Revised Ecologically Sustainable Development (ESD) Risk Assessment of the South Australian Commercial Blue Crab Fishery

December 2023

Revised Ecologically Sustainable Development Risk Assessment of the South Australian Commercial Blue Crab Fishery

Information current as of 18 December 2023

Disclaimer

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Contents

1 Introduction

This report provides the outcomes of a review of the 2009 Ecologically Sustainable Development (ESD) risk assessment of the South Australian Commercial Blue Crab Fishery (PIRSA 2009) undertaken by PIRSA in 2023. The review was undertaken to inform development of a replacement Management Plan for the South Australian Commercial Blue Crab Fishery ("the Management Plan" or "the Plan"), consistent with the outcomes of the review of the 2018 Management Plan as recommended by the Blue Crab Fishery Management Plan Review Committee (BCFMPRC – see Appendix 2 for membership), and approved by the Minister for Primary Industries and Regional Development on 24 October 2023.

To efficiently meet its Ecologically Sustainable Development (ESD) accountabilities under both State and Commonwealth legislation, PIRSA Fisheries and Aquaculture adopts the 'National ESD Reporting Framework for Fisheries' developed by Fletcher et al. (2002) to provide a consistent way to implement and assess fisheries with respect to the principles of ESD in Australia.

The 2009 ESD Risk Assessment for the Blue Crab Fishery provided a comprehensive analysis of the impacts and potential impacts of the fishing activity, as well as identifying ecological factors that could impact on the performance of the fishery. This risk assessment informed the development of the 2018 management plan for the Blue Crab Fishery

To inform development of a draft replacement management plan, the 2009 ESD risk assessment for the Blue Crab Fishery has been reviewed and updated, through consideration of new information relevant to risks to and from the fishery that has become available since the last assessment. New information was considered to ascertain if a change of risk ratings or if a new risk should be included in the revised risk assessment for the fishery.

The risks required for consideration in preparing a management plan for a fishery under section 43(2) of the *Fisheries Management Act 2007* (the Act) are:

1. identify the impacts or potential impacts of the fishery on its associated ecosystem or ecosystems, including impacts on non-target species of fish or other aquatic resources;

2. identify any ecological factors that could have an impact on the performance of the fishery: and

3. set out strategies to address the most serious risks.

Only these risks were reviewed and updated in this 2023 review of the 2009 ESD risk assessment, however it is noted that relevant social and economic objectives of the fishery will still have strategies outlined in the management plan to outline how they will be achieved.

2 Background

The commercial Blue Crab Fishery is based on the capture of a single species Blue Swimmer Crab, *Portunus armatus*, although other crustacean species are permitted to be landed and sold as by-product (Appendix 3). A number of other species are permitted to be taken for use as personal bait.

Access to the fishery is provided through a licence for the Blue Crab Fishery or the Marine Scalefish Fishery. Licences are endorsed with quota units for either the Gulf St Vincent zone or Spencer Gulf zone. Blue Crab Fishery licence holders use crab pots to trap their catch and bait nets are permitted to be used. Marine Scalefish Fishery licence holders are restricted to using crab nets (i.e. hoop nets or drop nets). The areas of waters in which holders of licences for the Blue Crab Fishery may take Blue Swimmer Crabs are provided in Figure 1 below.

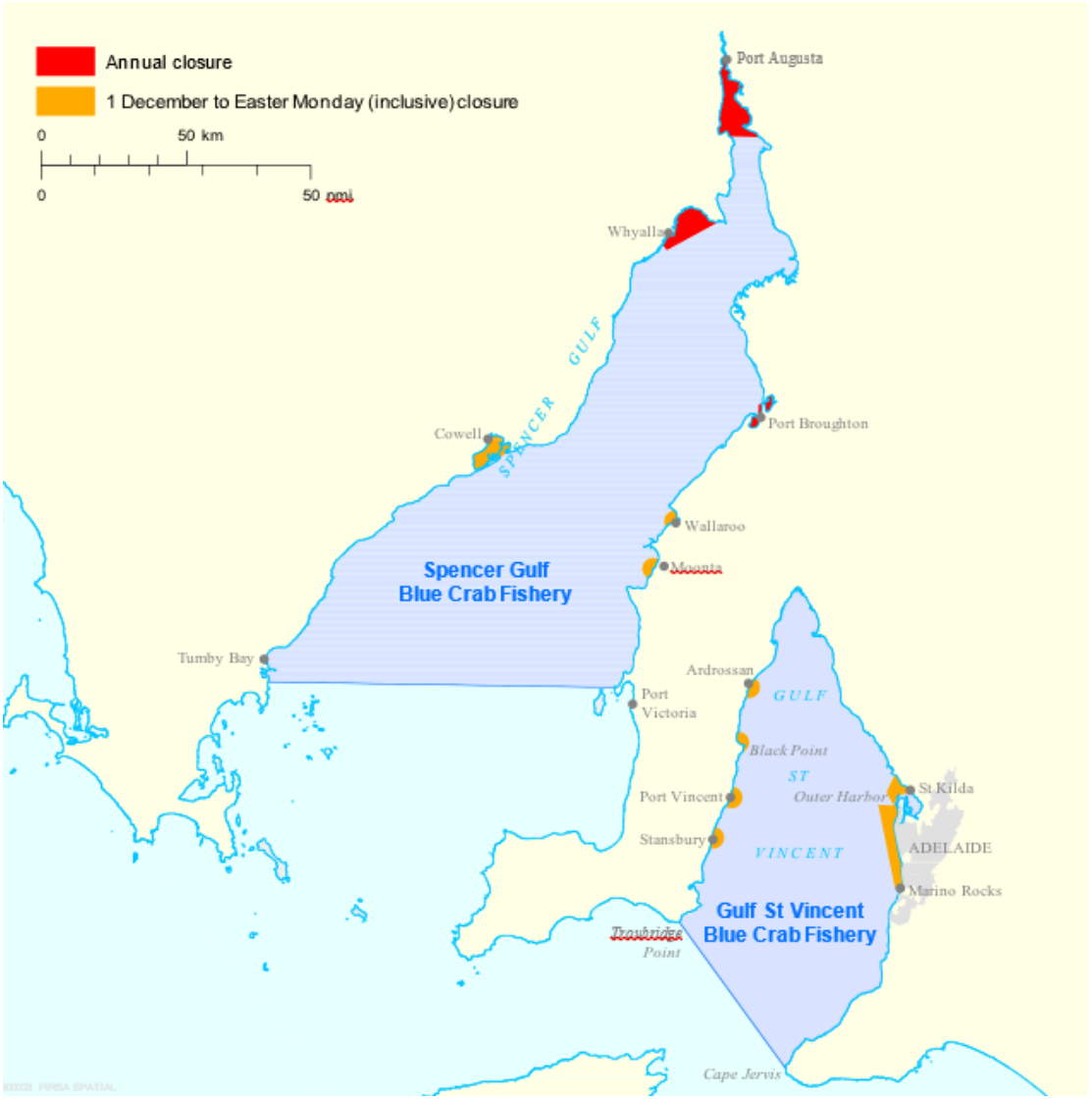

Figure 1. Area of the Blue Crab Fishery

Since 1997/98, the total number of licences with blue crab quota has decreased from 40 to 10. In 2023 there were nine Blue Crab Fishery licences and one Marine Scalefish Fishery licence with blue crab quota entitlements.

Since the establishment of the fishery, an Individual Transferable Quota (ITQ) management system has been in place. A Total Allowable Commercial Catch (TACC) in each zone is determined by application of the harvest strategy for the fishery. Blue Crab stocks in both fishing zones are classified as 'Sustainable' (SARDI 2023).

The total landed catch of Blue Crabs in the Blue Crab Fishery increased from 515 tonnes in 2002/03 to 521 tonnes in 2021/22. The total catch in 2021/22 (521t) was 1 per cent above that in 2002/03. While the nominal value of the catch was almost three times that in 2002/03, increasing from $3.2 million to $8.7 million in 2021/22. In real terms, GVP in 2021/22 was 74 per cent higher than that in 2002/03, a result of the increase in catch (1 per cent), and a significant rise in the real price (72 per cent).

In 2021/22, total Blue Crab fishing industry related contribution to Gross State Product (GSP) in South Australia was $26.9 million; $6.7 million generated by fishing directly, $6.3 million generated by downstream activities and $13.9 million generated in other sectors of the state economy. In 2021/22 there were an estimated 225 full time equivalent jobs generated, directly and indirectly (Econsearch 2023).

3 Method

The scope of this ESD Risk Assessment includes:

- Commercial fishing in the South Australian Commercial Blue Crab Fishery under normal fishing practices in the area of the fishery.
- Assessment of potential impacts on the fishery or ecosystem in the next five years.

The process for the review of the current risk assessment was:

1. Collated new documented information related to risk components included in the 2009 risk assessment report that had become available since the last risk assessment.
2. Conducted meetings of the BCFMPRC on 25 September and 28 November 2023 and invited comments and additional information in relation to the 2009 risk assessment from other key stakeholders (Appendix 2) to:
    a. Identify risk components that were relevant to the new information and determine if the new information would significantly change the risk ranking.
    b. Identify any new impacts on the fishery or ecosystem since the previous assessment.
    c. Complete risk assessments of the identified risk components based on the likelihood and consequence of events described in PIRSA (2009) using consequence and likelihood matrices provided at Appendix 1.

3. For those risks for which no new information is available, or the available information was not significant, the risk rating from the 2009 risk assessment was adopted.

4. Risks were prioritised according to their severity detailing the information considered and the reasons (information used, or adoption of previous risk rating) in assigning risk.

5. For higher level risks a full ESD performance report in the context of specific management objectives was prepared. This includes operational objectives, indicators, data required and performance measures.

6. This summary report was also prepared.

National ESD Reporting Framework for Fisheries

The 'National ESD Reporting Framework for Fisheries' developed by Fletcher et al. (2002) was used as the basis to assess the risks for general ecosystem impacts and external impacts on industry. It was agreed by the BCFMPRC that amended and simplified risk matrix, consequence and likelihood tables would be used in this risk assessment compared to that used in the 2009 assessment, consistent with other recent fisheries ESD risk assessments undertaken by PIRSA (**Appendix 1**). Where it was agreed in this assessment that the previous risk rating from the 2009 assessment be adopted, this rating was converted using the simpler risk matrix.

Further detail of the general ESD Risk Assessment methodology can be found in the 2009 risk assessment for the fishery (PIRSA 2009).

Table 1 - Risk matrix of consequence and likelihood (see Appendix 1 for more details).

Consequence × Likelihood Risk Matrix		**Likelihood**			
		Remote (1)	**Unlikely (2)**	**Possible (3)**	**Likely (4)**
Consequence	**Minor (1)**	Negligible (1)	Negligible (2)	Low (3)	Low (4)
	Moderate (2)	Negligible (2)	Low (4)	Medium (6)	Medium (8)
	High (3)	Low (3)	Medium (6)	High (9)	High (12)
	Major (4)	Low (4)	Medium (8)	High (12)	High (16)

Table 2: Risk categories and reporting requirements

Risk Category	Risk Values	Management Response	Reporting Requirements
Negligible	0-2	None	Brief Justification
Low	3-4	No Specific Management	Full Justification Report
Medium	6-8	Specific Management/ Monitoring Needed	Full Performance Report
High	9-16	Increased Management Activities Needed	Full Performance Report

4 Results

4.1. Retained species

Table 3: Summary of issues and revised risk scoring for retained species

ISSUE	2023 revised risk rating	2009 risk rating
Blue Swimmer Crab – Spencer Gulf population	**Medium**	Moderate
Blue Swimmer Crab – Gulf St Vincent population	**Medium**	Moderate
Other permitted species (Rock, Spider, Velvet Crab)	**Low**	Low
Bait species (Appendix 2)	**Negligible**	Negligible

Primary species - Blue Crab

Blue Crab remains the primary target and retained species in the fishery. Various changes in management, assessment and stock status have been observed since the last ESD assessment.

New information considered included:

- Fishery Assessment Report of the Blue Crab Fishery 2021/22, including results from the 2023 Fishery Independent Survey (FIS) (Beckmann and Hooper 2023)
- Updated harvest strategy as included in the amended (2020) version of the Management Plan for the Blue Crab Fishery (PIRSA 2020).
- Updated temporal and spatial management arrangements for the fishery as included in the amended (2020) version of the Management Plan for the Blue Crab Fishery (PIRSA 2020).
- Survey of Recreational Fishing in South Australia 2021/22 (Beckmann et al 2023).

Total Allowable Commercial Catches (TACCs) were introduced to the Blue Crab fishery in 1996/97 and catches have been effectively constrained within the TACCs.

Spencer Gulf

Spencer Gulf has been the most productive zone of the BCF in terms of total annual catch since 1984/85. From 2011/12 to 2020/21, the Spencer Gulf zone of the Blue Crab fishery has been classified as 'sustainable' (Beckmann and Hooper 2023).

From 2003/04 to 2019/20, between 94 and 100% of the TACC (381.7 t) was taken, with catches ranging from 359 t in 2017/18 to 382 t in 2007/08. In 2020/21 the TACC increased to 419.8 t, and the resulting catch was the highest on record (418 t). During 2021/22, catch decreased to 326.3 t, the lowest reported since 1998/99 (323.8 t), equating to 85% of the TACC (381.7 t).

The latest (2020/21) assessment notes the recent trends in FIS data reflect large fluctuations in legal-size CPUE, particularly since March/April surveys commenced in 2016. The 2022 legal-size CPUE was nearly double the 2021 CPUE and was the fourth highest value on record for March/April. The pre-recruit CPUE reflected high relative biomass, with the highest value on record observed in 2022.

In 2021/22, legal-size CPUE was 4.1 ± 0.3 (SE) kg.potlift^{-1}. This was above the trigger reference point (2.4 kg.potlift^{-1}). As a result, the stock is classified as '**sustainable**' (Beckmann and Hooper 2023).

Gulf St. Vincent

From 2013/14 to 2020/21, the Gulf St. Vincent zone of the Blue Crab fishery has been classified as 'sustainable'. In 2011/12 and 2012/13, it was classified as 'transitional depleting' and 'transitional recovering' respectively.

After 2005/06, commercial catches fluctuated with catches dropping to 129 t in 2012/13 when commercial catch was voluntarily reduced by almost half. The Gulf St. Vincent component of the TACC was subsequently reduced by 20% in 2013/14 to 196 t and remained at 196 t in 2014/15. In 2014/15, the entire annual TACC for the Gulf St. Vincent (196 t) was harvested for the first time. In 2015/16, the Gulf St. Vincent component of the annual TACC was increased to 245 t and until 2019/20, 98% of the TACC was harvested. In 2020/21 and 2021/22, the total Gulf St. Vincent harvest was 174.3 t and 195.1 t, respectively. In 2021/22, 195.1 t was harvested, approximately 72% of the TACC, a 12% increase compared to 2020/21 but below the previous 10-year average (214 t ± 13 t) (Beckmann and Hooper 2023).

The latest 2021/22 assessment notes that trends in FIS data reflect fluctuations in legal-size biomass, with high catch rates reported in four of the previous seven surveys. From 2019–2021, legal-size CPUE saw consecutive annual declines, but CPUE remains above historical levels. During 2022, legal-size CPUE was the highest reported. Pre-recruit CPUE has fluctuated through time with high values observed in 2006, 2010, 2015, 2017 and 2021. In 2022, legal-size CPUE was well below 2021, but remained the third highest reported for March/April (Beckmann and Hooper 2023).

In Gulf St. Vincent, the 2020/21 legal-size CPUE was 5.4 ± 0.4 (SE) kg.potlift^{-1}. This was above the trigger reference point (1.7 kg.potlift^{-1}). As a result, the stock is classified as '**sustainable**' (Beckmann and Hooper 2023).

The estimated retained recreational catch from the Spencer Gulf and Gulf St. Vincent in 2021/22 was a combined 225 t (102 t and 123 t respectively), representing 30% of the total Blue Crab catch taken from these areas.

It is considered that the commercial harvest strategy is effectively controlling harvest of Blue Crab to sustainable levels in both the Spencer Gulf and Gulf St . Vincent fishing zones. It was considered the commercial fishery could have a moderate impact on the population and that this was likely to occur. The risk rating was therefore retained at **MEDIUM.**

By-product species

Various other species are permitted to be taken in the fishery, including: Rock crab (*Nectocarcinus integrifrons*), spider crab (Family Majidae) and velvet crab (*Nectocarcinus tuberculosus*).

New information considered included:

- Commercial logbook information and industry comments.

Available information continues to indicate these species are rarely retained in the fishery and the previous risk scores were maintained. It was considered current fishing activities could have a minor impact on the populations of these permitted species, and it was possible of occurring. The resultant risk rating is therefore **LOW.** This assessment may need to be revisited if new markets are developed or any of these species become targeted in the future.

Bait

A wide range of species are permitted to be taken in the fishery for the purpose of bait (Appendix 2), however the take of these species for bait continues to be very rare. Once converted to the updated scoring tables, it was considered there was a remote likelihood of the fishery having a minor impact on the populations of these species, resulting in change to the risk rating of **NEGLIGIBLE**.

4.2. Non-retained species

Table 4: Summary of issues and revised risk scoring for non-retained species

ISSUE	**2023 revised risk rating**	2009 risk rating
Captured by gear (all discarded species appendix 2)	**Negligible**	Negligible
Direct interaction but no capture (all TEPS)	**Negligible**	Negligible

Captured by gear

Although Blue Crab Fishery licence holders are permitted to retain a number of species (Appendix 2), generally no species other than Blue Swimmer Crab are retained.

New information considered included:

- Available bycatch data as recorded in recent years during fishery independent surveys (**Appendix 4)**

Appendix 4 provides the total abundance and frequency of occurrence of species taken as bycatch during the FIS in Spencer Gulf and Gulf St Vincent in recent years. These data are a combination of bycatch from both small mesh research pots and commercial pots.

Whilst the species composition and frequency of non-retained species appears to be somewhat different in recent years compared with the data used for the 2009 ESD risk assessment, including increased number and frequency of trumpeter (*Pelates sexlineatus*), the information continues to indicate very low levels of bycatch in the fishery. Several of the most frequently caught species are also permitted to be retained in the fishery and are also expected to have relatively high post capture survival rates where they are discarded (e.g. Rock Crab and Spider Crab).

The composition and frequency of non-retained species does not raise any concerns for the populations of these species and the risk rating from the previous assessment have been retained. Once converted to the updated scoring tables, the potential impact of the Blue Crab Fishery on populations of non-retained species captured in fishing gear is considered to be minor and unlikely to occur, resulting in a risk rating of **NEGLIGIBLE.**

Direct Interaction but not captured

There are a number of species listed as threatened, endangered and protected under State and/or Australian Government legislation. These species are not permitted to be taken and must be released immediately if an interaction occurs.

All licence holders in South Australian commercial fisheries are required to record all interactions with threatened, endangered and protected species (TEPS) using a 'wildlife interaction' logbook, which are provided to PIRSA.

The potential exists for several TEPS to interact with crab pot float lines on rare occasions. These species include turtles, whales, dolphins, sharks, seals and birds. The degree to which fishers may encounter each of these species varies temporally and spatially, although this has not been formally quantified. However, the small number of operators and the fact that the Blue Crab Fishery is limited to Spencer Gulf and Gulf St Vincent restrict the interactions that may occur.

Pots in the BCF were typically set in strings joined with non-buoyant rope, with a float/ buoy line at the start and end, and this minimised risk of TEPS entanglement with the fishing gear.

New information considered included the latest reported wildlife interaction data:

- Operational Interactions with TEPS in South Australian Managed Fisheries 2007/08 to 2016/17 (Mackay 2018)

- SARDI Wildlife Interaction Reports provided to PIRSA annually since 2016/17 (Goldsworthy and Boyle 2019 and SARDI 2019-2023), including most recent years published on the PIRSA website at: https://pir.sa.gov.au/primary_industry/commercial_fishing/management/publications

The available information indicates the Blue Crab Fishery has rare interaction with TEPS. Since 2008/09 there have been three recorded instances of interactions with TEPS, including:

- one leatherback turtle entangled in the buoy line in both 2008/09 and 2009/10. In both instances the turtle was released alive.
- one cormorant mortality was reported in 2015/16.

After converting to the updated risk matrix, it was considered the fishery could have a minor impact on populations of TEPS through direct interaction, but there was a remote likelihood of this occurring, resulting in a risk rating of **NEGLIGIBLE.**

4.3. General ecosystem

Table 5: Summary of issues and revised risk scoring for general ecosystem

ISSUE	**2023 revised risk rating**	2009 risk rating
Removal of retained species on ecosystem (trophic impacts)	**Low**	Negligible
Bait collection	**Negligible**	Negligible
Lost gear	**Negligible**	Negligible
Discarding	**Negligible**	Negligible
Translocation (of noxious pests)	**Medium**	Moderate
Greenhouse gas / carbon emissions	**Negligible**	Moderate
Oil discharge	**Low**	Moderate
Rubbish / debris	**Negligible**	Low
Damage to seagrass	**Low**	Low
Damage to soft substratum	**Negligible**	Negligible
Damage to benthic invertebrates	**Negligible**	Negligible
Damage by bait collection	**Negligible**	Negligible

Impacts on the biological community

Removal of/damage to organisms by commercial blue crab fishing

In some fisheries there may be trophic impacts caused by the removal of high volumes of certain species. There is limited information available related to the ecosystem impacts of fishing that are directly relevant to the Blue Crab Fishery in South Australia.

New information considered:

- Spencer Gulf Research Initiative: Development of an Ecosystem Model for Fisheries and Aquaculture (Gillander et al 2015)

- A Trophic Model for Gulf St. Vincent: Balancing Exploitation of Three Fisheries in An EBFM Framework (Goldsworthy et al 2017)

In Spencer Gulf, Blue Crabs have been reported as being one of the main scavengers on discarded bycatch from prawn trawling. It is preyed upon by both Snapper and Gummy Shark. Through the development of a Spencer Gulf ecosystem model for fisheries and aquaculture, Gillander et al (2015) indicated a bottom-up control relationship with Gummy Shark and a top-down relationship with Snapper.

In Goldsworthy et al (2017), the major consumers of Blue Crab in the Gulf St. Vincent were omnivore crustaceans (76%) followed by Snapper (11%), Giant Australian Cuttlefish (5%) and Gummy Shark (5%).

The abundance of Blue Swimmer Crabs is highly variable from year to year, despite stable catches in the fishery. Neither of the above studies suggested the commercial take of Blue Crab had an impact on species with a trophic link to Blue Crab, however in acknowledgement of the fact that the fishery removed a significant amount of Blue Crab biomass, and as a precautionary approach, it was considered that it was possible the current commercial harvesting activities could have a minor impact on food chains or ecological communities. This resulted in a change of overall risk rating from negligible to **LOW**.

Removal of/damage to organisms by bait collection

Species of potential interest that may be targeted for bait were trumpeters, Australian Salmon and Yelloweye Mullet. Given industry advice that the fishery still predominantly purchased bait, it was considered the consequence on the ecosystem was minor and had a remote likelihood, resulting in an overall risk rating of **NEGLIGIBLE** being retained**.**

Removal of/damage to organisms by lost gear (Ghost gear)

Industry noted that improvements in fishing techniques and lost gear recovery had reduced risks associated with lost gear. In addition to environmental considerations, crab pots were expensive and it was in the financial interest of fishers to not lose pots. Prevention measures had also improved, with the Spencer Gulf Prawn Fishery implementing exclusion zones under a code of conduct to minimise interactions with Blue Crab Fishery pots. Fishers were in the process of developing similar arrangements with Gulf St Vincent Prawn Fishery.

After conversion to updated scoring tables, it was considered that lost gear in the fishery could have a minor impact on the ecosystem, yet there was a remote likelihood of this occurring, resulting in a risk rating of **NEGLIGIBLE** being maintained.

Addition / movement of biological material caused by discarding

The discarding of bait used in the fishery (9 BCF and 1 MSF licence holder) and discarding of non-retained bycatch was considered to have remained very low (Appendix 4).

After conversion to the updated scoring tables, it was considered that the fishery could have a minor impact on the ecosystem through discarding, yet there was a remote likelihood of this occurring. This resulted in a risk rating of **NEGLIGIBLE** being maintained.

Addition / movement of biological material caused by translocation

The previous assessment had included a risk associated with the translocation of exotic species such as *Caulerpa taxifolia* as vessels moved between regions.

Caulerpa taxifolia is an introduced aquatic pest in South Australia and listed as a noxious species.

- This seaweed is a serious threat to:
- native sea-grass meadows
- bottom-dwelling communities
- fish breeding grounds.

The weed was found in West Lakes, and the Port River near the Jervois Bridge, in March 2002. It was eradicated from West Lakes.

The infestation continues in the Port River despite many attempts to eradicate it. More infestations were found in the Port River Estuary in 2004. In 2011, a containment area was enforced in the Port River Estuary.

There had been no incidents of BCF vessels translocating noxious pests since the last risk assessment had been undertaken, yet due to the ongoing threat posed by Caulerpa and other noxious pest in the Port River (such as Pacific Oyster Mortality Syndrome), the risk related to translocation of Caulerpa and other noxious pests was considered the same as the previous assessment. After conversion to the updated scoring tables, the potential consequence was considered to be major yet unlikely to occur resulting in a precautionary risk rating of **MEDIUM** being maintained**.**

Broader Environment

Air Quality - Greenhouse gas / carbon emissions

The previous assessment had included a risk associated with the greenhouse gas (GHG) / carbon emissions from the fishery. Since the last assessment, 50% of the fleet had put in new motors in recent years, with many meeting Euro 3 emissions standards. There had also been significant reductions in engine hours due to bigger/more efficient pots being used.

Whilst reducing GHG / carbon emissions was recognisied as an important issue to seek ongoing improvements on, the potential impact of the fishery's greenhouse gas / carbon emissions (10 licences in total) on the environment associated with the fishery was considered to be minor, with a remote likelihood, resulting in reduced risk rating from moderate to **NEGLIGIBLE.**

Water Quality - Oil discharge Objective

The potential impacts of the Blue Crab Fishery on water quality were still considered to be low due to the small number of vessels operating across a relatively large geographic expanse. Blue Crab Fishery licence holders do not discharge oil at sea. Vessels were well maintained and relatively young. Stringent regulations remain in place regarding the management of oil at sea under the *Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987*.

Considering the existing controls, it was considered unlikely that an incident in the fishery associated with oil discharge could have a moderate impact on the ecosystem associated, resulting in an updated risk rating from medium to **LOW.**

Water Quality - Rubbish / debris Objective

There was no new information to consider in relation to the impact of rubbish from the fishery impacting the broader environment. Operators continued to comply with various state regulations and retained all rubbish on board the vessels for disposal on return to port. The fishery does not generate a significant amount of plastic waste in its fishing activities and has a small number of licences. It was therefore considered that rubbish from the fishery could have a minor impact on ecosystem associated with the fishery, and this was unlikely to occur, resulting in the risk rating of **NEGLIGIBLE**.

Damage to seagrass

Operators in the Blue Crab Fishery generally set pots over sandy or muddy substratum, where Blue Swimmer Crabs are found. Industry advised that pots are occasionally set near seagrass patches but not in dense seagrass areas. It was noted that some licence holders set pots over a large area and may pull the gear twice per day.

Only about half of the boats in the fishery anchor. Industry advised that anchors are set to minimise damage by setting in the sand and avoiding seagrass areas.

Most research regarding fishing impacts on benthic communities has traditionally focused on mobile gears, such as prawn, scallop and fish trawlers. Over the last decade, some research has been directed towards assessing impacts from pot fisheries, for example, Stevens (2021), and ABPmer (2016). These studies suggest that pot fisheries can have negative impacts on habitats, however the scale of impact is dependent of various factors, such as the frequency and intensity of fishing effort, the habitat type, the pot type, and natural disturbance regime of the habitat in question.

There have been no studies in South Australia to assess the impacts of pot fishing on habitats. Results from a Western Australian study showed that pots lift rather than drag when pulled, causing very little damage to the benthos (Moran and Jenke 1989).

The fishing intensity associated with BCF is considered relatively disperse, and pots are typically set on soft sand or mud in relatively shallow waters. Considering this, it is considered possible that the fishery could have a minor impact on seagrass habitats, with a risk rating of **LOW** retained.

Damage to soft substratum

‘Soft substratum’ refers to areas of sandy or muddy bottom in the area of the fishery.

Physical interactions do occur when blue crab pots, hoop nets, drop nets and crab nets are placed on the substrate. However, as these fishing devices are passive by nature, the interactions are not considered to be significant.

Once converted to the new risk tables, it was considered that the pot fishing activities of the Blue Crab Fishery could have minor impact on the substratum and this was unlikely to occur, resulting in the risk rating of **NEGLIGIBLE** being retained**.**

Damage to benthic invertebrates

Physical interactions do occur when blue crab pots, hoop nets, drop nets and crab nets are placed on the substrate. However, as these fishing devices are passive by nature, and considering the scale and extent of the fishery, the interactions are not considered to be significant. Once converted to the updated scoring tables, it is considered the pot fishing activities of the Blue Crab Fishery could have a minor impact on benthic invertebrate communities, yet this was unlikely. The overall risk rating of **NEGLIGIBLE** was retained.

Damage caused by bait collection

Bait nets are also permitted to be used by licence holders. These nets may be up to 150 m in length and have a mesh size of between 30 mm and 150 mm.

Given that industry have advised that fishers only rarely use the apparatus, , it is considered the impact on the ecosystem from the use of bait nets could be minor, yet has a remote likelihood of occurring, resulting in a risk rating of **NEGLIGIBLE** being retained.

4.4. External ecological factors affecting fishery performance

Table 6: Summary of issues and revised risk ratings for external ecological factors

ISSUE	**2023 revised risk rating**	2009 risk rating
Water quality	**Medium**	Moderate
Climate Change	**Medium**	N/A

Ecological Impacts on the Fishery

Human Induced Changes Water quality

New information considered:

- State of the Environment Report (EPA 2018)

As noted in the previous assessment, there remains a risk that impacts from human induced changes to water quality could have negative impacts on the Blue Crab Fishery. Research has illustrated that environmental influences of

temperature, salinity and rainfall impact significantly on various species of Blue Swimmer Crab. This impact relates predominantly to the abundance and composition of the species in these areas (Meagher, 1971; Potter et al., 1983).

Existing and further proposals for a desalination plant in Spencer Gulf and waterfront usage at Port Bonython in relation to the proposed Hydrogen Powerplant are of major concern to the Blue Crab Fishery The industry has raised concerns about the intake of larval/juvenile crabs into the plant as well as the impacts on the broader ecosystem through the expulsion of saline water and chemical pollutants.

Salinity is known to be a constraint on growth and reproduction of Blue Swimmer Crabs. In marine estuarine environments where considerable fluctuations in salinity levels can occur it has been noted that Blue Swimmer Crabs will move to areas of high salinity during winter months. Meagher (1971), noted that *P. pelagicus* prefers salinity levels between 30 and 40ppt. The salinity of seawater is approximately at the midpoint of this range and would explain the species preference for marine environments where *P. pelagicus* frequently passes through its whole lifecycle.

Crustaceans are very sensitive to pesticides, which may enter the gulfs via agricultural runoff. Acknowledging the uncertainty associated with these potential impacts, it was considered that water quality could still have moderate impact on the Blue Crab Fishery, and this was considered likely to occur, resulting in a risk rating of **MEDIUM** being retained.

Climate Change

A dedicated assessment of climate change impacts on the Blue Crab Fishery was undertaken for this revised assessment.

New information considered:

- Climate State of the Environment Report (EPA 2018)
- Regional projection for Southern Australia (CSIRO 2021)
- Decadal scale projection of changes in Australian fisheries stocks under climate change (Fulton et al 2018)
- Climate Change Adaptation Workshop for the Blue Crab Fishery – Draft Summary report (Draft CSIRO 2023)
- Guide to climate projections for risk assessment and planning in South Australia 2022 (DEW 2022)

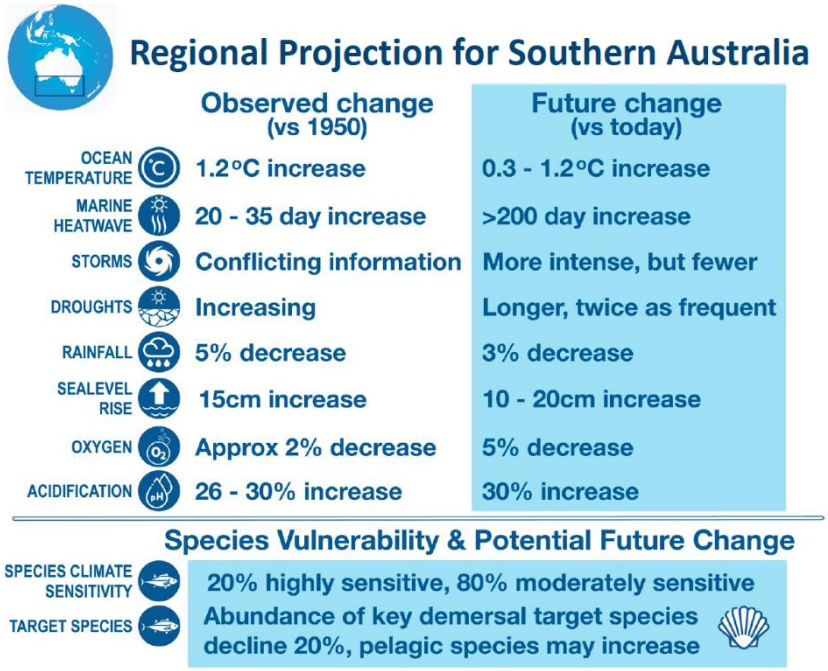

Figure 2: Regional projection for Southern Australia in 2040 (CSIRO 2021)

By 2030, mean sea surface temperatures are projected to increase by 0.5 °C at Port Adelaide, Victor Harbor and Portland (Victoria) and by 0.6 °C at Thevenard. Ocean pH is projected to decrease by 0.08 units (i.e. become more acidic). Salinity is projected to decrease by between 0.02 and 0.07 g/kg compared to baseline concentrations.

South Australia faces increasing impacts associated with rising sea surface temperatures and acidity including:

- changes in nutrient cycling in marine waters
- adverse impacts on the condition and extent of suitable habitat for coastal fisheries
- adverse impacts on shell-forming organisms including molluscs, crustaceans and foraminifera
- adverse impacts on fisheries, aquaculture and tourism.

Stakeholder observed changes in the fishery (draft CSIRO 2023)

- While there has been observed changes in physical conditions that has not manifested in a decline in crab abundance to date. Surveys have shown abundance has increased since 1991, especially over the past 20 years, likely due to warming waters and stochastic environmental events (like increased rainfall discharge or La Nina's, when recruitment is better). As a result, the fishery continues to catch crabs from the mangroves out to seagrass beds and beyond.
- The distribution of the crab has changed through time, extending further southwards since the 1970s (by 70-80 nm), this means the species is now seen where it had not been seen previously (e.g. off Port Lincoln, the Adelaide area (Trigger shoal) and in Coffin Bay). Interestingly, there does not appear to have been a matching southward contraction of the northern most extents; the Gulf geography could be

critical to this. While the northern parts of Gulfs are becoming hotter and saltier, the circulation of the Gulf mean the blue crabs do use these upper parts of the Gulfs as recruitment or nursery sites (unlike Snapper). Although further environmental change is anticipated in the northern ends of the Gulf and in their shallower waters (with temperature and salinity increases impacting abundance/biomass, distribution/range and recruitment).

- There has been no observed long-term change in frequency of “soft” crab overall or in the meat quality. Market changes have occurred though, including the need to value add – processing crab meat (so now see both cooked and raw crab being sold).

- While quality has not changed, fishers have observed, however, that there has been a shift in size to smaller crabs, especially in the warmer northern waters of the Gulfs. Scientific analysis of environmental conditions has shown that long, cold deep winter conditions have been replaced by short drier winters. This may explain why there has been an observed increase in spawning blue crab in early winter (linked to water temperatures, which have translated into extended summertime conditions which is when moulting historically peaked). It likely also explains why the crabs are smaller. There seems to be sufficient food as they are still in good condition, but due to the warmer conditions they are growing more rapidly and therefore moulting more frequently (around every 6-7 weeks); this is in contrast to colder years in the past where it was observed they didn’t moult so much.

- This increase in numbers of smaller crabs caught in “northern” fishery areas, compared to 10 years ago, is further motivating a southward shift in effort (as their gear is not well suited to small crab). Another motivation for this shift has been the increasing pressures present in the northern Gulf waters (due to increasing human populations, farming, water quality impacts and tourism).

- Catchability has remained good overall, though it can vary inter-annually, with fishers reporting that catch is best in drought years (especially if there are dry windy summers). The changes in the fishery have already motivated management changes (at least in part).

Noting the above observed changes in the fishery, and regional projection for South Australia, it was considered that climate change could have a moderate impact on the Blue Crab Fishery in the coming five years and that this was likely to occur, resulting in a risk rating of **MEDIUM**.

5 Risk Evaluation

5.1. Summary of risk ratings, performance measures and management strategies

A summary table outlining the consequence and likelihood scores and resultant risk ratings for all revised issues is provided in Appendix 5.

Table 7. Overview table of the 2023 revised risk ratings and associated performance measures and management strategies for the Blue Crab Fishery

Issue	Revised risk rating (score) 2023	Previous risk rating 2009	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Management Strategies / actions
Impacts on retained species							
Blue Swimmer Crab – Spencer Gulf population	**Medium (8)**	Moderate	Maintain the stock within sustainable limits in accordance with performance indicators.	CPUE; legal size abundance; Pre-recruit	Yes	Acceptable	Continue to manage fishery under harvest strategy and maintain annual assessment of fishery and fishery independent surveys
Blue Swimmer Crab – Gulf St Vincent population	**Medium (8)**	Moderate	Maintain the stock within sustainable limits in accordance with performance indicators.	CPUE; legal size abundance; Pre-recruit	Yes	Acceptable	Continue to manage fishery under harvest strategy and maintain annual assessment of fishery and fishery independent surveys
Other permitted species (Rock, Spider, Velvet Crab)	**Low (3)**	Low	Minimise fishery impacts on by-catch species and the ecosystem.	N/A	N/A	N/A	Continue to monitor the take of key by-product and bycatch species to ensure that catches remain at very precautionary levels.
Bait	**Negligible (1)**	Negligible	Minimise fishery impacts on by-catch species and the ecosystem.	N/A	N/A	N/A	Review at next risk assessment

Issue	Revised risk rating (score) 2023	Previous risk rating 2009	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Management Strategies / actions
Impact on non-retained species							
Captured by gear	**Negligible (2)**	Negligible	Minimise fishery impacts on by-catch species and the ecosystem.	N/A	N/A	N/A	Continue to monitor the take of key by-product and bycatch species to ensure that catches remain at very precautionary levels.
Direct interaction but no capture	**Negligible (1)**	Negligible	Minimise the interaction with endangered, threatened and protected species.	N/A	N/A	N/A	Continue to record and monitor all interactions with TEPS. Develop management measures to minimise interactions should any new issues arise in the fishery.
General impacts on the ecosystem							
Removal of retained species on ecosystem	**Low (3)**	Negligible	N/A – negligible risk	N/A	N/A	N/A	Review at next risk assessment
Bait collection	**Negligible (1)**	Negligible	N/A – negligible risk	N/A	N/A	N/A	Review at next risk assessment
Lost gear	**Negligible (1)**	Negligible	N/A – negligible risk	N/A	N/A	N/A	Review at next risk assessment
Discarding	**Negligible (1)**	Negligible	N/A – negligible risk	N/A	N/A	N/A	Review at next risk assessment
Translocation	**Medium (8)**	Moderate	Minimise fishery impacts on retained byproduct and discarded bycatch species and the ecosystem.	Yes	Yes	Acceptable	Develop / implement biofouling management plan
Greenhouse gas / carbon emissions	**Negligible (1)**	Moderate	N/A negligible risk TBC	N/A	N/A	N/A	NA

Issue	Revised risk rating (score) 2023	Previous risk rating 2009	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Management Strategies / actions
Oil discharge	**Low (4)**	Moderate	N/A TBC	N/A	N/A	N/A	Continue due diligence and compliance with relevant regulations
Rubbish / debris	**Negligible (2)**	Low	M/A	N/A	N/A	N/A	Continue due diligence and compliance with relevant regulations
Damage to seagrass	**Low (3)**	Low	Yes but low risk	N/A	N/A	N/A	Review at next risk assessment
Damage to soft substratum	**Negligible (2)**	Negligible	Yes but negligible risk	N/A	N/A	N/A	Review at next risk assessment
Damage to benthic invertebrates	**Negligible (2)**	Negligible	Yes but negligible risk	N/A	N/A	N/A	Review at next risk assessment
Damage by bait collection	**Negligible (1)**	Negligible	Yes but negligible risk	N/A	N/A	N/A	Review at next risk assessment
Ecological factors impacting the fishery							
Water quality	**Medium (8)**	Moderate	Proposed new objective - Ensure management is responsive to changes in environmental conditions	Yes	Yes	Acceptable	Mitigation measures are considered where performance of the fishery is considered to have been impacted by water quality / climate changes
Climate Change	**Medium (8)**	N/A	Proposed new objective - Ensure management is responsive to changes in environmental conditions	Yes	Yes	Acceptable	Mitigation measures are considered where performance of the fishery is considered to have been impacted by water quality / climate changes.

A total of 20 key ecological issues associated with the South Australian Commercial Blue Crab Fishery were scored for risk across five components: retained species, non-retained species, general ecosystem, external ecological factors. The majority of issues were ranked as medium, low or negligible risk (Table 8).

Table 8: Summary of ESD Risk outcomes for the Blue Crab Fishery

Component Trees	**High**	**Medium**	**Low**	**Negligible**	**Total**
Retained species		2	1	1	4
Non-retained species				2	2
General ecosystem impacts		1	3	8	12
External ecological impacts		2			2
Total		5	4	11	20

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Appendix 1: Risk matrices

Consequence, Likelihood and Risk Levels Based on AS 4360 / ISO 31000, modified from Fletcher et al. (2011) and Fletcher (2015)

Consequence × Likelihood Risk Matrix		Likelihood			
		Remote (1)	Unlikely (2)	Possible (3)	Likely (4)
Consequence	Minor (1)	Negligible (1)	Negligible (2)	Low (3)	Low (4)
	Moderate (2)	Negligible (2)	Low (4)	Medium (6)	Medium (8)
	High (3)	Low (3)	Medium (6)	High (9)	High (12)
	Major (4)	Low (4)	Medium (8)	High (12)	High (16)

LIKELIHOOD LEVELS

These are defined as the likelihood of a particular consequence level actually occurring within the assessment period.

1	Remote	The consequence has never been heard of in these circumstances, but it is not impossible within the timeframe (Probability <5%).
2	Unlikely	The consequence is not expected to occur in the timeframe but it has been known to occur elsewhere under special circumstances (Probability 5 - <20%).
3	Possible	Evidence to suggest this consequence level is possible and may occur in some circumstances within the timeframe (Probability 20 - <50%).
4	Likely	A particular consequence level is expected to occur in the timeframe (Probability ≥50%).

CONSEQUENCE LEVELS

These are the potential outcomes (levels of impact) of an event or occurrence that affect objectives.

Note that if an issue is not considered to have any measurable impact, it is considered to be a 0 consequence.

Generic		
1	Minor	Measurable but minimal impacts that are highly acceptable and easily meet objective.
2	Moderate	Maximum acceptable level of impact that would still meet the objective.
3	High	Above acceptable level of impact. Broad and/or long-term negative effects on objective which may no longer be met. Restoration can be achieved within a short to moderate time frame.
4	Major	Well above acceptable level of impact. Very serious effects on objective which is clearly not being met and may require a long restoration time or may not be possible.

1. Ecological: Target/Retained Species		
1	Minor	Fishing impacts either not detectable against background variability for this population; or if detectable, minimal impact on population size and none on dynamics. Spawning biomass > Target level
2	Moderate	Fishery operating at maximum acceptable level of depletion. Spawning biomass < Target level but > Threshold level (B_{MSY})
3	High	Level of depletion unacceptable but still not affecting recruitment levels of stock. Spawning biomass < Threshold level (B_{MSY}) but > Limit level (B_{REC})
4	Major	Level of depletion is already affecting (or will definitely affect) future recruitment potential of the stock. Spawning biomass < Limit level (B_{REC})

2. Ecological: Non-Retained (Bycatch) Species		
1	Minor	Species assessed elsewhere and/or take is very small and area of capture small compared with known distribution (< 20%).
2	Moderate	Relative area of, or susceptibility to, capture is < 50% and species do not have a vulnerable life history.
3	High	N/A - Once a consequence reaches this point, it should be examined using target/retained species table.
4	Major	N/A.

3. Ecological: Threatened, Endangered and Protected Species (TEPS)		
1	Minor	Few individuals directly impacted in most years, level of capture/interaction is well below that which will generate public concern.
2	Moderate	Level of capture is the maximum that will not impact on recovery or cause unacceptable public concern.
3	High	Recovery may be affected and/or some clear, but short-term public concern will be generated.
4	Major	Recover times are clearly being impacted and/or public concern is widespread.

4. Ecological: Habitat		
1	Minor	Measurable impacts but very localized. Area directly affected well below maximum accepted.
2	Moderate	Maximum acceptable level of impact to habitat with no long-term impacts on region-wide habitat dynamics.
3	High	Above acceptable level of loss/impact with region-wide dynamics or related systems may begin to be impacted.
4	Major	Level of habitat loss clearly generating region-wide effects on dynamics and related systems.

5. Ecological: Ecosystem/Environment		
1	Minor	Measurable but minor changes to the environment or ecosystem structure but no measurable change to function.
2	Moderate	Maximum acceptable level of change to the environment or ecosystem structure with no material change in function.
3	High	Ecosystem function altered to an unacceptable level with some function or major components now missing and/or new species are prevalent.
4	Major	Long-term, significant impact with an extreme change to both ecosystem structure and function; different dynamics now occur with different species/groups now the major targets of capture or surveys.

Appendix 2: Stakeholder input

BCFMPRC Meeting attendees:

- Rory McEwen (Chair)
- Dennis Holder (BCF)
- Garry Barnes (BCF) (proxy for Jarrad Barnes for part of meeting)
- Asher Dezsery (RecFish SA)
- Katherine Heldt (SARDI)
- Sam Stone (PIRSA)
- Apologies - Ann Newchurch (Narungga Nation Aboriginal Corporation) and Alicia Bolitho (RecFish SA)
- Craig Noell – (SARDI Observer)

Additional information and comments on the 2009 ESD risk assessment were invited from the Department of Environment and Water and the Conservation Council of South Australia. Comments provided were considered during the meeting on 28 November 2023.

Appendix 3 - Aquatic resources prescribed for the Blue Crab Fishery

The following species are prescribed to be taken in the Blue Crab Fishery as provided for in Schedule 1 of the *Fisheries Management (Blue Crab Fishery) Regulations 2013*

Part 1—Aquatic resources prescribed for purposes of regulation 4(2)(a)

Crustaceans

Blue Swimmer Crab (*Portunus armatus*)
Rock Crab (*Nectocarcinus integrifons*)
Spider Crab (Family Majidae)
Velvet Crab (*Nectocarcinus tuberculosus*)

Part 2— Aquatic resources prescribed under regulation 4(2)(b) – for the purpose of bait

Molluscs

Octopus (*Octopus* spp)
Gould's Squid (*Nototodarus gouldi*)

Scalefish

Australian Anchovy (*Engraulis australis*)
Barracouta (*Thyrsites atun*)
Black Bream (*Acanthopagrus butcheri*)
Cod (marine species) (Family Moridae)
Flathead (Family Platycephalidae)
Flounder (Family Bothidae or Pleuronectidae)
Bluespotted Goatfish (Upeneichthys vlamingii)
Eastern Striped Grunter (Pelates sexlineatus)
Australian Herring (Arripis georgianus)
Yellowtail Kingfish (Seriola lalandi)
Leatherjacket (Family Monacanthidae)
Blue Mackerel (Scomber australasicus)
Common Jack Mackerel (Trachurus declivis)
Morwong (Family Cheilodactylidae)
Mullet of all species (Family Mugilidae)
Mulloway (Argyrosomus japonicus)
West Australian Salmon (Arripis truttaceus)
Australian Sardine (Sardinops sagax)
Snook (Sphyraena novaehollandiae)
Southern Sole (Aseraggodes haackeanus)
Sea Sweep (Scorpis aequipinnis)
Trevally (Carangidae spp)
Wrasse (Labridae) (other than Western Blue Groper (Achoerodus gouldii))

Sharks

Rays of all species (Class Elasmobranchii)
Shark of all species (Class Elasmobranchii) other than White Shark (Carcharodon carcharias)
Skate of all species (Class Elasmobranchii)

Appendix 4 - Bycatch recorded in fishery-independent pot surveys for the Blue Crab Fishery in recent years.

Total abundance and frequency of occurrence (% in brackets) of species taken as by-catch during fishery-independent pot surveys in Spencer Gulf from 2018-2020

Spencer Gulf Common name	2018 Lifts = 600		2019 Lifts = 600		2020 Lifts = 600		Total (out of 1800 lifts)	Individuals per pot lift
	No.	Freq.	No.	Freq.	No.	Freq.		
Trumpeter	341(51.8)	101(16.8)	171(48.9)	56(9.3)	328(49.0)	83(13.8)	840	0.467
Rock crab	181(27.5)	64(10.7)	127(36.3)	36(6.0)	254(38.0)	71(11.8)	562	0.312
Pt Jackson	40(6.1)	30(5.0)	5(1.4)	5(0.8)	26(3.9)	21(3.5)	71	0.039
Leatherjacket	20(3.0)	18(3.0)	17(4.9)	17(2.8)	20(3.0)	16(2.7)	57	0.032
Red Mullet	18(2.7)	16(2.7)	8(2.3)	7(1.2)	11(1.6)	4(0.7)	37	0.021
Spider crab	7(1.1)	7(1.2)	3(0.9)	3(0.5)	7(1.0)	7(1.2)	17	0.009
Nudibranch	11(1.7)	5(0.8)	0(0)	0(0)	0(0)	0(0)	11	0.006
Ascidian	9(1.4)	8(1.3)	0(0)	0(0)	0(0)	0(0)	9	0.005
Puffer Fish	4(0.6)	3(0.5)	2(0.6)	2(0.3)	2(0.3)	2(0.3)	8	0.004
Starfish	3(0.5)	3(0.5)	3(0.9)	3(0.5)	2(0.3)	2(0.3)	8	0.004
Snapper	1(0.2)	1(0.2)	3(0.9)	3(0.5)	2(0.3)	2(0.3)	6	0.003
Catfish	3(0.5)	3(0.5)	1(0.3)	1(0.2)	2(0.3)	2(0.3)	6	0.003
Cuttlefish	2(0.3)	2(0.3)	0(0)	0(0)	4(0.6)	3(0.5)	6	0.003
Hairy Mussel	4(0.6)	1(0.2)	1(0.3)	1(0.2)	0(0)	0(0)	5	0.003
Cowfish	0(0)	0(0)	1(0.3)	1(0.2)	3(0.4)	3(0.5)	4	0.002
Gurnard Perch	4(0.6)	4(0.7)	0(0)	0(0)	0(0)	0(0)	4	0.002
Brittle star	3(0.5)	3(0.5)	1(0.3)	1(0.2)	0(0)	0(0)	4	0.002
Balmain Bug	2(0.3)	2(0.3)	1(0.3)	1(0.2)	1(0.1)	1(0.2)	4	0.002
Sand crab	0(0)	0(0)	0(0)	0(0)	3(0.4)	3(0.5)	3	0.002
Numb Fish	1(0.2)	1(0.2)	0(0)	0(0)	2(0.3)	2(0.3)	3	0.002
Dog Whelk	0(0)	0(0)	3(0.9)	3(0.5)	0(0)	0(0)	3	0.002
Fiddler	0(0)	0(0)	2(0.6)	2(0.3)	0(0)	0(0)	2	0.001
Hermit Crab	1(0.2)	1(0.2)	0(0)	0(0)	0(0)	0(0)	1	0.001
Beche De Mer	0(0)	0(0)	0(0)	0(0)	1(0.1)	1(0.2)	1	0.001
Scallop	0(0)	0(0)	1(0.3)	1(0.2)	0(0)	0(0)	1	0.001
Stingray	1(0.2)	1(0.2)	0(0)	0(0)	0(0)	0(0)	1	0.001
Jelly Fish	1(0.2)	1(0.2)	0(0)	0(0)	0(0)	0(0)	1	0.001

Total abundance and frequency of occurrence (% in brackets) of species taken as by-catch during fishery-independent pot surveys in Gulf St. Vincent in 2019 and 2020.

Gulf St Vincent **Common name**	**2019** **Lifts = 600**		**2020** **Lifts = 600**		**Total (out of 1200 lifts)**	**Individuals per pot lift**
	No.	**Freq.**	**No.**	**Freq.**		
Rock crab	204(67.1)	79(13.2)	724(90.2)	190(31.7)	928	0.773
Trumpeter	60(19.7)	29(4.8)	16(2.0)	10(1.7)	76	0.063
Leatherjacket	19(6.3)	15(2.5)	24(3.0)	15(2.5)	43	0.036
Spider crab	7(2.3)	4(0.7)	12(1.5)	12(2.0)	19	0.016
Red Mullet	8(2.6)	6(1.0)	4(0.5)	4(0.7)	12	0.010
Balmain Bug	0(0)	0(0)	6(0.7)	6(1.0)	6	0.005
Starfish	0(0)	0(0)	5(0.6)	5(0.8)	5	0.004
Dog Whelk	4(1.3)	4(0.7)	0(0)	0(0)	4	0.003
Beche De Mer	1(0.3)	1(0.2)	2(0.2)	2(0.3)	3	0.003
Pt Jackson	0(0)	0(0)	3(0.4)	3(0.5)	3	0.003
Puffer Fish	0(0)	0(0)	2(0.2)	2(0.3)	2	0.002
Abalone	0(0)	0(0)	2(0.2)	2(0.3)	2	0.002
Soldier Fish	0(0)	0(0)	1(0.1)	1(0.2)	1	0.001
Flathead	0(0)	0(0)	1(0.1)	1(0.2)	1	0.001
Cockle	1(0.3)	1(0.2)	0(0)	0(0)	1	0.001
Razorfish	0(0)	0(0)	1(0.1)	1(0.2)	1	0.001

Note – no FIS was undertaken in the GSV in 2018 due to restrictions implemented in the eastern part of the gulf to minimise the spread of Pacific Oyster Mortality Syndrome (POMS).

Appendix 5 - Risk scoring

Table 9: Consequence, likelihood and resultant risk scoring across four components of the Blue Crab Fishery

Issue	Consequence (1 minor, 2 moderate, 3 high, 4 major)	Likelihood (1 remote, 2 unlikely, 3 possible, 4 likely)	Revised Risk Rating (Score 0-2 Neg; 3-4 Low; 6-8 Medium; 9-16 High)
Impacts on retained species			
Blue Swimmer Crab – Spencer Gulf population	2	4	Medium (8)
Blue Swimmer Crab – Gulf St Vincent population	2	4	Medium (8)
Other permitted species (Rock, Spider, Velvet Crab)	1	3	Low (3)
Bait	1	1	Negligible (1)
Impacts on non-retained species			
Captured by gear	1	2	Negligible (2)
Direct interaction but no capture	1	1	Negligible (1)
General impacts on the ecosystem			
Removal of retained species on ecosystem	1	3	Low (3)
Bait collection	1	1	Negligible (1)
Lost gear	1	1	Negligible (1)
Discarding	1	1	Negligible (1)
Translocation	4	2	Medium (8)
Greenhouse gas / carbon emissions	1	1	Negligible (1)
Oil discharge	2	2	Low (4)
Rubbish / debris	1	2	Negligible (2)
Damage to seagrass	1	3	Low (3)
Damage to soft substratum	1	2	Negligible (2)
Damage to benthic invertebrates	1	2	Negligible (2)
Damage by bait collection	1	1	Negligible (1)
Ecological factors impacting the fishery			

Issue	Consequence (1 minor, 2 moderate, 3 high, 4 major)	Likelihood (1 remote, 2 unlikely, 3 possible, 4 likely)	Revised Risk Rating (Score 0-2 Neg; 3-4 Low; 6-8 Medium; 9-16 High)
Water quality	2	4	Medium (8)
Climate Change	2	4	Medium (8)