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ECOLOGICALLY SUSTAINABLE DEVELOPMENT RISK ASSESSMENT OF COMMERCIAL FISHING FOR GIANT CRABS IN SOUTH AUSTRALIA

20 JULY 2018

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ENVIRONMENT



DRAFT ECOLOGICALLY SUSTAINABLE DEVELOPMENT RISK ASSESSMENT OF COMMERCIAL FISHING FOR GIANT CRABS IN SOUTH AUSTRALIA

Information current as of 20 July 2018

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Table of Contents

Background.....	4
Biology.....	4
Export Approval.....	5
Stock Status.....	5
By-catch.....	5
Method of the Risk Assessment.....	5
ESD Risk Assessment Component Trees.....	8
Issues related to the retained species in a fishing activity (All Sectors):.....	8
Issues related to the non retained species of a fishing activity:.....	10
Issues related to the general environment impacts of a fishing activity:.....	12
Contribution of the fishing activity/industry to community wellbeing:.....	13
Issues related to the governance of the fishing activity/industry:.....	15
External impacts affecting performance of the fishing activity:.....	18
Appendix.....	21
Summary of ESD Reporting.....	21
Appendices.....	23
References.....	28

Background

Commercial fishing for Giant Crabs is not formally identified as a discrete fishery under the *Fisheries Management Act 2007* and is 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*.

Targeted commercial fishing for Giant Crab (*Pseudocarcinus gigas*) was initiated in Tasmanian waters in 1990/91 and began in South Australian waters in 1992, however, Giant Crab has been taken as a by-catch in the Rock Lobster Fishery (RLF) in southern Australia for over 80 years. Greater detail on the history of commercial fishing activity for Giant Crab in South Australia can be found in Sloan (2002).

Management of fishing for Giant Crab in South Australia has been separated into two zones, the Southern Zone (SZ) and Northern Zone (NZ) since 1997, consistent with zones designated for the RLF. Fishing in each zone is subject to a seasonal closure. The fishing season in the SZ is between 1 October and 30 April, while fishing in the NZ is between 1 November and 31 May.

An annual Total Allowable Commercial Catch (TACC) of 26 tonnes was implemented for commercial harvest of Giant Crab in 1999. From 2000 onwards this TACC was reduced to 22.1 t and has remained unchanged since that time. At the time of conducting this assessment two licence holders in the Miscellaneous Fishery and all licence holders in the RLF could access Giant Crab for commercial purposes through Giant Crab quota entitlements, or for non-quota holders through an allowance to of up to five individual Giant Crabs per fishing trip as by-product. In 2015, fourteen licence holders held Giant Crab quota units: one in the South Australian Miscellaneous Fishery and 13 in the RLF. A total of 230 RLF licence holders could harvest Giant Crab as by-product. 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. 60.6% of the quota is allocated to the Northern Zone with the remainder allocated to the Southern Zone.

The management arrangements for commercial fishing for Giant Crabs considered for this assessment was 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). The management objectives listed in this document were:

- To ensure sustainable harvests from the Giant Crab resource
- To minimise any disruption to the structure, productivity, function and biological diversity of the marine ecosystem, within which the fishery operates
- To provide efficient and cost effective management of the fishery
- To maximise the economic returns and social benefits associated with the exploitation of the Giant Crab resource
- To ensure equitable distribution of the Giant Crab resource.

Biology

Giant Crab is endemic to southern Australia at depths from 20 to 600 metres, however, the highest population densities are found at depths of approximately 100 to 200 metres, noting this information is largely

based on catch and effort records from commercial fishers. Giant Crabs are long-lived and slow growing (up to 15 years between moults) and therefore may be susceptible to fishing pressure.

In Tasmania, research indicates that undersized crabs occupied the same depth range as legal sized crabs, however a concentration of undersized crabs in one area was identified possibly due to a larval “sink” (Williams et al. 2009). Migration patterns for Giant Crabs is not clear in South Australia, however Giant Crab movement may be driven by water temperatures, with crabs moving to deep water in summer to escape higher surface temperatures (S Clark pers comm.).

Export Approval

Commercial fishing for Giant Crabs 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.

Stock Status

Classification in the national Status of Australian Fish Stocks report for Giant Crab stocks in southern Australia report the Victorian and South Australian stocks as Undefined, Western Australian stocks as Sustainable and Tasmania as Overfished (Hartmann et al. 2016). The most recent classification of the South Australian Giant Crab stock as undefined took into account the contrasting inferences of stock status between the (then) performance indicators for the fishing activity described in Sloan (2002) resulting in high levels of uncertainty in the assessment (McLeay 2016).

By-catch

Research on the by-catch in the Tasmanian Giant Crab Fishery identified the main bycatch species as antlered crab, hermit crab and draftboard shark with these species considered to have a high chance of post release survival (Hobday et al., 2008). Observers in the Victorian Giant Crab Fishery reported that 95% of bycatch was hermit crabs that also have a high probability of survival on release (Fisheries Victoria 2009). Information related to by-catch in South Australia is less certain with no formal monitoring of by-catch for Giant Crab fishing; however, based on bycatch in the Rock Lobster Fishery it is likely that by-catch could include hermit crabs, other crabs, leather jackets, bearded rock cod and octopus.

Method of the Risk Assessment

The identification of issues, risk assessment, and reporting process is closely based on the National Ecologically Sustainable Development (ESD) Framework *How To Guide* (see www.fisheries-esd.com), as well as the Department of Fisheries, Western Australia ESD performance reports pioneered by Dr Rick Fletcher and other WA Fisheries staff (Fletcher et al. 2002). The assessment process examined an extensive range of issues, risks and opportunities. The identification of issues was informed by the generic ESD component tree approach with each component tree refined specifically across all of the fisheries.

Each major component tree reflects the primary components of ESD, and the ESD report assesses the performance of a fishing activity for each of the relevant ecological, economic, social and governance issues facing the activity (Table 1). The process also identifies where additional (or reduced) management or research attention is needed, and identifies strategies and performance criteria to achieve management objectives to the required standard.

Table 1: Primary ESD Components

Retained Species	<i>Ecological Wellbeing</i>
Non-Retained Species	
General Ecosystem Impacts	
Community	
Aboriginal Community	<i>Human Wellbeing</i>
Governance	

The steps followed to complete the ESD Risk Assessment Report are detailed below:

1. A set of “Generic ESD Component Trees” were modified from the ESD Risk Assessment of the South Australian Rock Lobster Fishery (PIRSA 2011) and the draft ESD Risk Assessment for the exploratory harvest of deep water crabs (PIRSA in draft). These component trees were considered to be an appropriate starting point for fishing for Giant Crab, as they operate with similar gear in the same, or overlapping areas, and Giant Crabs were considered as potential by-catch or by-product in these fishing activities. This process identified the issues relevant to ESD performance of each fishing activity under the categories described in Table 1.
2. A risk assessment of the identified issues (or components) was completed based on the *consequence* arising from the issue (described in Table 6 through to Table 11) and *likelihood* that this consequence will occur (described in Table 12). The combination of the consequence and likelihood produce and estimated level of *risk* associated with issues that may undermine or alternatively contribute to ESD objectives (Table 2).

Table 2: Risk matrix

		Consequence Level					
		Negligible	Minor	Moderate	Severe	Major	Extreme
Likelihood Levels		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30

3. Risks were prioritised according to their severity. For higher level risks - where an increase in management or research attention was considered necessary - a detailed analysis of the issue, associated risks, and preferred risk management strategies will be completed. For low risk issues, the reasons for assigning low risk and/or priority will be recorded.
4. For higher level risks, a full ESD performance report was prepared in the context of specific management objectives and include operational objectives, indicators and performance measures.

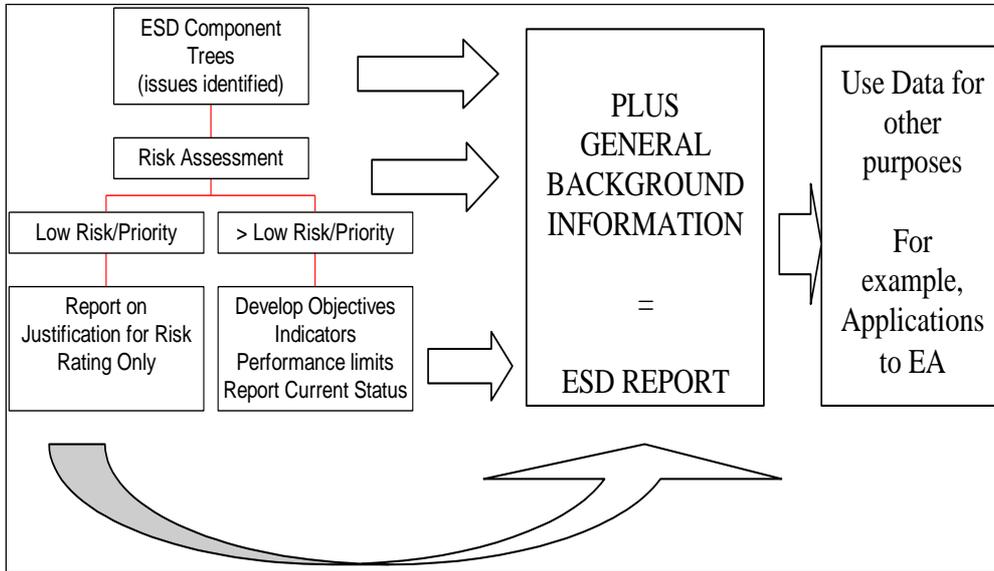
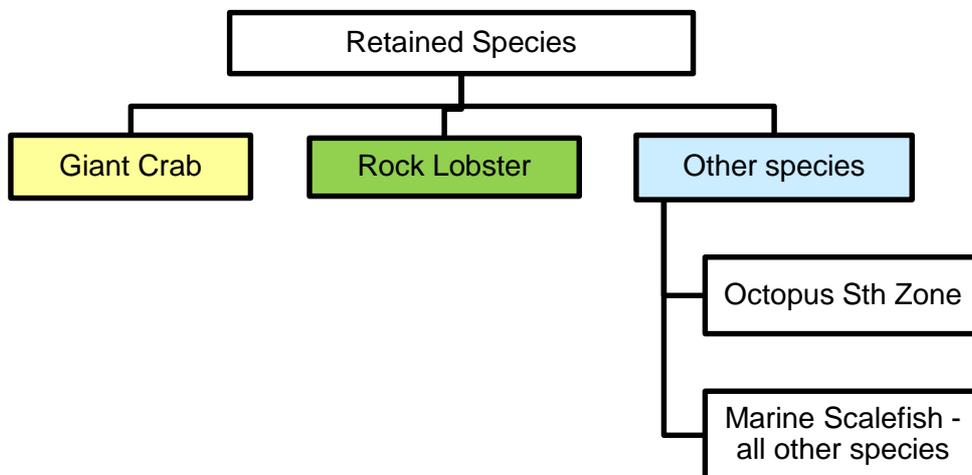


Figure 1: Summary of the ESD reporting framework processes

ESD Risk Assessment Component Trees

Issues related to the retained species in a fishing activity (All Sectors):



Component	Consequence	Likelihood	Risk
Primary Species – Giant Crab	3	4	12
By-product Species – Rock Lobster (RLF only)	1	1	1
Marine Scalefish Species - Other Species – Octopus (RLF Only)	0		0
Marine Scalefish Species - Other Species – (RLF Only)	0		0

Giant Crab

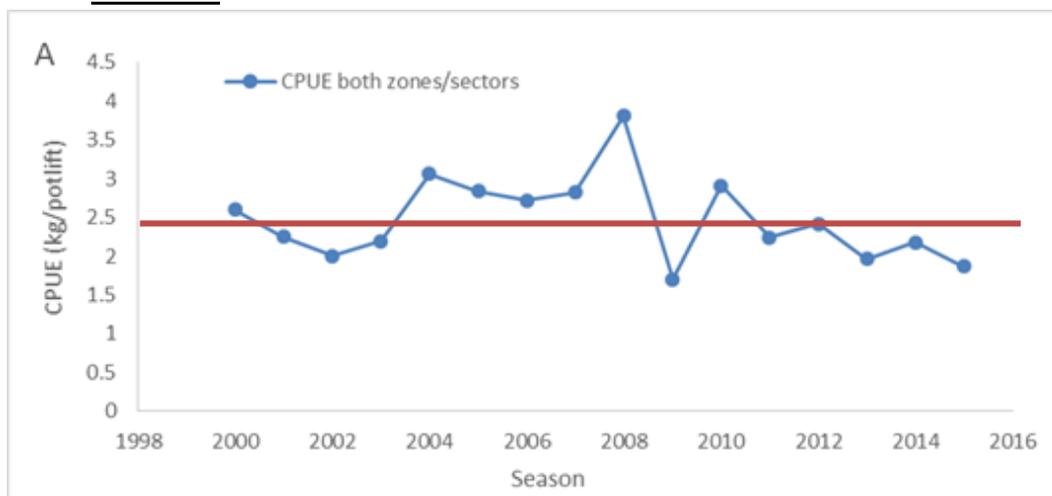


Figure 2: CPUE of legal sized Giant Crab. Figure SARDI. Red line is long term average (2000-2015).

- The TACC has been set at 22 t since 1999. Other management arrangements include
 - Minimum Legal Size Limit

- Protection of egg bearing females
- Gear restrictions (max number pots)
- Fishing closure (June to October (SZ) or November (NZ)).
- Management Policy describes performance indicators and reference levels, noting that a new harvest strategy will be developed in 2017.
- At a harvest of 22 tonnes under a TACC for Giant Crab the most severe consequence to the stock from the activity was recruitment overfishing. Consequence of this outcome was considered to be severe (Consequence Level 3)
- Likelihood of recruitment overfishing was considered possible given current evidence that stocks are declining across southern Australia (Tasmania - TACC declining and currently classified as Overfished; Victoria - TACC declining) and declining catch rates (Figure 2) in South Australia (Likelihood Level 4). **Risk Score (12) = Moderate.**

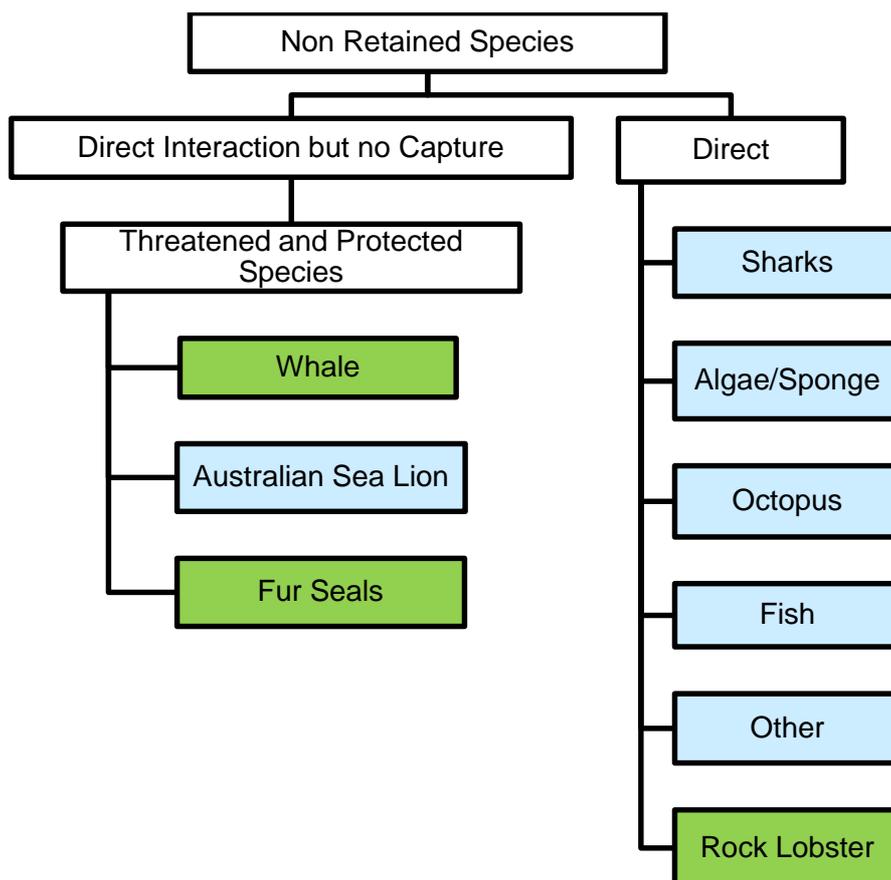
Rock Lobster

- The majority of licence holders fishing for Giant Crab are RLF licence holders who may retain legal sized Rock Lobster.
- A TACC for Rock Lobster is in place. Other management arrangements include:
 - Minimum Legal Size Limit
 - Protection of egg bearing females
 - Gear restrictions (max number pots)
 - Fishing closure (June to October (SZ)).
- Objectives, strategies, performance indicators and reference levels for Rock Lobster are described in management plans for each zone of the Rock Lobster Fishery (PIRSA 2012 and 2014) and the status of the RLF stock is monitored and assessed annually.
- When fishers are targeting Giant Crab it is assumed that fishing is likely to be in depths >100m where it is less likely that Rock Lobster occur, therefore the risk of this component should be lower than assessed for Rock Lobster Fishery (Risk Rating Moderate, PIRSA, 2013).
- The consequence of fishing for Giant Crabs on Rock Lobster is considered to be Minor as the activity is likely to have minor impact on the population size (Consequence Level 1) with likelihood considered to be remote (Likelihood Level 1). **Risk Score (1) = Low.**

Other species

- The majority of Giant Crab fishers being RLF licence holders may retain marine scalefish species dependent on the level of access they have attained.
- There is no TACC in place for most Marine Scalefish species, however other management arrangements are in place (see Management Plan for the Marine Scalefish Fishery, PIRSA 2013).
- Octopus is encountered at shallower depths than is likely when targeting Giant Crab, and hence the level of consequence of commercial fishing for Giant Crabs on Octopus populations was considered to be insignificant (Consequence Level 0) and with likelihood considered to be remote (Likelihood Level 1).
- Consequences to other by-product species in the RLF were also ranked as Negligible. (Consequence Level 0). **Risk Score (0) = Negligible.**

Issues related to the non retained species of a fishing activity:



Component	Consequence	Likelihood	Risk
Direct interaction but no capture - Threatened, Endangered and Protected Species –			
Whales	1	3	3
ASL	0		0
Fur Seals	1	1	1
Direct - Sharks	0		0
Direct - Sponge/Algae	0		0
Direct – Octopus	0		0
Direct – Fish	0		0
Direct – Rock Lobster by-catch	1	1	1
Direct –Other	0		0

TEPS

- Given the depth of the fishing activity for Giant Crab at predominately 100-200m and the use of sea lion exclusion devices (SLEDs) in rock lobster pots used in depths of <100m in the Northern Zone it is considered that almost no Australian sea lion would be impacted. The consequence is considered to be negligible as although some level of interaction may occur extremely few are recorded at the

time scale of years. (Consequence Level 0) and the likelihood of interactions is remote (Likelihood Level 1). **Risk Score (0) = Negligible.**

- Giant Crab fishers in the Southern Zone are not required to use SLEDs. Long nose fur seals can dive to deeper depths than Australian sea lions, there may be some fur seals that could interact with fishing gear used by commercial Giant Crab fishers but this would likely not impact on the population of this species (Consequence level 1) and the likelihood of this consequence was considered to be remote (Likelihood Level 1). **Risk Score (1) = Low.**

Whales

- Species of whales that commonly occur in South Australian waters and their EBPC Classification include:

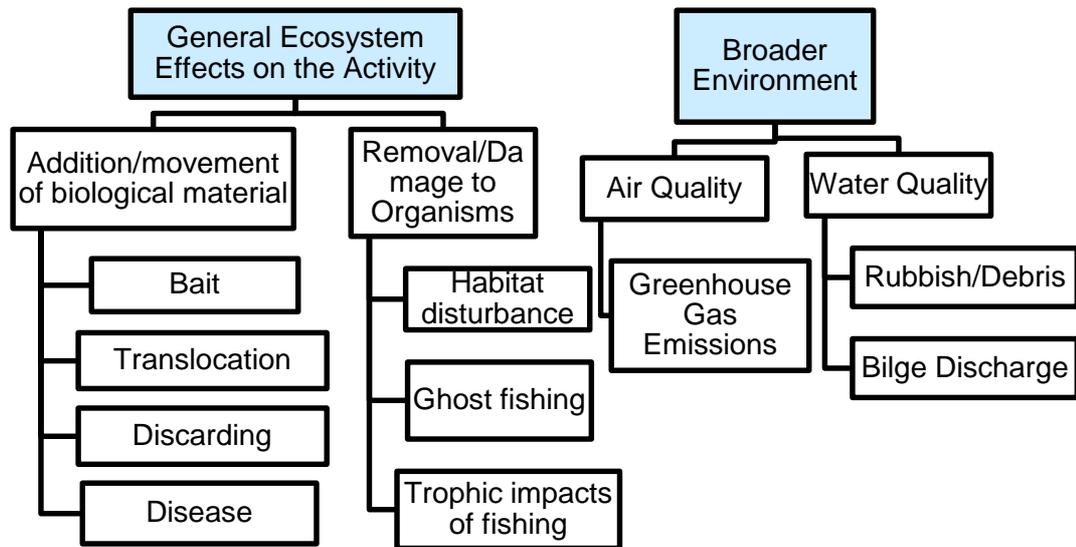
<u>Species</u>	<u>Scientific name</u>	<u>SA National Parks and Wildlife Act (1972) listing</u>
Southern Right Whale	<i>Eubalaena australis</i>	Vulnerable
Sperm Whale	<i>Physeter macrocephalus</i>	Rare
Humpback Whale	<i>Megaptera novaeangliae</i>	Vulnerable
Minke Whale	<i>Balaenoptera acutorostrata</i>	Rare
Orca (Killer Whale)	<i>Orcinus orca</i>	Migratory
Pygmy Blue Whale	<i>Balaenoptera musculus breviceuda</i>	A subspecies of the Blue Whales. Blue Whales are listed as Endangered

- Interactions between headlines and buoys attached to rock lobster pots and migrating Humpback and Southern Right whales has been reported for the Western Australian Western Rock Lobster fishery (WAWRLF). Industry in the WAWRLF have implemented mitigation methods to reduce impacts on whales. Giant Crab fishers in South Australia operate with similar gear to the South Australian RLF (pots with headlines and buoys).
- There have been no reports of interactions with cetaceans in the South Australian RLF or fishing for Giant Crabs for the period for which reporting of wildlife interactions has been monitored (Mackay 2016).
- The consequence of interactions between Giant Crab fishing gear and whale populations is ranked as Minor (Consequence Level 1) as some whales could be impacted with the likelihood being Unlikely (Likelihood Level 3). **Risk Score (3) = Low.**

Other species

- For non-retained rock lobster (undersized and spawning females) collected while fishing for Giant Crab, the risk was considered at the same level as for retained rock lobster. (Consequence Level 1) (Likelihood Level 1). **Risk Score (1) = Low.**
- In conjunction with information from Tasmania, it was considered that most of the by-catch species would not have swim bladders and were therefore less susceptible to barotrauma. Survival was considered to be reasonable and therefore would have little impact on the populations. It was considered that by-catch was likely (Likelihood Level 6) however the consequence to populations of by-catch species was considered Negligible (Consequence Level 0) **Risk Score (0) = Negligible.**

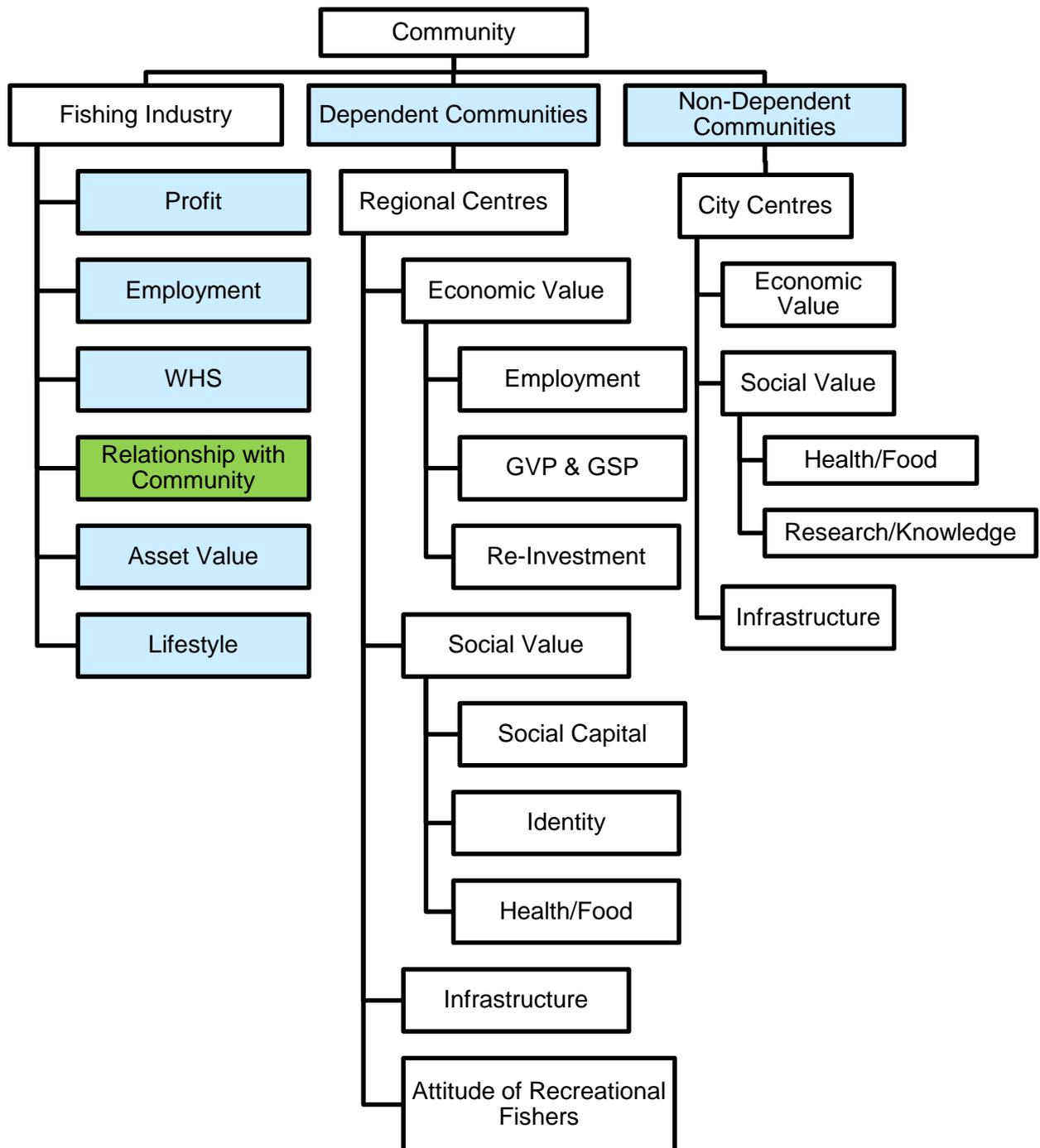
Issues related to the general environment impacts of a fishing activity:



Component	Consequence	Likelihood	Risk
Addition/movement of biological material - Bait	0	1	0
Addition/movement of biological material - Translocation	0	1	0
Addition/movement of biological material - Discarding	0	1	0
Addition/movement of biological material - Disease	0	1	0
<hr/>			
Removal/Damage to Organisms – Habitat Disturbance	0	1	0
Removal/Damage to Organisms – Ghost fishing	0	1	0
Removal/Damage to Organisms – Trophic impacts of fishing	0	1	0
<hr/>			
Broader Environment – Air quality – Greenhouse gas emissions	0	1	0
<hr/>			
Broader Environment – water quality – Rubbish/Debris	0	1	0
Broader Environment – water quality – Bilge discharge	0	1	0

- Pots used to fish for Giant Crabs are the same, or similar to, pots used in the South Australian RLF. It is generally considered that the rock lobster pots cause minimal environmental disturbance in their normal area of operations (Casement and Svane 1999).
- For all general ecosystem and broader environment components it was considered there would be insignificant impacts on habitat or populations of species in the area of the activity (Consequence Level 0). **Risk Score (0) = Negligible.**

Contribution of the fishing activity/industry to community wellbeing:

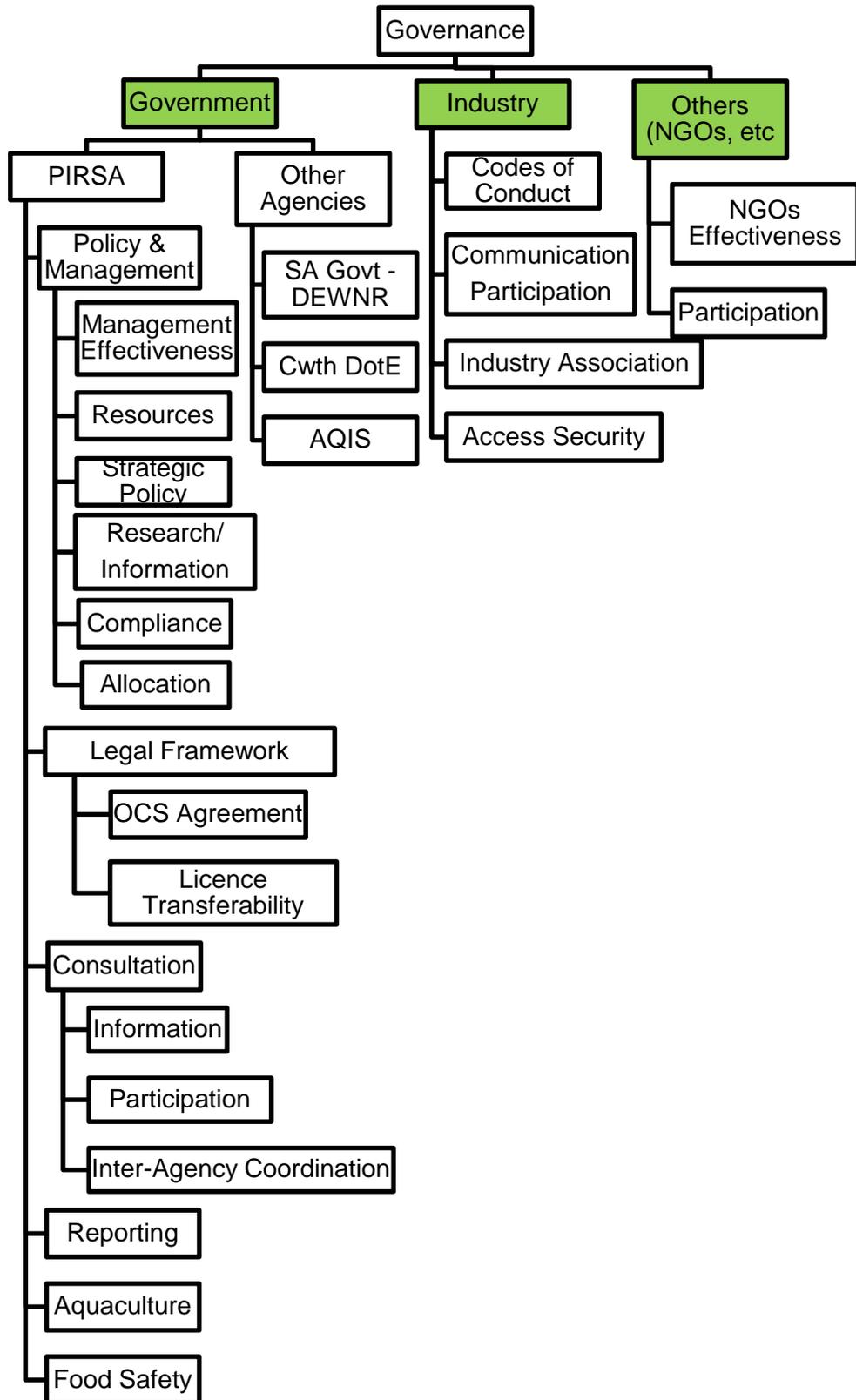


Component	Consequence	Likelihood	Risk
Fishing Industry – Profit	0		0
Fishing Industry – Employment	0		0
Fishing Industry – WHS	0		0
Fishing Industry – Relationship with Community	1	3	3
Fishing Industry – WHS	0		0

Fishing Industry – Asset value	0		0
Fishing Industry – lifestyle	0		0
Dependent communities – regional centres – Economic Value - Employment	0		0
Dependent communities – regional centres – Economic Value – GRP/GSP	0		0
Dependent communities – regional centres – Economic Value - Reinvestment	0		0
Dependent communities – regional centres – Social Value – Social Capital	0		0
Dependent communities – regional centres – Social Value – Identity	0		0
Dependent communities – regional centres – Social Value – Health/food	0		0
Dependent communities – regional centres – Infrastructure	0		0
Dependent communities – regional centres – Attitude of recreational fishers	0		0
Non-dependent communities –city centres – Economic value	0		0
Non-dependent communities –city centres –Social value – Health/Food	0		0
Non-dependent communities –city centres – Social value – Research/knowledge	0		0
Non-dependent communities –city centres – Infrastructure	0		0

- Due to the limited size of the activity with respect to the number of participants compared to other commercial fisheries, and the integration of much of the activity in the RLF most of the community components were considered to have negligible social or political impacts (Consequence level 0). **Risk Score (0) = Negligible.**
- With respect to relationships with the community, it was considered loss of social licence and degrading of the relationship with the community may occur if a whale interaction was recorded, or if the Giant Crab stock was to be depleted. This risk was ranked as a Minor consequence for communities (Consequence Level 1) with a likelihood of unlikely (Likelihood Level 3). **Risk Score (3) = Low.**

Issues related to the governance of the fishing activity/industry:



Component	Consequence	Likelihood	Risk
Government - PIRSA – Policy & Management – Management Effectiveness	1	1	1
Government - PIRSA – Policy & Management – Resources	1	1	1
Government - PIRSA – Policy & Management – Strategic Policy	1	1	1
Government - PIRSA – Policy & Management – Research Information	1	1	1
Government - PIRSA – Policy & Management – Compliance	1	1	1
Government - PIRSA – Policy & Management – Allocation	1	1	1
Government - PIRSA – Legal Framework - OCS	1	1	1
Government - PIRSA – Legal Framework – Access rights/licence transferability	1	1	1
Government - PIRSA - Consultation – Information	1	1	1
Government - PIRSA - Consultation – Participation	1	1	1
Government - PIRSA - Consultation – Inter-agency Coordination	1	1	1
Government - PIRSA - Reporting	1	1	1
Government - PIRSA - Aquaculture	1	1	1
Government - PIRSA – Food Safety	1	1	1
Government – Other agencies– SA DEWNR – Marine Parks	1	1	1
Government – Other agencies– Cwth DotE	1	1	1
Government – Other agencies– AQIS	1	1	1
Government – Industry– Codes of Conduct	1	1	1
Government – Industry– Communication/participation	1	1	1
Government – Industry– Industry Association	1	1	1
Government – Industry– Access Security	1	1	1
Government – Other (NGOs)– NGO effectiveness	1	1	1
Government – Other (NGOs)– Participation	1	1	1

PIRSA

- The management framework for fishing for Giant Crab in South Australia is described in a document submitted to the (then) Environment Australia (Cwth) in 2002 as part of the assessment of the fishing activity under *the Environment Protection and Biodiversity Act 1999*. This document sets out objectives for the fishery, performance indicators and reference levels to measure performance of the fishing activity. It has been acknowledged that the performance indicators and reference levels may not be effective and a new harvest strategy will be developed (McLeay 2016). The harvest strategy is planned for development in 2017.
- Due to the small scale of the fishing activity (14 licence holders with quota units in 2016) a management plan as described under section 44 of the *Fisheries Management Act 2007* may not be

required. A document describing the activity and the management arrangements relevant to that activity may serve in the absence of a formal management plan.

- PIRSA has adequate strategic policy in place to adequately manage fisheries including fishing for Giant Crabs including an Allocation Policy and Harvest Strategy Policy. SARDI Aquatic Sciences are the preferred research provider for monitoring fisheries in South Australia, and a service level agreement for delivery of research for Giant Crab fishing is in place. A compliance risk assessment is undertaken every year for each fishing activity. The risk assessment identifies and priorities the compliance risks that exist in the activity to inform annual compliance planning processes.
- PIRSA cost recovers the costs of managing the fishing activity through licence fees consistent with Government's Cost Recovery Policy. Considering the resources required by PIRSA to manage a small fishing activity there was considered to be some impact of policy and management related to the activity. It was considered that the impact to the activity was minor (Consequence level 1) with a likelihood of remote (Likelihood level 1). **Risk Score (1) = Low.**

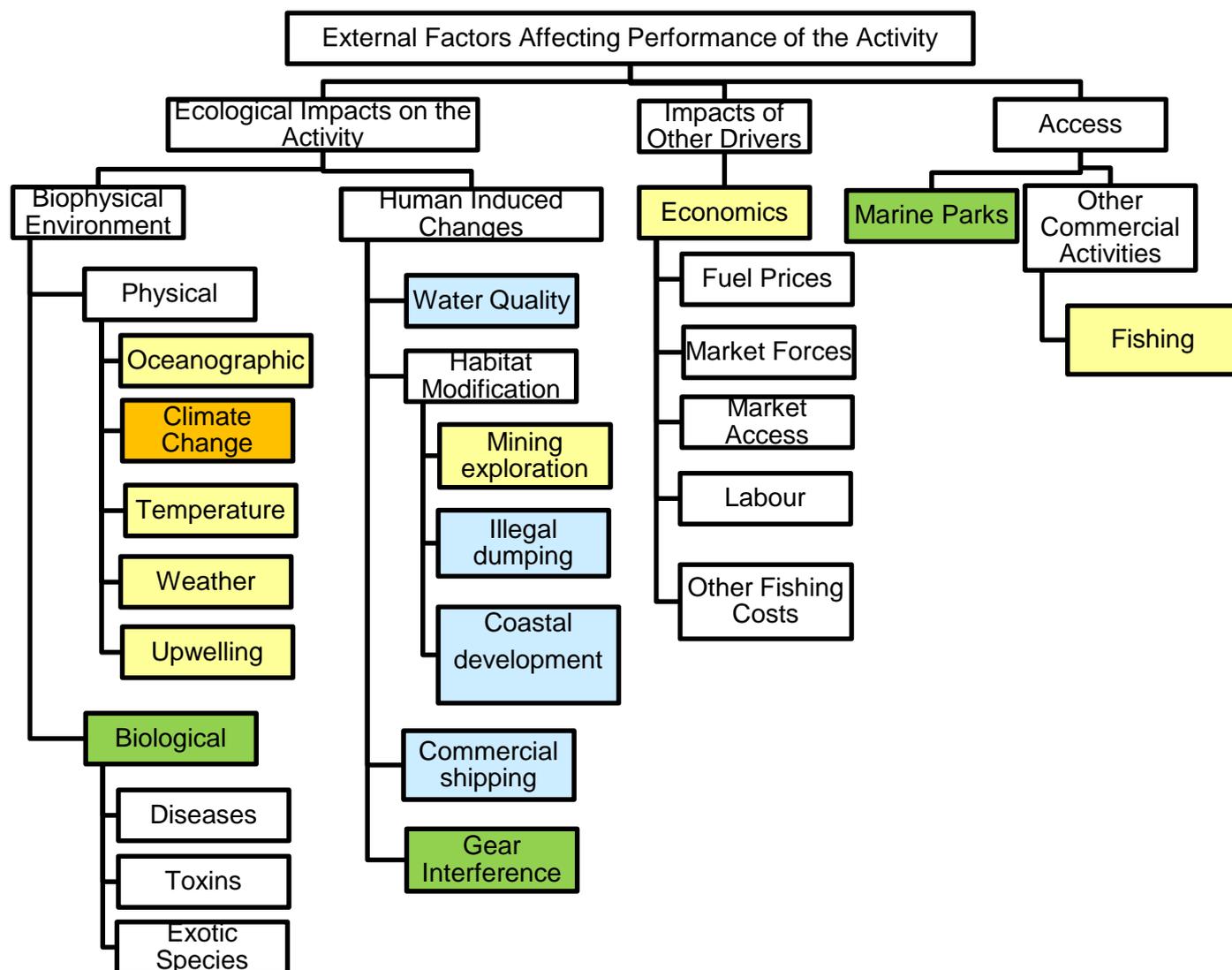
Other Government Agencies and NGOs

- Other Government agencies include the South Australian Department of Environment, Water and Natural Resources and the Commonwealth Department of the Environment and Energy under relevant legislation. The activities of these agencies (and others) provide a stable environment for the fishing activity to operate.
- Due to the size of the activity, the benign nature of the gear used and the management arrangements in place, NGO's are unlikely to prioritise the fishing activity. All other Sub-components within the Government and other NGOs were considered to have a minimal impact (Consequence level 1) with a likelihood of remote (Likelihood level 1) due to the limited size of the activity. **Risk Score (1) = Low.**

Industry

- While it is noted that there is no industry organisation representing Giant Crab fishers at the time of conducting this assessment, due to the size of the activity it may not be necessary to have such an organisation. RLF licence holders are represented (to some extent) by their relevant RLF associations. All sub-components were considered to have a minor impact (Consequence Level 1) with a likelihood of remote (Likelihood Level 1). **Risk Score (1) = Low.**

External impacts affecting performance of the fishing activity:



Component	Consequence	Likelihood	Risk
Ecological Impacts – Biophysical environment – Physical – Oceanography	2	6	12
Ecological Impacts – Biophysical environment – Physical - Climate Change	4	4	16
Ecological Impacts – Biophysical environment – Physical - Temperature	2	6	12
Ecological Impacts – Biophysical environment – Physical - Weather	2	6	12
Ecological Impacts – Biophysical environment – Physical – Upwelling	2	6	12

Ecological Impacts – Biophysical environment – Biological - Disease	4	1	4
Ecological Impacts – Biophysical environment – Biological - Toxins	4	1	4
Ecological Impacts – Biophysical environment – Biological - Exotic species	4	1	4
Ecological Impacts – Human induced changes – Water quality	0		0
Ecological Impacts – Human induced changes – Habitat Modification – Mining/Exploration	2	4	8
Ecological Impacts – Human induced changes – Habitat Modification – Illegal Dumping	0		0
Ecological Impacts – Human induced changes – Habitat Modification – Coastal Development	0		0
Ecological Impacts – Human induced changes – Commercial shipping	0		0
Ecological Impacts – Human induced changes – Gear Interference	0		0
Impacts of other drivers– Economics	2	6	12
Impacts of other drivers– Access – Marine Parks	1	3	3
Impacts of other drivers– Access – Other fishing activities	2	4	8

- Reduced catch rates through movement of Giant Crabs in response to water temperature changes may impact on the performance of the fishing activity.
- A series of severe upwelling events in southern South Australia have infrequently occurred over the last 10 years, with sea temperature dropping to 3 degrees below the usual temperatures in seasonal upwellings. One of the factors that may potentially influence this is persistent offshore south east winds lasting for long periods. As well as temperature, Giant Crab are also potentially affected by dissolved oxygen, bottom currents, and turbidity. The survival of larvae (and thus recruitment to the fish stock) may be influenced by these factors however the extent to which these factors may impact on population processes is unknown. It was considered likely (Likelihood level 6) that upwellings would continue to have a moderate consequence (Consequence Level 2) impact on the fishing activity. **Risk Score (12) = Moderate**
- Climate change is likely to see increased water temperatures and changes to oceanographic systems. While the potential impact of climate change on upwellings (and other components of the biophysical environment) is unknown, it was considered possible (Likelihood Level 4) that it may have a major (Consequence level 4) impact on the fishing activity. **Risk Score (16) = High**
- Oceanographic, temperature, and weather factors are all known to play a significant role in the productivity of Giant Crab. Consequently, it was considered likely (Likelihood level 6) that they would continue to have a moderate (Consequence level 2) impact. **Risk Score (12) = Moderate.**
- Unlike other fisheries, disease and exotic species have not been an issue for Giant Crab. Nonetheless, it was acknowledged that disease and exotic species can have a major impact on a

fishing activity. Consequently, it was considered a remote (Likelihood Level 1) possibility that disease could have a major impact (Consequence Level 4). **Risk Score (4) = Low.**

- The regions where Giant Crab fishing occur are generally remote from major human settlements where human induced change including water quality, illegal dumping, coastal development and dredging could impact the fishing activity. It was therefore considered these factors would have a negligible (Consequence level 0) impact on the fishing activity. **Risk Score (0) = Negligible**
- The impacts of mining/exploration activities include loss of habitat and impact of seismic surveys. While the impacts of these factors are not known at this time, it was considered that mining/exploration activities could have a moderate impact on the activity (Consequence Level 2) and the likelihood of this was possible (Likelihood Level 4). **Risk Score (8) = Moderate**
- The potential exists for commercial shipping to have an impact on the RLF through potential oil spills. However, given the depth of operation, it was considered that the level of impact on fishing for Giant Crabs was negligible (Consequence level 0). **Risk Score (0) = Negligible**
- Gear interference does occur in the RLF whereby pots are lifted and the catch is taken. However, as Giant Crab fishing is generally conducted further from the coast, this activity would have a negligible impact on the performance of the activity (Consequence level 0). **Risk Score (0) = Negligible**
- Increasing fuel price, the availability and cost of labour, and interest rates, have recently been unpredictable and are likely to have an impact on the long term profitability of the fishing activity. The boom in the mining sector has reduced availability of labour for a number of commercial fisheries. To a lesser extent, market forces and other costs of fishing (such as licence fees, maintenance and equipment costs) also impact on fishers. Given these costs are likely to rise in the future it was considered that economic factors could have a moderate impact on the activity (Consequence Level 2) with a likelihood of likely (Likelihood Level 6). **Risk Score (12) = Moderate.**
- The majority of marine parks are situated close to the coast, and therefore are considered to have a minor impact on the fishing activity (Consequence Level 1) with a likelihood of unlikely (Likelihood Level 3). **Risk Score (1) = Low.**
- The impact of demersal trawling on Giant Crab fisheries has been an issue in Tasmania and Victoria and areas of these fisheries overlap with the South Australian fishing activity. Interactions between trawl fisheries and fishing for Giant Crab includes habitat modification as well as interactions of trawl gear with pots resulting in the loss of gear. Some research has been conducted on possible interactions between the fisheries in Tasmania (Williams et al., 2009). In South Australia, the main area where the two activities overlap is offshore between Victorian border and Robe in the South East. The impact of these interactions in South Australia with respect to performance or economics is not quantified at the time of conducting this risk assessment. However, the consequence of these interactions are considered to be Moderate (Consequence Level 2) given the large area of the activity compared with area of interaction, with the likelihood considered to be possible (Likelihood Level 4) **Risk Score (8) = Moderate.**

Appendix

Summary of ESD Reporting

A summary table of identified risks is provided in Table 3

Table 3: Summary of National ESD Reporting Framework outcomes for Giant Crab fishing activity.

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 4 Performance report for Extreme, High and Moderate Risk elements of Giant Crab ESD Risk Assessment. ; * = Review under development of new management policy; ** = Review at next major ESD assessment,

Issue	Risk / Priority	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	Actions
Retained Species							
Giant Crab	Moderate	Yes	Yes	Yes	No defined	High	*
Non-Retained Species							
N/A							
General Ecosystem Impacts of Fishing							
N/A							
Community							
N/A							
Governance							
N/A							
External factors affecting performance of the fishing activity							
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	**

Appendices

Table 5: General consequence categories for the major target/vulnerable species.

Level	Ecological (Retained: target/Non-retained: major)
Negligible (0)	Insignificant impacts to populations. Unlikely to be measurable against background variability for this population.
Minor (1)	Possibly detectable, but minimal impact on population size and none on dynamics.
Moderate (2)	Full exploitation rate, but long-term recruitment/dynamics not adversely impacted.
Severe (3)	Affecting recruitment levels of stocks/or their capacity to increase.
Major (4)	Likely to cause local extinctions, if continued in longer term (i.e. probably requiring listing of species in an appropriate category of the endangered species list (e.g. IUCN category).
Catastrophic (5)	Local extinctions are imminent/immediate

Table 6 - Consequence categories for the major target/vulnerable species. The default objective is - maintain the biomass above the target reference point”.

Level	Ecological (Target/Vulnerable Species)
Negligible (0)	Insignificant impacts to populations. Unlikely to be measurable against background variability for this population.
Minor (1)	Possibly detectable, but minimal impact on population size and none on dynamics.
Moderate (2)	Full exploitation rate, but long-term recruitment/dynamics not adversely impacted.
Severe (3)	Affecting recruitment levels of stocks/or their capacity to increase.
Major (4)	Likely to cause local extinctions, if continued in longer term (i.e. probably requiring listing of species in an appropriate category of the endangered species list (e.g. IUCN category).
Extreme (5)	Local extinctions are imminent/immediate

Table 7 - Consequence categories for the by-product species/minor by-catch species. The default objective is - to maintain appropriate levels of biomass of by-catch species to minimize any significant impact on their dynamics and the broader ecosystem.

Level	Ecological (by-product/general by-catch)
Negligible (0)	Insignificant impacts to populations. Unlikely to be measurable against background variability for this population.
Minor (1)	Possibly detectable, but minimal impact on population size and none on dynamics.
Moderate (2)	Full exploitation rate, but long-term recruitment/dynamics not adversely impacted.
Severe (3)	Affecting recruitment levels of stocks/or their capacity to increase.
Major (4)	Likely to cause local extinctions, if continued in longer term (i.e. probably requiring listing of species in an appropriate category of the endangered species list (e.g. IUCN category).
Extreme (5)	Local extinctions are imminent/immediate

Table 8 - Consequence categories for the by-catch of protected species. The default objective is to maintain levels of catch of these species at acceptable levels.

Level	Protected species by-catch
Negligible (0)	Some level of interaction may occur but either no mortalities generated or extremely few are recorded at the time scale of years.
Minor (1)	Very few individuals of the protected species are directly impacted in most years and there is no impact on stock
Moderate (2)	The fishery catches or impacts on these species at the maximum level that is accepted
Severe (3)	Same as target species
Major (4)	Same as target species
Extreme (5)	Same as target species

Table 9 - Consequence categories for the impacts on ecosystems. The default objective is - to maintain the spatial extent of habitat impacts from the fishing activity to a comparatively small percentage of the ecosystem.

Level	Ecological (ECOSYSTEM)
Negligible (0)	General - Insignificant impacts to habitat or populations, Unlikely to be measurable against background variability Ecosystem: Interactions may be occurring but it is unlikely that there would be any change outside of natural variation
Minor (1)	Ecosystem: Captured species do not play a keystone role – only minor changes in relative abundance of other constituents.
Moderate (2)	Ecosystem: measurable changes to the ecosystem components without there being a major change in function. (no loss of components).
Severe (3)	Ecosystem: Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. Recovery measured in years.
Major (4)	Ecosystem: A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major targets of capture) Recovery period measured in years to decades.
Extreme (5)	Ecosystem: Total collapse of ecosystem processes. Long-term recovery period may be greater than decades.

Table 10 - Consequence categories for the impacts on habitats. The default objective is - to maintain the spatial extent of habitat impacts from the fishing activity to a comparatively small percentage of the habitat/ community.

Level	Ecological (HABITAT)
Negligible (0)	Insignificant impacts to habitat or populations of species making up the habitat – probably not measurable levels of impact. Activity only occurs in very small areas of the habitat, or if larger area is used, the impact on the habitats from the activity is unlikely to be measurable against background variability. (Suggestion- these could be activities that affect < 1% of original area of habitat or if operating on a larger area, have virtually no direct impact)
Minor (1)	Measurable impacts on habitat(s) but these are very localised compared to total habitat area. (Suggestion – these impacts could be < 5% of the original area of habitat)
Moderate (2)	There are likely to be more widespread impacts on the habitat but the levels are still considerable acceptable given the % of area affected, the types of impact occurring and the recovery capacity of the habitat. (Suggestion – for impact on non-fragile habitats this may be up to 50% [similar to population dynamics theory] - but for more fragile habitats, to stay in this category the percentage area affected may need to be smaller, e.g. 20%)
Severe (3)	The level of impact on habitats may be larger than is sensible to ensure that the habitat will not be able to recover adequately, or it will cause strong downstream effects from loss of function. (Suggestion - Where the activity makes a significant impact in the area affected and the area > 25 - 50% [based on recovery rates] of habitat is being removed)
Major (4)	Substantially too much of the habitat is being affected, which may endanger its long-term survival and result in severe changes to ecosystem function. (Suggestion this may equate to 70 - 90% of the habitat being affected or removed by the activity)
Extreme (5)	Effectively the entire habitat is in danger of being affected in a major way/removed. (Suggestion: this is likely to be in range of > 90% of the original habitat area being affected).

Table 11 - Consequence categories for social or economic disruptions. The default objective is - maintenance or enhancement of social structure and economic activity.

Level	Economic
Negligible (0)	None or not detectable
Minor (1)	Possible detectable, but no real impact on the economic pathways for the industry or the community.
Moderate (2)	Some level of reduction for a major fishery or a large reduction in a small fishery that the community is not dependent upon.
Severe (3)	Significant reduction in employment. Significant levels of community concern
Major (4)	Fishery/industry has declined significantly in economic generation and this will have clear flow on effects to other parts of the community. May result in some level of political intervention.
Extreme (5)	Total collapse of any economic activity coming from what was an industry that the community derived a significant level of their income or employment (resource dependency), including possible debts. High levels of political intervention likely.

Table 12 - Likelihood Definitions – these are usually defined for the likelihood of a particular consequence level actually occurring within the assessment period.

Level	Descriptor
Likely (6)	A particular consequence level is expected to occur
Occasional (5)	Consequence level may occur
Possible (4)	Evidence to suggest this consequence level is possible and may occur in some circumstances
Unlikely (3)	The consequence is not expected to occur but it has been known to occur elsewhere
Rare (2)	Nay occur in exceptional circumstances
Remote (1)	The consequence has never been heard of in these circumstances, but it is not impossible

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