquaculture in consultation with industry and SARDI will determine if it is appropriate to re-open the fishery based on the observed CPUE derived from the survey.
- Should it be determined appropriate to re-open the fishery, PIRSA Fisheries and Aquaculture in consultation with industry and SARDI will determine the TACCs for the respective zones for the subsequent season.
- The standardised CPUE from the first season the fishery is open will be used to determine the TACCs for the second season the fishery is open, for the respective zones, under Tables 4 and 5.
- The standardised CPUE from the second season the fishery is open will be used to determine the TACCs for the third season the fishery is open, for the respective zones, under Tables 4 and 5.
- Once three years of standardised CPUE have been obtained the 3-year average standardised CPUE will be used to set the TACCs consistent with the "Framework for the annual decision making process" (see Section 7.2).

8 Compliance and monitoring

8.1 Objectives

PIRSA Fisheries and Aquaculture runs a compliance program consistent with the National Fisheries Compliance Policy that has dual objectives:

- To maximise voluntary compliance with fisheries rules[1]; and

[1] Rules include regulations, licence conditions, closure notices or any other enforceable instrument under the *Fisheries Management Act 2007*.

- To create effective deterrence to breaching fisheries rules

Voluntary compliance is maximised by ensuring that fishers are aware of the rules that apply to their fishing activities, understand the rules and the purpose of those rules and operate in a culture of compliance. Effective deterrence is created through the presence of Fisheries Officers and awareness of compliance operations, as well as through detection and prosecution of illegal activity[2].

8.2 Planning

PIRSA Fisheries and Aquaculture compliance programs are developed through a three-year planning cycle. This planning cycle is designed to ensure that compliance programs:

- support the fisheries management objectives for each fishing activity;
- identify compliance risks in each fishing activity;
- respond to key risks within each three-year period;
- have an appropriate mix of tools designed to maximise voluntary compliance and create effective deterrence; and
- establish benchmarks against which to measure responses to risks.

A compliance risk assessment is undertaken every year for each fishing activity. A major risk assessment is undertaken periodically (approximately every three years) or is triggered by a major change in management arrangements. In intervening years that risk assessment is updated. The risk assessment identifies and prioritise the compliance risks that exist in the fishing activity ranked according to the likelihood and consequence of the risk occurring. This risk assessment is used to inform annual compliance planning processes.

Compliance activities are planned to respond to the risks identified in each fishing activity, with an emphasis on the most serious risks. Responses must include measures aimed at both maximising voluntary compliance and creating effective deterrence.

Benchmarks are established by which to measure compliance activities. These benchmarks are used to guide the allocation of resources in compliance planning.

Each year a report is to be prepared assessing the compliance status of commercial fishing for Giant Crab. This report:

- describes the compliance program for the previous three years including an overview of activities and relevant statistics;
- describes how the program has been implemented to achieve both voluntary compliance and create effective deterrence;
- describes the risks that have been addressed as a priority over that period;
- comments on any changes to the risk profile of the fishing activity during that period;
- analyses the compliance status of the fishing activity (including information about intelligence reports received); and
- makes suggestions for future compliance planning.

[2] Prosecution may include the issuing of a formal caution or an expiation notice, in addition to prosecution through the courts.

9 Review of the policy

This policy, including the harvest strategy, may be reviewed at any time to incorporate such measures into the management framework of the fishing activity required to address any significant issues that were not anticipated when the policy and harvest strategy were developed. A review of the harvest strategy will consider an assessment of performance indicators including the application of a pre-recruit biological performance indicator and further analysis of the use of soak time when applying standardised CPUE.

In the absence of a recognised management advisory committee for the activity, PIRSA would coordinate the review process. In conducting this review PIRSA may consult with relevant stakeholders including licence holders and other relevant non-industry stakeholders including conservation groups, recreational fishers and other government departments.

Should reliable length-frequency data become available in the future, this will be considered in incorporating into a new harvest strategy. A FRDC project to address the lack of length frequency data across the giant crab fisheries in Australia is currently underway. This project is titled "*Giant Crab Enhanced Data Collection - Innovative approaches to enhance data collection in the Victorian, South Australian and Tasmanian Giant crab fisheries*" (FRDC 2019-114). It aims to develop imaging systems and hardware to facilitate onboard length-frequency data collection across fishing fleets in all three jurisdictions.

10 Appendices

10.1 Summary of ESD Reporting

Table 5: Summary of National ESD Reporting Framework outcomes for Giant Crab fishing in SA.

Component Trees	Extreme	High	Moderate	Low	Negligible	Total
Retained Species			1	1	1	3
Non-retained species				3	6	9
General Ecosystem					2	2
General Community				1	7	8
Governance				3		3
External Factors		1	7	3	4	15
Total		1	8	11	20	40

Table 6: Performance report for Extreme, High and Moderate Risk elements of Giant Crab ESD Risk Assessment (PIRSA 2018).

Issue	Risk / Priority	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	Actions
Retained Species							
Giant Crab	Moderate	Yes	Yes	Yes	Undefined	High	*
Non-Retained Species							
N/A							
General Ecosystem Impacts of Fishing							
N/A							
Community							
N/A							
Governance							
N/A							
External factors affecting the performance of the fishery							
Oceanographic	Moderate	No	No	No	N/A	N/A	**
Climate change	High	No	No	No	N/A	N/A	**
Temperature	Moderate	No	No	No	N/A	N/A	**
Weather	Moderate	No	No	No	N/A	N/A	**
Upwellings	Moderate	No	No	No	N/A	N/A	**
Mining / exploration activities	Moderate	No	No	No	N/A	N/A	**
Economic	Moderate	No	No	No	N/A	N/A	**
Other commercial fishing	Moderate	No	No	No	N/A	N/A	**

* = Review under development of new management policy; ** = Review at next major ESD assessment

10.2 Standardisation methodology

Standardisation using a linear regression model (see, e.g., Kimura (1981)). Without loss of generality, this presentation pertains to a particular fishery zone r, be it Northern or Southern.

The time variable $t \in \mathbb{T} = \{2000, \ldots, 2022\}$ will be the annual fishing seasons. Therefore, the time effect factor will be annual and its estimate will become the standardised index of relative abundance. Once scaled, it is known as the "standardised CPUE".

The month variable $m \in \{1, \ldots, 12\}$ will be the calendar months of the year within a fishing season.

The licence variable $l \in \mathcal{L} = \{1, \ldots, n_l\}$ will represent the licences. Let n_l be the total number of distinct licences in the fishery zone.

The area variable $a \in \mathcal{A} = \{1, \ldots, n_a\}$ will represent the Marine Fishing Areas (MFAs). Let n_a be the total number of MFAs in the fishery zone.

Treat the depth d as a categorical variable with 30-metre-wide bins. This will be used as a categorical factor to control for in the standardisation. The depth category levels in our data are $\mathcal{D} = \{[60,90), \ldots, [330,360)\}$, as well as missing. Hopefully without any confusion, this section will use the term "depth" to mean the depth category.

The catch rate U will follow a multiplicative model that depends on the season (as time) and other controlling variables, with a lognormal error factor. That way, linearising this model will result in a linear model with a normal error term. For this linear model, the response will be $Y := \ln(U)$.

Assume a non-time-varying catchability coefficient $q_{mlad} \geq 0$ that depends on month of year m, licence number l, MFA a and depth d. Then the catch rate U_{tmlad} is proportional to the biomass B_t through

$$U_{tmlad} = q_{mlad} B_t, \quad \begin{cases} t \in \mathbb{T}, \\ m \in \{1, \ldots, 12\}, \\ l \in \mathcal{L}, \\ a \in \mathcal{A}, \\ d \in \mathcal{D}. \end{cases}$$

It can be shown that under the assumptions for q_{mlad}, the catch rate can be written as the multiplicative statistical model

$$U_{tmlad} = U_{2000,1,1,1,[60,90)}\, \tau_t\, \gamma_m\, \lambda_l\, \alpha_a\, \theta_d\, \varepsilon_{tmlad}, \quad \begin{cases} t \in \{2001, \ldots, 2022\}, \\ m \in \{2, \ldots, 12\}, \\ l \in \{2, \ldots, n_l\}, \\ a \in \{2, \ldots, n_a\}, \\ d \in \{[90,120), \ldots, [330,360)\}, \end{cases}$$

where $U_{2000,1,1,1,[60,90)}$ is the reference catch rate, τ_t is the time effect factor of season t relative to the 2000 season, γ_m is the calendar month effect factor of month m relative to January, λ_l is the efficiency factor of licence l relative to some licence 1, α_a is the area effect factor of MFA a with respect to the first MFA in the data, θ_d is the depth effect factor relative to the shallowest depth category, and ε_{tmlad} is the "error" factor that accounts for the deviation between the observed catch rate U_{tmlad} and the expected catch rate for a given (t, m, l, a, d). Here, the time effect factor is a standardised index of relative abundance, controlling for the depth, calendar month, licence and MFA factors.

Linearise this multiplicative model through a logarithmic transformation. In this linear model, the response variable is $Y_{tmlad} = \ln(U_{tmlad})$. We write the transformed statistical model as

$$Y_{tmlad} = \mu + \tau_t^* + \gamma_m^* + \lambda_l^* + \alpha_a^* + \xi_s^* + \varepsilon_{tmlad}^*, \quad \begin{cases} t \in \{2001, \dots, 2022\}, \\ m \in \{2, \dots, 12\}, \\ l \in \{2, \dots, n_l\}, \\ a \in \{2, \dots, n_a\}, \\ d \in \{[90,120), \dots, [330,360)\}. \end{cases}$$

where $\mu = \ln\left(U_{2000,1,1,1,[60,90)}\right)$ is the logarithm of the reference catch rate, $\tau_t^* = \ln(\tau_t)$ is the log-time effect of season t relative to the 2000 season, $\gamma_m^* = \ln(\gamma_m)$ is the log-calendar month effect term of month m relative to January, $\lambda_l^* = \ln(\lambda_l)$ is the log-efficiency effect term of licence l relative to some licence 1, $\alpha_a = \ln(\alpha_a)$ is the log-area effect term of MFA a with respect to the first MFA in the data, $\theta_d^* = \ln(\theta_d)$ is the log-depth effect of d relative to the shallowest depth, and $\varepsilon_{tmlad}^* = \ln(\varepsilon_{tmlad})$ is the "error" term that accounts for the deviation between the observed response Y_{tmlad} and the expected linear model response for a given (t, m, l, a, d).

Assume that the error term ε_{tmlad}^* is distributed Normally with zero mean and constant variance σ_ε^2. Then the error factor $\varepsilon_{tmlad} = \exp(\varepsilon_{tmlad}^*)$ of the multiplicative model has a lognormal distribution.

The statistical linear model can also be written with the use of dummy indicator variables (using the Kronecker delta notation) as

$$Y_{tmlad} = \mu + \sum_{t\prime=2001}^{2022} \tau_{t\prime}^* \, \delta_{t\prime,t} + \sum_{m\prime=2}^{12} \gamma_{m\prime}^* \, \delta_{m\prime,m} + \sum_{l\prime=2}^{n_l} \lambda_{l\prime}^* \, \delta_{l\prime,l} + \sum_{a\prime=2}^{n_a} \alpha_{a\prime}^* \, \delta_{a\prime,a} + \sum_{s\prime=2}^{15} \theta_{d\prime}^* \, \delta_{d\prime,d}$$
$$+ \varepsilon_{tmlad}^*, \quad \begin{cases} t \in \{2001, \dots, 2022\}, \\ m \in \{2, \dots, 12\}, \\ l \in \{2, \dots, n_l\}, \\ a \in \{2, \dots, n_a\}, \\ d \in \{[90,120), \dots, [330,360)\}. \end{cases}$$

This is in the form of the general linear model equation $Y = x^T\beta + \varepsilon^*$, with μ being the intercept β_0. Therefore, we fit the linear model in R as follows for the Northern Zone (and similarly for the Southern Zone by modifying the filter).

```
lm_log_CPUE_Northern_SEASON_MONTH_LIC_MFA_DEPTH <- lm(
  formula = log_CPUE ~ SEASON + TRIP_MONTH + LIC_NO + MFA + DEPTH
  ,data = FACT_LOG_DEPTH_MFA_LIC_MONTH_SEASON_ZONE  |>
    filter(
      ZONE == "Northern"
    ) |>
    mutate(
       SEASON = as.factor(SEASON)
      ,TRIP_MONTH = as.factor(TRIP_MONTH)
      ,LIC_NO = as.factor(LIC_NO)
      ,MFA = as.factor(MFA)
      ,DEPTH = factor(
        DEPTH_CATEGORY
        ,exclude = NULL   #Include NA as a level
      )
    )
)
```

The estimates of the log-time effect parameters $\hat{\tau}_t^*$ for seasons 2001 to 2022 are output as the coefficients of the variables of the format SEASONYYYY, where YYYY is the year at the start of the annual season. We can extract these estimates from the fitted linear model to then estimate the time effect factors $\hat{\tau}_t = \exp(\hat{\tau}_t^*)$ for $t = 2001, \dots, 2022$, knowing that $\hat{\tau}_{2000} = 1$ for the reference 2000 season, which make up the **standardised index of relative abundance** $\{\hat{\tau}_t\}_{t\in\mathbb{T}}$.

We can calculate a standardised index of relative abundance $\widehat{U}_t$ relative to the CPUE U_{2000} observed in the reference 2000 season (to be called the "**standardised CPUE**" in this document) as

$$\widehat{U}_t = \hat{\tau}_t \, U_{2000}, \quad t = 2001, \ldots, 2022.$$

The 95% confidence interval of this "standardised CPUE" relative to the 2000 season as

$$\exp\left(\hat{\tau}_t^* \pm 1.96 s_{\hat{\tau}_t^*}\right) U_{2000}, \quad t = 2001, \ldots, 2022.$$

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