FISHERIES & AQUACULTURE
PIRSA

Ecologically Sustainable Development Risk Assessment of South Australia's Gulf St Vincent Prawn Fishery

INCORPORATING THE NATIONAL ECOLOGICALLY SUSTAINABLE DEVELOPMENT (ESD) REPORTING FRAMEWORK AND THE ECOLOGICAL RISK ASSESSMENT FOR EFFECTS OF FISHING (ERAEF) ON SPECIES COMPONENTS

MARCH 2016

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia
Primary Industries and Regions SA

Ecologically Sustainable Development Risk Assessment of South Australia's Gulf St Vincent Prawn Fishery

Information current as of March 2016

Disclaimer

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Acknowledgments

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- The Saint Vincent Gulf Prawn Boat Owner's Association and other invited stakeholders for their participation in ESD risk assessment workshop and meetings
- Dr Brent Wise for facilitating the ESD stakeholder workshop
- The ESD risk assessment closely followed the National ESD reporting framework developed by Fletcher et al. (2002). PIRSA Fisheries and Aquaculture would also like to thank Dr Rick Fletcher and Dr Brent Wise for their assistance in adapting this framework to the most up to date processes for the Gulf St Vincent Prawn Fishery.

1. Executive Summary

Commercial prawn fishing in Gulf St Vincent Prawn Fishery (GSVPF) started in 1967, targeting Western King Prawns (*Melicertus latisulcatus*) but licence holders are also permitted to retain Balmain Bugs (*Ibacus* spp) and Southern Calamari (*Sepioteuthis australis*) if they are accidentally caught. No species other than Western King Prawns, Balmain Bugs and Southern Calamari that are captured in the GSVPF are permitted to be retained.

The *Fisheries Management Act 2007* (the 'Act') requires management plans to include risk assessments of the impacts or potential impacts of the fishery on relevant ecosystems, and ecological factors that could have an impact on the performance of the fishery. These risk assessments are used to identify and inform development of ecological, economic and social objectives of the fishery management plan that are consistent with ecologically sustainable development (ESD) principles.

To efficiently meet its ESD accountabilities under both State and Commonwealth legislation, Primary Industries and Regions South Australia (PIRSA) Fisheries and Aquaculture has adopted the 'National ESD Reporting Framework for Fisheries' developed by Fletcher et al. (2002). The initial steps of this analysis included identifying the issues relevant to the fishery and then prioritising these issues (Fletcher et al. 2005). The primary method chosen to complete these two elements was to conduct a qualitative risk assessment for each of the main biological and socio-economic components that make up the fishery. Risk analysis involves consideration of a risk, the consequences and the likelihood of that risk occurring.

After assessment of all of the components of the fishery, there were 11 areas identified as moderate or high risk from the 117 components assessed. Six risks were identified as being 'high' risk and five 'moderate' risk activities were identified. This included both King Prawns and Balmain Bugs being high risk, while Blue Swimmer Crabs, community structure and habitat disturbance were assessed as having a moderate risk.

A full ESD performance report in the context of specific management objectives including current operational objectives, indicators, and preferred strategies for each of the identified moderate and high risks is provided in Table 9.

2. Introduction

2.1 Fisheries management plans and ESD reporting

The *Fisheries Management Act 2007* (the 'Act') has been in place since 1 December 2007. Management plans are a significant instrument, guiding decisions on annual catch or effort levels, the allocation of access rights, and establishing the tenure of valuable commercial licences.

The Act also describes the nature and content of fisheries management plans. Among other requirements, management plans must describe the biological, economic and social characteristics of a fishery. Management plans must also include risk assessments of the impacts or potential impacts of the fishery on relevant ecosystems, and ecological factors that could have an impact on the performance of the fishery. Importantly, these risk assessments are used to identify and inform development of ecological, economic and social objectives of the fishery management plan that are consistent with ecologically sustainable development (ESD) principles.

The Minister has requested a management plan for GSVPF be prepared by 31 July 2016. This ESD risk assessment report provides important information for the development of this plan.

2.2 ESD risk assessment and reporting process

To efficiently meet its ESD accountabilities under both State and Commonwealth legislation, PIRSA Fisheries and Aquaculture has adopted the 'National ESD Reporting Framework for Fisheries' developed by Fletcher et al. (2002). The purpose of this reporting framework was to provide a consistent way to implement and assess fisheries with respect to the principles of ESD in Australia.

There are a number of elements to the ESD reporting process including the initial steps of identifying the issues relevant to the fishery and then prioritising these issues (Fletcher et al. 2005). The primary method chosen to complete these two elements was to conduct a qualitative risk assessment for each of the main biological and socio-economic components that make up a fishery. This approach, developed in Australia, has been extensively used to analyse and report on the ESD performance of commercial fisheries, and has the potential to drive substantial performance improvements.

When applied appropriately the national framework will:

- Substantially improve knowledge about the environmental, economic, and social issues relevant to the ESD performance of a fishery
- Enable consistent and comprehensive analysis and reporting of the current and strategic operating environment for fisheries (this may also inform industry strategic and business planning initiatives)
- Engage industry, key fishery stakeholders, managers and scientists in a proven, transparent, and clearly defined collaborative process to understand and improve fisheries management performance
- Improve the efficiency and quality of performance reporting against a range of public and private sector accountabilities (such as the *Environment Protection and Biodiversity Conservation Act 1999* strategic assessment process, or industry business planning initiatives).

The ESD reporting process provides a logical framework for managers and stakeholders to identify, prioritise, and efficiently manage risks to achieve agreed ESD objectives. Where there are substantial knowledge gaps, the process informs cost-effective and efficient research strategies targeted to high risk areas.

2.3 Ecological risk assessment for the effects of fishing (ERAEF)

The ecosystem based approach to fisheries management (EBFM) has become the preferred approach to address the issue of fishery impacts on the marine environment, i.e. beyond the direct impacts on target species that are monitored through regular fisheries management processes. A key challenge to effective implementation of this approach has been the development of tools to identify potential impacts and risks. This is further hampered by a lack of data on the broader ecological impacts of fishing on the environment.

The approach is based on five generic components of fishing impacts on the ecological system:

- Target species
- By-product and by-catch species
- Threatened, endangered and protected species (TEPS)
- Habitats
- Ecological communities.

3. Background

Several key documents were consulted for preparing the following background information on the GSVPF (see section 6), along with relevant legislation (*Fisheries Management Act 2007*, *Fisheries Management (General) Regulations 2007*, *Fisheries Management (Prawn Fisheries) Regulations 2006*). These documents should be referred to for additional information.

A summary of the fishery is outlined in (Table 1).

Table 1: Description summary of the South Australian Gulf St Vincent Prawn Fishery.

Characteristic	Description	
Target species	Western King Prawns (*Melicertus latisulcatus*)	
Other species	Balmain Bugs and Southern Calamari	
Fishing method	Demersal otter trawl	
Area	Gulf St Vincent and Investigator Strait	
Fishing season	1 November to 31 July (closed from 25 December to the last day in February)	
Primary landing port	Port Adelaide	
Catch and effort data	Daily logbook and Unloading logbook submitted after each trip	
Management methods	Input controls: Individual transferrable effort system, limited effort, limited entry, gear restrictions, maximum head line length, minimum T90 cod end mesh size, bycatch reduction grid (BRD)	
Legislation	*Fisheries Management Act 2007*, *Fisheries Management (General) Regulations 2007*, *Fisheries Management (Prawn Fisheries) Regulations 2006*	
Management plan	Management Plan for the South Australian Gulf St Vincent Prawn Fishery (Dixon & Sloan 2007)	
Harvest strategy	Yes	
Consultative forum	Saint Vincent Gulf Prawn Boat Owner's Association	
Main market	Domestic	
Assessments under the *Environment Protection and Biodiversity Conservation Act* 1999	Protected species (Part 13) & wildlife trade operations (Part 13A) accreditations were provided in October 2009. Part 13 expired late in 2014 and the list of exempt native species was then amended to include species under Part 13, taken in the GSVPF, until 29 October 2015.	
Fishery statistics	2009/10	2010/11
Number of licences	10	10
Annual catch (tonnes)	224 t	178 t
Gross value of production ($m)	2.6	2.1
Total licence fees ($'000)	340	353

3.1 Fishery description

3.1.1 Retained species

Commercial prawn fishing in Gulf St Vincent Prawn Fishery (GSVPF) started in 1967, targeting Western King Prawns (*Melicertus latisulcatus*). In addition to prawns, commercial licence holders are permitted to retain and sell two species of by-product, harvested incidentally during prawn trawling: the Balmain Bug (*Ibacus* spp) and Southern Calamari (*Sepioteuthis australis*).

No species other than Western King Prawns, Balmain Bugs and Southern Calamari that are captured in the GSVPF are permitted to be retained.

3.1.2 Area of the fishery

The fishery area of waters is described in detail in the *Fisheries Management (Prawn Fisheries) Regulations 2006* as:
The waters of Gulf St. Vincent, Investigator Strait and Backstairs Passage contained within and bounded by a line commencing at Mean High Water Springs closest to 35°13′ 26.90″ South, 137°00′ 00.00″ East, then beginning easterly following the line of Mean High Water Springs to the location closest to 35°39′ 37.06″ South, 138°13′ 38.09″ East (Porpoise Head), then south-westerly to the location on Mean High Water

Springs closest to 35°48′ 06.93″ South, 138°07′ 29.06″ East (Cape St Albans, Kangaroo Island), then beginning south-westerly following the line of Mean High Water Springs to the location closest to 35°40′ 20.07″ South, 137°0′ 00.00″ East, then northerly to the point of commencement.

3.1.3 Fishing method and operation

Commercial fishing is undertaken using a demersal otter trawl, this essentially consists of towing one or multiple cone shaped nets along the sea floor. The GSVPF has provisions to allow for a single, double or triple rig trawls depending of satisfying certain other rules (Figure 1).

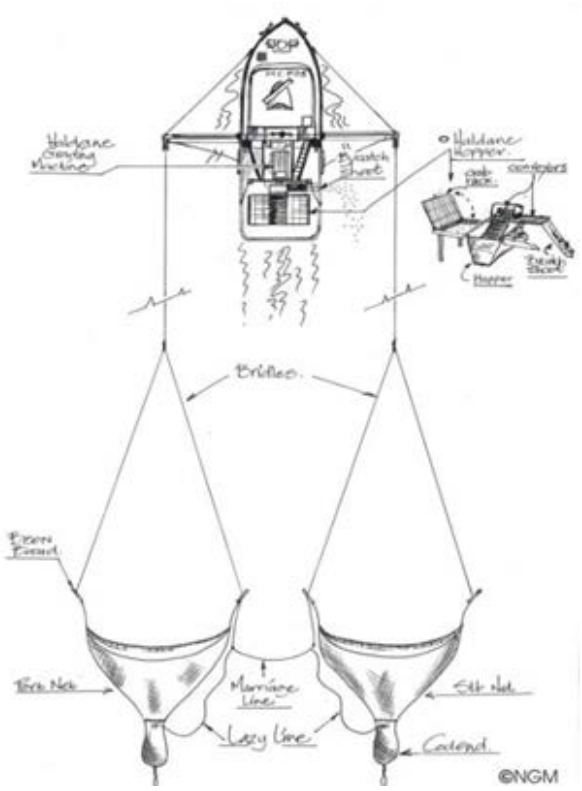

Figure 1: A double rigged trawl set used by the majority of vessels in the Gulf St Vincent Prawn Fishery.

Fishing is undertaken at night, between sunset and sunrise and trips are generally undertaken during the new moon period (generally between the last quarter of the moon, through the phase of the new moon to the first quarter).

Prawn trawlers generally tip their catch into a hopper system full of sea water, which increases the survival rates of by-catch that is subsequently discarded. The contents of the hopper trickle onto a conveyer belt system where the retained catch is sorted from the by-catch. Discarded by-catch is returned directly to the water from the conveyer system. Vessels without hoppers sort through the catch by hand.

The prawns are then graded into sizes before being either cooked and frozen, or frozen raw, and placed into a freezer in cartons ready for unloading. Between 1997/98 and 2005/06, a large proportion of South Australian prawn catch was exported overseas (EconSearch 2012), the majority of prawn product has been sold on the domestic market since this period.

3.1.4 Management history

Commercial prawn fishing for Western King Prawns in the GSVPF started in 1967. The fishery has had a complicated history with zone changes, jurisdiction moving to the Commonwealth Government and then back to the State of South Australia, and changes in the number of licences in the fishery.

In 1968, the then Department of Fisheries closed all South Australian waters to trawling and offered permits for fishing in waters greater than 10 metres within different management zones. The *Preservation of Prawn Resources Regulations 1969* were introduced with vessels being licensed to fish for Western King Prawns. The fishery was divided into geographical zones and licences issued to operate within specific zones (Table 3).

In its early years, the GSVPF was developed as a single fishery with operators permitted to fish all waters of GSV and Investigator Strait (between Kangaroo Island and the mainland). In 1975, a High Court decision established the Investigator Strait to be under Commonwealth jurisdiction, being outside of the three nautical mile limit of State waters. With the mixed jurisdiction, five operators were entitled to fish State and Commonwealth waters and three entitled to fish the Commonwealth waters only from 1977 until 1981. At that time, one of the dual State and Commonwealth fishers surrendered his entitlement. By 1982, the number of fishers was further reduced to two, after an agreement between the governments that the Commonwealth would not renew the fishing permits for this area. Subsequently, jurisdiction over the region was transferred from the Commonwealth to the State in February 1983. The Investigator Straits continued to be managed separately until the 1986/87 licensing year. In April 1987 the State Government introduced the *Fisheries (Gulf St Vincent Prawn Fishery Rationalisation) Act 1987*, removing six licences through a buy-back system. Two further licences were removed between 1987 and 1990, leaving the current ten licences in the fishery (Table 3).

The commercial catch in 2010/11 was 189 t; the third lowest since the fishery was closed in 1991/92 and 1992/93, with only 1994/95 and 2003/04 being lower. As a result PIRSA introduced a number of initiatives during 2011/12 to improve industry flexibility as well as environmental performance of the fishery.

Catches declined further in 2011/12 to 131 t, with survey catch rates declining over this period to a level similar to when surveys began in 2004/05. In December 2012 the fishery was closed at the request of all ten licence holders due to poor economic performance. The fishery reopened in November 2014.

Table 2: A chronology of major milestones in the Gulf St Vincent Prawn Fishery.

Date	Management Change
1967	Commercial prawn fishing commences in Gulf St Vincent
1968	All South Australian waters closed to trawling except for specific managed zones for which permits are offered and all waters less than ten metres are closed to trawling
1969	The *Preservation of Prawn Resources Regulations 1969* is introduced and vessels licensed to fish for prawns
1975	The fishery is split into two zones when five permits are issued to specifically fish in Investigator Strait
1982	Number of Investigator Strait zone fishers reduced to two
1982	Triple rig trawl nets introduced
1986	A review of management was completed by Prof. Parzival Copes
1986	A licence rationalisation strategy was implemented as an outcome of the review
1987	The *Fisheries (Gulf St Vincent Prawn Fishery Rationalisation) Act 1987* is introduced
1987	The two Investigator Strait entitlements removed and four Gulf St Vincent licences removed over the following four years and the two zones are once again amalgamated
1990	Prof. Parzival Copes was requested to complete his second review of the fishery
1991	Fishery closed in June
1991	A Select Committee of the House of Assembly of South Australia reviewed the fishery's management options
1994	The fishery re-opened in February
1995	A review of the fishery was conducted by Dr Gary Morgan
1997	First Management Plan for the fishery was introduced
2000	*Fisheries (General) Regulations 2000* enabled "large" vessels to enter the fleet
2007	The second Management Plan was implemented
2011	A review of the fishery was undertaken by Cobalt Marine Resource Management Pty Ltd
2012	The fishery was closed in November by unanimous agreement of industry
2013	Morgan & Cartwright completed a review of the fishery management framework
2014	The fishery was re-opened in November under a new management framework

Table 3: Number of licences issued in the Gulf St Vincent Prawn Fishery from 1969 to 2006.

Period	Gulf St Vincent	Investigator Strait	Total
1969	5	-	5
1970 – 1973	10	-	10
1974	12	-	12
1975 – 1976	12	5	17
1977 – 1979	14	8	22
1980 – 1981	14	6	20
1982 – 1986	14	2	16
1987	10	2	12
1988 – 1989	11	-	11
1990 – 2006	10	-	10

3.1.5 Current management

The commercial fishery management is aimed at using a mix of input controls, matching harvesting capacity with resource availability and promoting stock recovery (Table 4).

An independent review of the GSVPF management framework in 2013 by Dr Gary Morgan and Mr Ian Cartwright (unpublished) found that rationalisation and restructure are required for the fishery to realise its potential. This is partly due to a decline in the economic performance of the fishery resulting from declining catches, a high Australian dollar, prawn price decreases due to the increased competition from imported farmed prawns and increasing operation costs.

Due to these findings a proposal was developed on the longer term harvest strategy and management framework to improve economic performance, based on recommendations from an independent review. The management framework was developed with stakeholder input and implemented in November 2014, when the fishery reopened from a two year closure. This framework is outlined in the management plan for the fishery.

The management framework developed for the GSVPF received support from the majority of licence holders, including an individual transferrable effort (ITE) system, which adopts transferrable nights as the effort unit, until 2016/17 with a total allowable commercial effort (TACE), in the form of fishing nights, set for each fishing season, starting on 1 November each year and finishing on 31 July. From 2017/18 an individual transferrable quota (ITQ) system would be implemented, providing industry with an effective property right to harvest prawns, providing an incentive for responsible fishing practices.

The TACE is used to calculate the number of units required to fish a whole night, the trade of units between the licence holders is allowed on a temporary and permanently basis.

The framework allows for two classes of units; Class A (all year) and Class B (post-Christmas). The two unit types are used to limit the amount of fishing that can occur before Christmas (between 1 November and 24 December). This is designed to protect the spawning biomass while spawning is occurring.

A system to allow the amalgamation of fishing licences has also been implemented to aid in the fishery restructure by allowing licence holders to increase their efficiency, if they choose, by using triple rig gear with a bigger headline length as long as their unit holding is above a certain level. If a licence holder chooses to use this gear type, and meets the set criteria, their unit holding is decreased by a set percentage to allow them to only catch the same amount of prawn as other operators but savings can be found through fishing less nights for the same catch.

The management framework for the GSVPF also contains rules on boat lengths, the number of rigged trawls and the continuous braked horsepower. For more information on the different configurations that are allowed please check the *Fisheries Management (General) Regulations 2007 and the Fisheries Management (Prawn Fisheries) Regulations 2006*.

Table 4: Management arrangements for the Gulf St Vincent Prawn Fishery for the 2014-15 fishing season

Management tool	Current restriction
Permitted species	*Melicertus latisulcatus, Ibacus spp* and *Sepioteuthis australis*
Licensing year	1 November – 31 July
Limited entry	10 licences
Method of capture	Demersal otter trawl
Licence transferability	Permitted
Corporate ownership	Permitted
Effort scheme (ITE)	Yes
Unit transferability	Yes – permanently and temporarily
Total Allowable Commercial Effort (2014-15)	300 fishing nights (50 pre-Christmas and 250 post-Christmas)
Spatial closures	Yes
Temporal closures	Yes
Maximum vessel length	22 metres
Maximum vessel power	336 kilowatts
Monitoring tool	**Requirement**
Catch and effort data	Daily logbook submitted within 48 hrs upon landing
Catch and Disposal Records	Unloading logbook submitted within 48 hrs upon landing
Prior to fishing reports	2 hrs prior leaving port and 1 hr prior to fishing any night after leaving port
Prior to landing reports	2 hrs prior unloading to designated area or 3 hrs prior unloading to other

3.1.6 Catch and effort reporting

Commercial catch and effort data are fundamental to undertaking fishery assessments in State fisheries, which are important to inform policy and management decisions. While in recent years fishery independent surveys have been used to inform the main fishery performance indicators, commercial catch and effort data has still been collected.

The daily and unloading catch and effort data are provided by licence holders through compulsory logbook returns to South Australian Research and Development Institute (SARDI) Aquatic Sciences within 48 hours of unloading at the end of a trip. SARDI Aquatic Sciences maintain the data in a comprehensive database for the fishery. Copies of the unloading logbook are sent to PIRSA Fisheries and Aquaculture for the calculation of the number of unit entitlements that are used per trip.

Data provided in the logbook returns include: licence information, date(s), shot number, fishing block number, trawl start/end time (duration), GPS location, estimated catch (retained), depth, and size grade information.

Licensed fishers report any fishing interactions with threatened, endangered and protected species to PIRSA Fisheries & Aquaculture by filling out a 'Wildlife interaction identification and logbook' form and returning it to SARDI Aquatic Sciences for collation and reporting purposes.

3.1.7 Legislation

The legislation that governs the management of the GSVPF is the *Fisheries Management Act 2007* (the Act) and subordinate regulations *Fisheries Management (General) Regulations 2007* and *Fisheries Management (Prawn Fisheries) Regulations 2006*.

The Act provides the broad statutory framework to provide for the conservation and management of South Australia's aquatic resources. In the administration of the Act, the Minister for Agriculture, Food and Fisheries must pursue the following relative objectives, outlined in section 7 of the Act:

(1) An object of this Act is to protect, manage, use and develop the aquatic resources of the State in a manner that is consistent with ecologically sustainable development and, to that end, the following principles apply:

(a) proper conservation and management measures are to be implemented to protect the aquatic resources of the State from over-exploitation and ensure that those resources are not endangered;

(b) access to the aquatic resources of the State is to be allocated between users of the resources in a manner that achieves optimum utilisation and equitable distribution of those resources to the benefit of the community;

(c) aquatic habitats are to be protected and conserved, and aquatic ecosystems and genetic diversity are to be maintained and enhanced;

(d) recreational fishing and commercial fishing activities are to be fostered for the benefit of the whole community;

(e) the participation of users of the aquatic resources of the State, and of the community more generally, in the management of fisheries is to be encouraged.

(2) The principle set out in subsection (1)(a) has priority over the other principles.

(3) A further object of this Act is that the aquatic resources of the State are to be managed in an efficient and cost effective manner and targets set for the recovery of management costs.

(4) The Minister, the Director, the Council, the ERD Court and other persons or bodies involved in the administration of this Act, and any other person or body required to consider the operation or application of this Act (whether acting under this Act or another Act), must –

(a) act consistently with, and seek to further the objects of, this Act; and

(b) insofar as this Act applies to the Adelaide Dolphin Sanctuary, seek to further the objects and objectives of the Adelaide Dolphin Sanctuary Act 2005; and

(d) insofar as this Act applies to areas within a marine park, seek to further the objects of the Marine Parks Act 2007.

(5) For the purposes of subsection (1), ecologically sustainable development comprises the use, conservation, development and enhancement of the aquatic resources of the State in a way, and at a rate, that will enable people and communities to provide for their economic, social and physical well-being while –

(d) sustaining the potential of aquatic resources of the State to meet the reasonably foreseeable needs of future generations; and

(e) safeguarding the life-supporting capacity of the aquatic resources of the State; and

(f) avoiding, remedying or mitigating adverse effects of activities on the aquatic resources of the State,

(taking into account the principle that if there are threats of serious or irreversible damage to the aquatic resources of the State, lack of full scientific certainty should not be used as a reason for postponing measures to prevent such damage).

3.2 Biology

3.2.1 Western King Prawns

Prawns are crustaceans with five pairs of swimming legs (pleopods) as well as five pairs of walking legs (pereiopods) with the front three having claws. They are nocturnal and burrow into the seabed during the day and emerge at night to feed.

Adult Western King Prawns aggregate, mature, mate and spawn in deep water between October and April, with the main spawning period between November and February. Females may spawn on multiple occasions during one season. During the peak spawning period, females tend to be more prevalent in the catch, due likely to increased feeding activity associated with ovary development. At other times the catch is generally male biased. Larger female prawns are proportionally more fecund than smaller prawns. Further, the proportion of female prawns with fertilized eggs increases with size. Therefore, the combination of the short spawning season, increased catchability of females, disproportionate fecundity levels and varying fertilization success, means that the harvest of prawns, particularly larger size classes of females, during the peak spawning period has substantial implications on recruitment to the fishery and thus sustainable management.

Whilst adult *M. latisulcatus* have an offshore life phase, the juvenile phase is spent in shallow near-shore environments generally associated with mangroves and/or tidal flats. Prawn larvae undergo metamorphosis through four main larval stages: nauplii, zoea, mysis and post-larvae. The length of the larval stage depends on water temperature, with faster development in warmer water (Hudinaga 1942).

Post-larvae settle in inshore nursery areas when 2–3 mm carapace length (CL) and can remain there for up to 10 months, depending on the time of settlement (Carrick 1996). The post-larvae produced from early spawning events settle in nursery areas during December or January where they grow rapidly and then emigrate to deeper water in May or June. Alternatively, post-larvae produced from spawning after January settle in nurseries from March and then grow slowly. They "over-winter" (prawns do not recruit into the fishery before winter and have limited growth during the colder months and recruit into the fishery the following season) in nursery areas before recruiting to trawl grounds in February the following year (Carrick 2003). The effects of over-wintering on adult growth and survival are not fully understood.

Growth of the Western King Prawn in GSV is highly seasonal and increases with increasing temperature. The highest growth period is immediately after the spawning period is completed, as prawns reduce the energy spent on reproduction. Female prawns grow faster and attain a larger maximum size than males.

3.2.2 Distribution and stock structure

The Western King Prawn is distributed broadly throughout GSV. It is a benthic species that prefers sand or mud sediments to seagrass or vegetated habitats (Tanner & Deakin 2001). Adults tend to inhabit waters greater than 10 metres depth and are harvested in depths of up to 45 metres in the Investigator Straits.

Although prawns are broadly distributed throughout the gulf, commercial effort tends to be concentrated in areas with large prawns at high density. During the past decade there have been no clear trends in the spatial distribution of catches throughout GSV (Dixon et. al. 2006). Of note, catches from the northern regions of GSV have been low compared to other regions. Anecdotal evidence from fishers suggests that this represents a major shift in the distribution of effort for the fishery, where a high proportion of the catch was previously removed from northern GSV in the 1970's and 1980's.

3.2.3 Southern Calamari and Balmain Bugs

In GSV, Southern Calamari are spatially segregated into an offshore nursery ground and inshore spawning grounds (Steer et al. 2007), having a seasonal, systematic distribution that starts at Kangaroo Island in spring and ends up at Edithburgh during late winter, travelling anti-clockwise (Steer et. al. 2006). These patterns were closely attributed to spawning behaviour and water clarity. Detailed studies on the general and reproductive biology of calamari in GSV are presented by Steer et al. (2006).

Balmain Bugs are commonly referred to as a Bug or Slipper Lobster, of seven species found in Australia *Ibacus peronii* was the only species of slipper lobster captured in recent studies on by-product from the GSVPF (Dixon et al. 2006). *Ibacus peronii* inhabits depths of 4–288 m (Brown & Holthuis 1998). It is long-lived, with low fecundity compared to other lobsters in the Scyllarid family (Stewart & Kennelly 1997, Stewart & Kennelly 2000). Whilst little is known of its biology in Spencer Gulf, it exhibits limited movement patterns in NSW (Stewart & Kennelly 1998).

Only one other species of bug, *I. alticrenatus*, has been identified in South Australian waters, however it is unlikely to be captured by GSV prawn fishers as it inhabits water depths greater than those fished (depth range: 82–696 m, (Brown and Holthuis 1998).

3.3 Ecosystem and habitat

3.3.1 Coastal habitats

Dixon et al. (2006) presented analyses of habitat types associated with GSV coastal habitats from data presented in Bryars (2003). These analyses concentrated on the habitat types crucial to prawn recruitment, particularly tidal flats and mangrove habitats that were associated with tidal flats.

The GSV coastline was estimated as 551 km in total length, of this, 225 km (41%) was tidal flat only and 79 km (14%) was mangrove forest associated with tidal flat. Far Northern GSV (~31 km of tidal flat only and 47 km of mangrove forests (+ tidal flat)) and Port Adelaide (~41 km of tidal flat only and 32 km of mangrove forests (+ tidal flat)) were the areas with the highest abundance of these habitat types (Dixon and Sloan 2007).

The estimated proportion and distance of coastline of tidal flat only and mangrove forest associated with tidal flat for the GSV coastline (Dixon et. al. 2006).

3.4 Current status of the fishery

The Status of key Australian fish stocks reports 2012 produced by the Fisheries Research and Development Corporation classified the stock as sustainable, based on survey results and the amount of commercial catch in 2010 (Flood et al. 2012).

The status of the fishery is comprehensively assessed and reported in each fishing year by SARDI Aquatic Sciences. The most recent available report was published in May 2012 and relates to the 2010/11 fishing season (Dixon et al. 2012). This report states that due to recent management arrangement changes there has been considerable impact on the assessment of the fishery which has resulted in increased uncertainty in the status of the resource for at least the next two years (Dixon et al. 2012)

The primary measures for stock status in GSV has been the average catch rates obtained during fishery-independent surveys conducted in December, March, April and May, which were used as indices of relative biomass. These performance indicators have used the survey catch rates as a proxy for relative biomass, were considered to be at or above maximum sustainable yield (MSY). It was considered that maintaining catch rates above the historical minimum level will ensure adequate egg production for the fishery. The survey design was reviewed as part of the new management framework and harvest strategy.

3.5 Research

3.5.1 Fishery independent data collection

Fishery independent surveys using commercial vessels have been conducted in the GSVPF prior to December, March, April and May harvest periods from 2004/05 to 2010/11 (Dixon et al. 2012). Due to the high research costs of undertaking numerous surveys, PIRSA Fisheries and Aquaculture developed a new management framework for the reopening of the fishery for the 2014/15 fishing season. The associated harvest strategy was in development at the time of writing this management plan, during the harvest strategy development, reducing the number of fishery independent surveys per year and using commercial fishery dependent data will be considered.

3.5.2 Bycatch survey

A bycatch survey program was designed and initiated in 2009/10, including the collection and storage of bycatch data obtained during the March 2010 fishery independent survey. Due to the fishery being closed in December 2012 the data analysis and reporting of the bycatch survey was postponed. With the fishery reopening in 2014, future bycatch research needs to consider the remaining analysis and reporting requirements to finalise a bycatch survey conducted in 2010/11.

3.5.3 Bio-economic model

During 2014 SARDI Aquatic Sciences undertook a research project to develop a bio-economic model for both GSVPF and the Spencer Gulf Prawn Fishery. It is expected, when the model is finalised, the outputs from the model will be used to inform the setting of TACE and total allowable commercial catch (TACC) levels in the fishery. At the time of writing the ESD risk assessment report the model had not been finalised.

4. Methodology

4.1 ESD reporting framework

The issue of identification, risk assessment, and performance reporting of the non-species components in this report is closely based on the National ESD framework 'how to' guide for Australian fisheries developed by Fletcher et al. (2002) and supporting resources found on the website http://www.fisheries-esd.com.

Scoping work to identify the majority of management issues facing the fishery and to prepare ESD component trees was carried out by the fisheries manager, scientists, and industry prior to a stakeholder's workshop. The component trees were prepared by modifying generic component trees (used in conjunction with the 'How to' guide of Fletcher et al. (2002), accessed at the website http://www.fisheries-esd.com/c/implement/implement0200.cfm) with issues that are specific to the GSVPF.

In June 2013, PIRSA conducted an ESD risk assessment workshop and invited key stakeholders of the GSVPF, engaging an independent facilitator to run the workshop.

The key steps undertaken at the ESD stakeholder workshop were:

1. Prior to assigning risks, each of the fishery-specific component trees (for retained species, non-retained species, general ecosystem, community wellbeing, governance, and external factors affecting fishery performance) were presented to stakeholders for either confirmation or modification before systematically assigning a risk rating to each identified issue.

2. Based upon the combination of likelihood and consequence of events that may undermine or alternatively contribute to ESD objectives, a risk rating is generated for each of the identified issues at the lowest branches of the component trees. This was a process involving managers, scientists, industry and key stakeholders at the workshop.

3. Each risk rating was converted to a colour-coded risk category, which was then prioritised according to a scale of severity. For higher level risks a detailed analysis of the issue, associated risks, and preferred risk management strategies was completed. For low risk issues, the reason(s) for assigning low risk and/or priority were recorded.

4. 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, performance measures, and preferred management responses.

5. Finally this report was prepared, which includes a detailed fishery-specific background to guide the identification of issues, risks and management strategies.

4.1.1 Scope

This ESD risk assessment report describes the contribution of the GSVPF to ESD in the context of South Australian fisheries legislation and policy. The actual risk assessment is based on preliminary scoping work (much of which is contained in the background section earlier) and issues identified by PIRSA Fisheries and Aquaculture staff in conjunction with GSVPF industry representatives. The identification of issues was guided by the generic ESD component trees to include issues that were applicable to the GSVPF.

Each fishery-specific component tree is developed to ensure consistency with ESD principles and, as such, the ESD report assesses the performance of the fishery for up to seven components (within three categories), each of which focus on ecological, economic, social or governance issues facing the fishery (Table 5). 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 5: Components of the national ESD reporting framework for Australian fisheries.

Category	Component
Contributions of the fishery to ecological wellbeing	Retained species
	Non-retained species
	General ecosystem
Contributions of the fishery to human wellbeing	Aboriginal community
	Community wellbeing
Factors affecting the ability of the fishery to contribute to ESD	Governance
	External factors affecting fishery performance

4.1.2 Process

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

1. A set of 'generic ESD component trees' were modified into a set of trees specific to the fishery through consultation with stakeholders. This process identified the issues relevant to ESD performance of the fishery under the categories described in Table 5 above.

2. This assessment requires determination of two factors for each issue within the fishery: the potential consequence arising from an issue, then the likelihood that this consequence will occur. The combination of consequence and likelihood produce an estimated level of risk associated with the issue that may undermine or alternatively contribute to ESD objectives (Table 7). This process involved managers, scientists, industry and other key stakeholders at a one-day workshop held on 4 March 2015 in Adelaide dedicated to this purpose (participants at the workshop are listed in Appendix 8.1, Table 11).

3. Components were prioritised according to their risk. For higher-level risks, an increase in management or research attention was considered necessary, involving a detailed analysis of the issue, associated risks, and preferred risk management strategies were completed to reduce the risk to an acceptable level. For low risk issues, the reasons for assigning low risk and/or priority were recorded.

4. For higher level risks a full ESD performance report was prepared (section 5.1 of this report). This was completed in the context of specific management objectives and includes operational objectives, indicators and performance measures (Table 9).

5. A background report providing context and necessary supporting information about the fishery was also prepared to guide the identification of issues, risks and management strategies. This report includes a description of the fishery, retained and non-retained species, the history of the fishery and its management, biological and physical characteristics, and other relevant information.

This process is also illustrated in Figure 2.

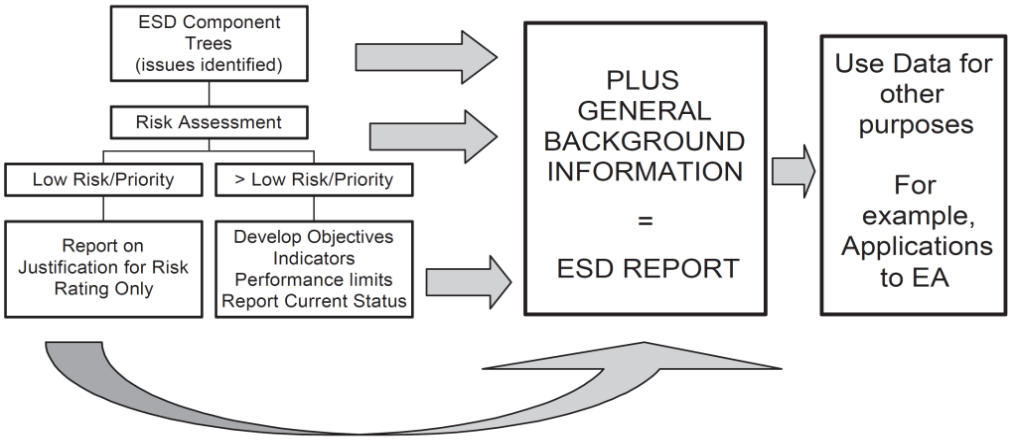

Figure 2: Summary of the ESD reporting framework process (source: Fletcher et al. 2002).

4.1.3 Issue identification (component trees)

The ESD reporting component trees for the GSVPF are a refined version of the generic trees intended to be used in conjunction with the 'How to' guide of Fletcher et al. (2002). The generic trees and the issues that they encompass were the result of extensive consideration and refinement during the initial development of the national ESD approach for wild capture fisheries. The trees were designed to be very comprehensive to ensure that all of the conceivable issues facing a fishery would be considered during the workshop process. The fishery-specific component trees developed after expert and stakeholder consideration provide a more realistic and practical illustration of the issues facing a particular fishery.

The generic component trees have been used as the starting point to ensure thorough, consistent, and rigorous identification and evaluation of ESD issues across all of the South Australian fisheries being assessed. When developing each of the major fishery-specific component trees, each primary component is broken down into more specific sub-components for which operational objectives can then be developed (Figure 3).

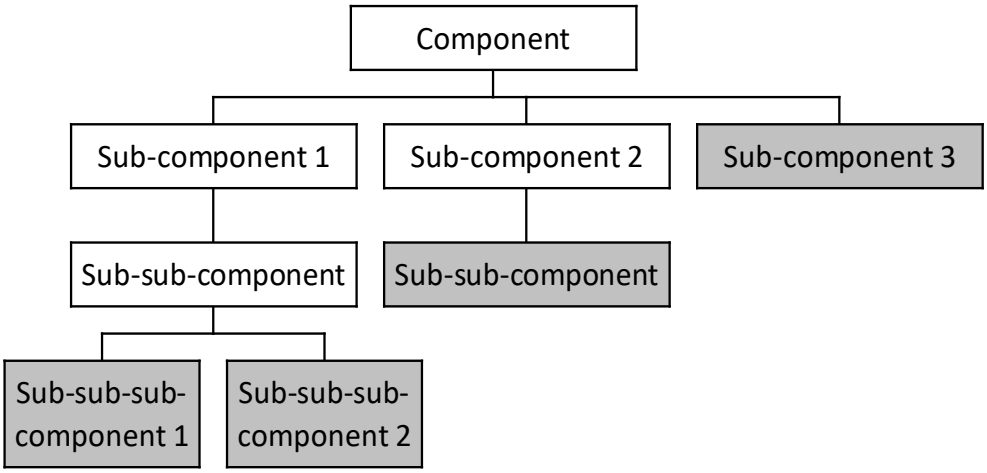

Figure 3: Structure of component trees used in the ESD reporting framework (found in an information package used in conjunction with Fletcher et al. (2002).

4.1.4 Risk assessment and prioritisation of issues

Once the major fishery-specific component trees were finalised, the focus moved to the assessment and prioritisation of risks and opportunities facing the fishery. These have been considered in the context of the specific management objectives for each fishery being assessed. The higher level management objectives and desired ESD outcomes are those described in the Act. Risks and opportunities are also evaluated against more detailed fishery-specific objectives - such as those articulated in the management plan for the GSVPF.

The development of the risk levels for the GSVPF used likelihood and consequence scores based on the current management of the fishery. Hence the risk assessment conducted during the stakeholder workshop on 4 March 2015 considered the management framework introduced in late 2014 but not the harvest strategy because it was yet to be implemented at the time the workshop was held.

What is risk analysis?

'*Risk analysis involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur' (AS/NZS 4360:1999).*

A risk assessment applied under the national ESD framework was designed to be consistent with the Australian and New Zealand Standard AS/NZS 4360:1999 for risk management (AS/NZS 4360-1999 has since been superseded by AS/NZS 4360:2004, which was then superseded by AS/NZS ISO 31000:2009). Subject matter experts and key fishery stakeholders consider the range of potential consequences of an issue, activity, or event (identified during the

component tree development process) and how likely those consequences are to occur. The estimated consequence of an event is multiplied by the likelihood of that event occurring to produce an estimated level of risk.

ESD workshop participants worked methodically through each component tree from the top down and conducted a qualitative risk assessment of each issue. An estimate of the consequence level for each issue was made and scored from 0–4 based on scoring criteria, with 0 being negligible and 4 being high (Appendix 8.2).

The level of consequence was estimated at the appropriate scale and context for the issue in question. For the target species (Western King Prawn) the consequence assessment was based at the stock level not the individual level. For example, the death of one prawn is catastrophic for the individual but not for the stock. Similarly, when assessing possible ecosystem impacts this was done at the level of the whole ecosystem or at least in terms of the entire extent of the habitat, not at the level of an individual patch, or individuals of a non-target species.

The likelihood of that consequence occurring was scored from 0-4, with 0 being negligible and 4 being likely (Appendix 8.2). This was based on a judgment about the probability of the events, or chain of events, occurring that could result in a particular adverse consequence. This judgment about conditional probability was again based on the collective experience and knowledge of workshop participants.

From the consequence and likelihood scores, the overall risk value was calculated (i.e. risk = consequence x likelihood). The calculated risk values were then linked to one of the colour-coded risk categories, the relationship for which is illustrated by a risk matrix (Table 6).

Based on a reviewed and refined method for application of the risk assessment (Fletcher & Bianchi 2014) the component trees for General Community, Governance and External Factors were assigned a risk level based on the available evidence rather than applying the consequence x likelihood process.

Table 6: Risk matrix of consequence and likelihood, the numbers in the cells indicate the risk value, and the colours indicate risk categories (table should be matched with Table 7).

		Consequence Level				
Likelihood Levels		Negligible	Minor	Moderate	Major	Extreme
		0	1	2	3	4
Negligible	0	0	0	0	0	0
Remote	1	0	1	2	3	4
Unlikely	2	0	2	4	6	8
Possible	3	0	3	6	9	12
Likely	4	0	4	8	12	16

4.1.5 Reporting requirements

The national ESD reporting framework suggests that only those issues scored at moderate or high, which require additional management attention, need to have full ESD performance reports completed. This is the approach that has been adopted by PIRSA in the preparation of fishery ESD reports. The rationale for scoring other issues as low or negligible risk is also documented and form part of these reports. This encourages transparency and should help stakeholders to understand the basis for risk scores and the justification for no further management, or for additional management action if necessary. Components with additional management action required are outlined in Table 9, with the action linked to the related GSVPF management plan.

Table 7: Relationship between risk value, risk category, management response 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
Moderate	6-8	Specific Management/ Monitoring Needed	Full Performance Report
High	9-16	Increased Management Activities Needed	Full Performance Report

As noted above, a comprehensive ESD performance report has only been prepared for higher risk/priority issues that require additional management attention (section 5.3). The content of these reports is based on standard subject headings recommended in Fletcher et al. (2002).

The full performance report for the GSVPF was developed by PIRSA Fisheries and Aquaculture, informed by the initial consultation with industry and then broader stakeholders at the stakeholder workshop on 4 March 2015. This ESD report was released for industry and other stakeholder comments before it is finalised.

4.2 Stakeholder engagement process

A recognised part of conventional risk assessment is the participation of stakeholders involved in the activities being assessed. Stakeholders can make an important contribution by providing expert judgment, fishery-specific and ecological knowledge, and process and outcome ownership. Stakeholders were able to input into the ESD risk assessment process with personnel from a varied background being invited to the ESD stakeholder workshop and through the public submission period of the Management Plan for the South Australian Commercial Gulf St Vincent Prawn Fishery where the moderate to high risk scores were incorporated in the plan.

4.3 Subsequent ESD risk assessments

The frequency at which each fishery must revise and update the ESD risk assessment is not fully prescribed; however, it is anticipated that the main drivers for determining the need for further assessment(s) would include, but not necessarily be limited to:

- Preparation of a new management plan for the GSVPF before the expiry of the management plan that is currently being developed; and
- Any related conditions/recommendations placed upon the GSVPF, its research and/or management following assessment by Commonwealth Department of the Environment in order to meet ecologically sustainable fisheries management requirements.

As management arrangement changes occur, or new information arises, in the GSVPF, reassessment of any components (or component trees), issues or risks may be undertaken whenever the Minister considers it necessary. As with this ESD risk assessment report, PIRSA may take ownership of this process, and scientific consultants may be engaged. In any case, the assessment process should again involve stakeholders to maintain transparency.

5. Results

5.1 ESD risk assessment outcomes

Note that the following risk assessments include a summary of comments from individual stakeholders at the workshop in dot-point form; these comments are a summary of individual views and may not be representative of all stakeholders at the workshop.

The risk ratings are reflective of the group consensus in the workshop, unless otherwise stated.

5.1.1 Retained species

Western King Prawn (*Melicertus latisulcatus*)

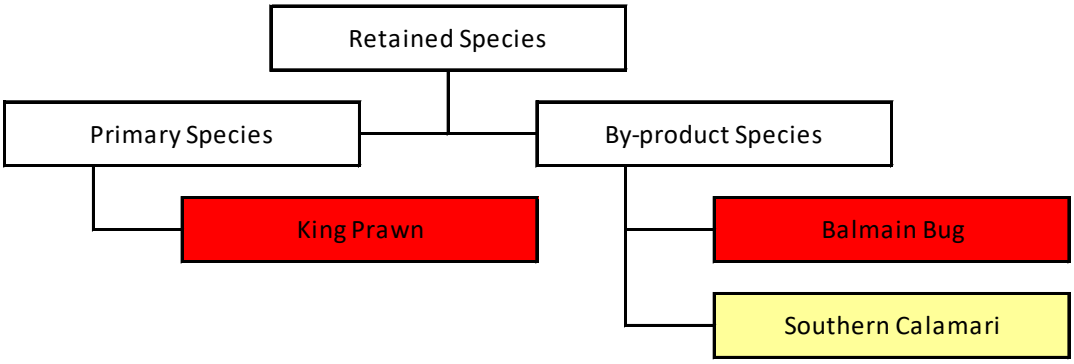

Figure 4: Retained species component tree for the Gulf St Vincent Prawn Fishery. See Table 7 for explanation of colour-coded risk categories.

- The GSVPF was closed in December 2012 due to poor economic performance
- The stock assessment advice produced by SARDI in March 2013 indicated the GSV Prawn stock as 'transitional depleting', based on a weight of evidence approach
- A fishery survey was completed in May 2014, the results of the survey showed signs of stock recovery
- Due to the results of the May 2014 survey, the fishery was reopened under a new management framework in November 2014
- The new management framework includes;
    - Individual transferrable effort unit system based on allocated fishing nights
    - Other controls - limited entry, temporal fishing restrictions, restrictions on the type and size of fishing gear allowed, and limited area of waters
- The reopening of the fishery for 2014/15 included the allocation of 300 fishing nights to the fishery with 50 of these allocated for fishing prior to Christmas
- The harvest strategy was still in development at the time of holding the ESD risk assessment workshop on 4 March 2015
- The St Vincent Gulf Prawn Boat Owner's Association have a code of conduct with voluntary arrangements, including spatial arrangements and Western King Prawn size criteria
- Western King Prawns grow rapidly and live for 4 to 5 years; Western King Prawns can be selected by trawl gear from 2 years old and mainly spawn between November and February each year
- Consequence: 3, Likelihood: 4, Risk rating: 12 (high)

Balmain Bug (*Ibacus* spp)

- Byproduct in the GSVPF
- The species is long-lived, slow growing, has relatively low fecundity and exhibits limited movement, together with its localised life-history strategy suggest that this species may be vulnerable to over-fishing (Shepherd et al. 2008)

- Berried Balmain Bugs are returned to the water, plus many others are returned (i.e. depending on marketability, not all legal-size bugs are kept)
- Survey catch rates in the Spencer Gulf Prawn Fishery were likely to be indicative of localised depletion of Balmain Bugs across the high and medium trawl effort areas (Roberts and Steer 2010)
- Since the finding in Roberts and Steer (2010) the Spencer Gulf Prawn Fishery introduced a minimum size length based on 50 per cent of female Balmain Bugs being able to reach physiological maturity (size at sexual maturity). It is also recognised the data set used to calculate the size at sexual maturity was negatively biased due to samples being collected outside of the spawning period
- '*By-product assessment in the Spencer Gulf Prawn Fishery with an emphasis on developing management options*' report by Roberts and Steer (2010) suggests a size limit would be an appropriate management measure, ensuring at least 50% of female bugs breed at least once
- The report calculated this size of sexual maturity at 113 mm carapace width
- There is no size limit on Balmain Bugs at the time of writing this report
- Industry stakeholders at the ESD workshop suggested there has been a decrease in the stock since the inception of the fishery
- Consequence: 3, Likelihood: 4, Risk rating: 12 (high)

Southern Calamari (*Sepioteuthis australis*)

- Byproduct in the GSVPF
- Southern Calamari catches are not well understood in the GSVPF because catches were only required to be recorded in logbooks since December 2005 (Shepherd et al. 2008)
- The life span of Southern Calamari is thought to be less than one year, with the largest animal from the GSV being aged 280 days old (Shepherd et al. 2008)
- Southern Calamari are found across southern Australia from Dampier in Western Australia to Moreton Bay in Queensland, including Tasmania (PIRSA 2013)
- Southern Calamari are multiple spawners, with continuous egg production in mature females (Shepherd et al. 2008)
- The species is a major recreational fishery and targeted in the Marine Scalefish Fishery by both jigging and haul netting, catch rates of both methods have increased and have been relatively stable over the last 20 years for the two methods, respectively (Fowler et al. 2014)
- The Marine Scalefish Fishery monitors numerous performance indicators and reference points for the Southern Calamari stock (Fowler et al. 2014)
- The GSVPF has an allocation trigger of 0.45% for Southern Calamari, the triggers are monitored and were not breached in the most recent analysis (Fowler et al. 2014)
- Consequence: 1, Likelihood: 3, Risk rating: 3 (low)

5.1.2 Non-retained species

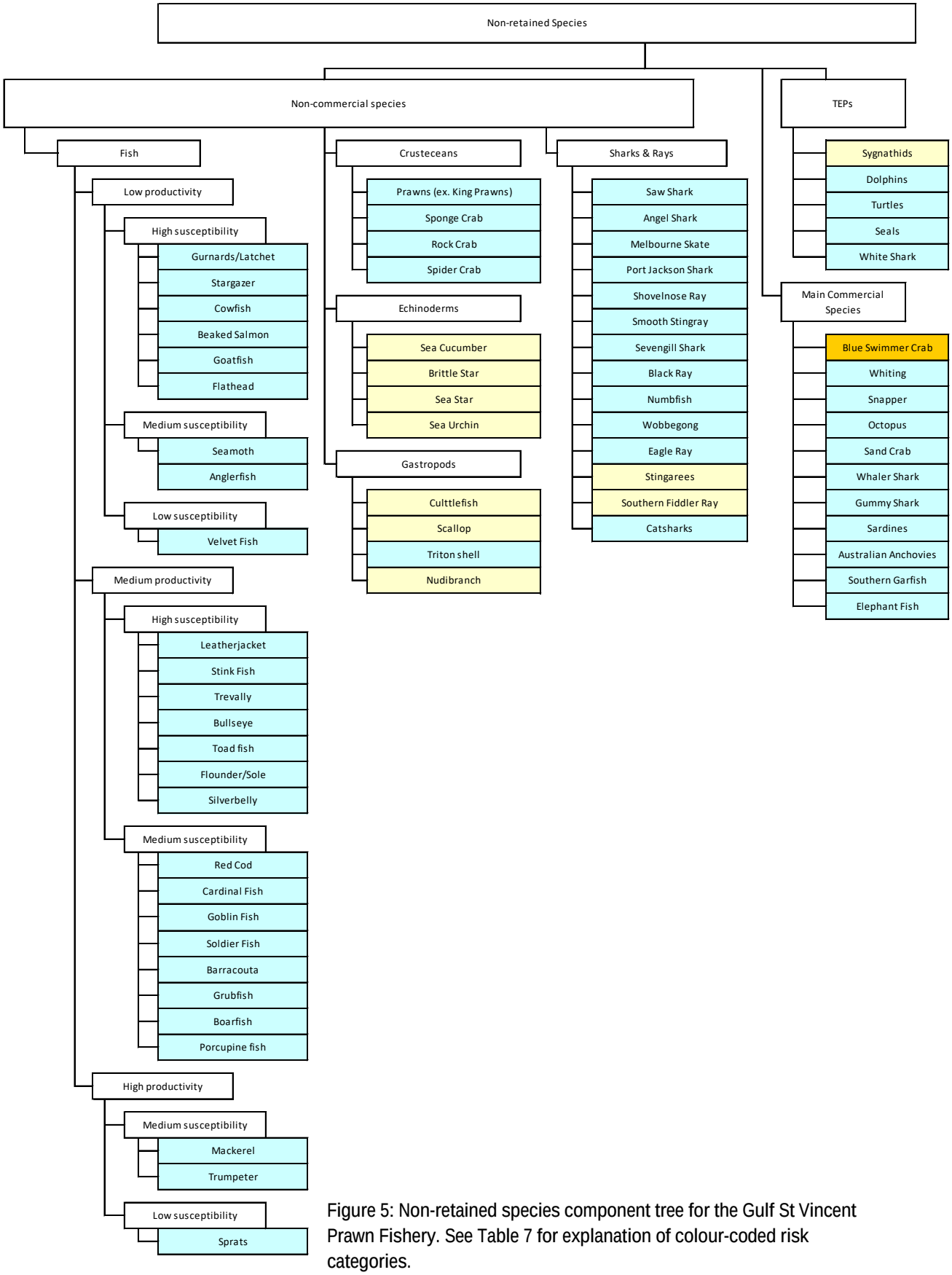

Figure 5: Non-retained species component tree for the Gulf St Vincent Prawn Fishery. See Table 7 for explanation of colour-coded risk categories.

The ESD workshop noted that for all non-retained species there was a lack of information to hold a detailed discussion on each species. Participants agreed that the finalisation of a bycatch study in the fishery, and other possible research, could improve our understanding of these species.

Due to the lack of information ESD workshop participants agreed the best approach was to assign risks based on the discussion of the best available information. The workshop agreed that when new data becomes available it would be useful to update the ESD risk assessment.

GSVPF handling practices, including the use of a hopper system was considered highly important in reducing the post capture mortality of all non-retained species. It has been shown hoppers can contribute significantly to improving short-term bycatch survival. They produce less mortality due to their mode of operation, and enable the discard of bycatch back to sea in the shortest turn-around time. A greater number and diversity of animals appeared to survive (Dell et al. 2003)

The use of the T90 cod end and the bycatch reduction devices were introduced in March 2012. FRDC project 2009/069 showed with the adoption of the new gear technologies the bycatch in the fishery will potentially be significantly reduced (Dixon et al. 2012)

Fish, low productivity and high susceptibility

Gurnards / Latchets, Stargazers, Cowfish, Goatfish and Flathead

- The ESD risk assessment workshop considered the bycatch reduction device combined with the T90 cod end would be effective to minimise catch for these species
- Consequence: 1, Likelihood: 2, Risk rating: 2 (negligible)

Beaked Salmon

- The ESD risk assessment workshop considered the bycatch reduction device combined with the T90 cod end would be more effective for this species and therefore the likelihood was lower
- Consequence: 1, Likelihood: 1, Risk rating: 1 (negligible)

Fish, low productivity, and medium and low susceptibility

Seamoth, Anglerfish and Velvet Fish

- Bycatch reduction device and T90 cod end would reduce catch
- Consequence: 1, Likelihood: 1, Risk rating: 1 (negligible)

Fish, medium productivity and high susceptibility

Leatherjacket, Stink Fish, Trevally, Bullseye, Toadfish, Flounder/Sole, and Silverbelly

- Bycatch reduction device and T90 cod end would reduce catch
- Consequence: 1, Likelihood: 1, Risk rating: 1 (negligible)

Fish, medium productivity and medium susceptibility

Red Cod, Cardinal Fish, Goblin Fish, Soldier Fish, Barracouta and Grubfish

- Bycatch reduction device and T90 cod end would reduce catch
- Consequence: 1, Likelihood: 1, Risk rating: 1 (negligible)

Boarfish and Porcupine Fish

- The ESD risk assessment workshop considered the bycatch reduction device would be more effective to minimise catch for these species and therefore the consequence was lower
- Consequence: 0, Risk rating: 0 (negligible)

Fish, high productivity and medium susceptibility

Mackerel and Trumpeter

- Bycatch reduction device and T90 cod end would reduce catch
- Consequence: 1, Likelihood: 1, Risk rating: 1 (negligible)

Fish, high productivity and medium susceptibility

Sprats

- Bycatch reduction device and T90 cod end would reduce catch
- Catch would be minimal due to where they live in the water column
- Consequence: 0, Risk rating: 0 (negligible)

Crustaceans

Prawns (excluding Western King Prawns), crabs (Sponge Crabs, Rock Crabs, Spider Crabs)

- ESD workshop participants considered there would be high post capture survival due to the use of the hopper system
- The bycatch reduction grid reduces the catch of large crabs, including spider crabs
- The T90 cod end would contribute to reducing the catch of prawns
- Consequence: 0, Risk rating: 0 (negligible)

Echinoderms

Sea cucumber, brittle star, sea star and sea urchin

- The ESD workshop considered there was limited information to assign a consequence and likelihood to these species, therefore the workshop assigned a risk based on the workshop discussion
- It was noted that the Spencer Gulf risk assessment process listed *Holothuria (Thymiosycia)*
- *Hartmeyeri* (a species of sea cucumber) with a productivity-susceptibility analysis (PSA) risk rating of high but the panel considered that due to its wide distribution there was little risk to the species. Other species of sea cucumber (*Ceto cuvieria*) was given a PSA risk rating of low (PIRSA 2014)
- The ESD workshop consider there was a low risk to these species
- Risk rating: low

Gastropods

Cuttlefish, Scallop and Nudibranch

- The ESD workshop considered there was limited information to assign a consequence and likelihood to these species, therefore the workshop assigned a risk based on the workshop discussion
- It was noted that the Spencer Gulf risk assessment process listed:
    - Giant Cuttlefish as a medium risk however it was assessed that the management arrangements mitigated risks to the species pending further information on speciation of Giant Cuttlefish in north Spencer Gulf
    - Queen Scallop as a moderate risk
    - nudibranch as a moderate risk
- The bycatch reduction grid would reduce catches of all cuttlefish and the T90 cod end would reduce catches of nudibranchs
- The ESD workshop considered there was a low risk to these species
- Risk rating: low

Triton

- It was considered that Tritons would have a high post capture survival and therefore there was enough information to assign a consequence
- Consequence: 0, Risk rating: 0 (negligible)

Sharks and Rays

Saw Shark, Angel Shark, Melbourne Skate, Port Jackson Shark, Shovelnose Ray, Smooth Stingray, Sevengill Shark, Black Ray, Numbfish, Wobbegong and Eagle Ray

- The ESD workshop participants suggested the bycatch reduction grid may prevent catches of these species based on their size
- Consequence: 0, Risk rating: 0 (negligible)

Stingarees (Sparsely Spotted Stingaree and Coastal Stingaree)

- Grouped together due to identification issues
- The bycatch reduction grid may reduce catches of these species based on their size
- GSVPF bycatch handling practices, including the use of a hopper system is considered highly important in reducing the post capture mortality of stingarees.

- *Sparsley Spotted Stingaree* - widely distributed on the continential shelf off southern Australia from Crowdy Head to Lancelin (Last & Steven 2009)
- The IUCN red list of threatened species lists the Sparesley Spotted Stingaree as Least Concern (http://www.iucnredlist.org/details/60102/0)
- A trawl simulation experiment that looked at trawl time, air exposure and over crowding, showed the post capture mortality rate of trawl caught Sparesley Spotted Stinagrees was low (less than 15 per cent). Trawl time representing the common trawling time in South Australian Trawl Fisheries (one hour) and a longer trawl (three hours). No deaths occurred during the one hour trawl while 37.5 per cent dies in the three hour trawl simulation (Heard et al. 2014).
- Bycatch handling procedures have been shown to be the main factor in reducing mortality in stingarees. minimising air exposure after a one hour trawl, compared to 10 minutes air exposure reduced the mortality rate from 25 per cent to no deaths (Heard et al. 2014).
- *Coastal Stingaree* - found off South Australia only between Ceduna and Beachport, depths 20 – 50 m (Last & Steven 2009)
- Coastal Stingaree was rated at a low risk in the Spencer Gulf Prawn Fishery risk assessment but the stakeholder panel considered collecting further information on the species
- The IUCN red list of threatened species lists the Coastal Stingaree as Endangered (http://www.iucnredlist.org/details/summary/60100/0)
- Consequence: 2, Likelihood: 2, Risk rating: 4 (low)

Southern Fiddler Ray

- Found from eastern Bass Strait to Lancelin from 30 to 205 m (Last & Stevens 2009)
- Bycatch reduction device would reduce catch
- Consequence: 1, Likelihood: 4, Risk rating: 4 (low)

Catsharks (Rusty Catshark and Gulf Catshark)

- The bycatch reduction grid may reduce catches of these species based on their size
- Fishery independent bycatch survey to inform risk assessment of the Spencer Gulf Prawn Trawl Fishery report (Currie et al. 2009) highlights catches of the Gulf Catshark in the Spencer Gulf Prawn Fishery had a restricted distribution and were not found outside the central region.
- The ESD workshop participants considered the take and area of capture in the GSVPF is considered small, compared to known area of distribution
- Rusty Catshark - Found from Gabo Island to Albany (south coast of Australia only), from 5 to 150 m (Last & Stevens 2009)
- Gulf Catshark - Found along the south coast of Australia only and main depth of 130-220 m (Last & Stevens 2009). Mainly outside of prawn trawling depth range
- Consequence: 1, Likelihood: 3, Risk rating: 3 (low)

Threatened, Endangered and Protected Species

Syngnathids

- In the absence of a finalised report from the GSV bycatch survey workshop paricipants agreed that Currie et al (2009) was the most relevant information source for considering risks to sygnathids. Currie et al. (2009) indicates that in Spencer Gulf, seven species of sygnathids were caught in waters greater than 10 metres depth. The workshop participants suggested the finalisation of the GSVPF bycatch report would provide further information on the species composition.
- T90 cod end is expected to increase escapement of Syngnathids (Dixon et al. 2013).
- The spatial closure of all grounds shallower than 10 metres would provide protection to many species.
- The Spencer Gulf Prawn Fishery bycatch report noted that many captured syngnathids are likely to be returned to the water alive after trawling but their subsequent fate is uncertain (Currie et al. 2009). It has been reported that syngnathids are taken as prey by several fish species and they may be particularly vulnerable to predation after release (Whitley and Allan, 1958, Jordan and Gilbert 1982). The report suggested additional studies, such as survival experiments, may also be conducted to improve our understanding on the fate of discarded individuals (Currie et al. 2009).

- ESD workshop participants considered there was minimal syngnathids bycatch noting that some species may be difficult to see or identify. In the Spencer Gulf surveys Tiger Pipefish was the syngnathids of the highest abundance in high trawl areas. It was noted that these species are difficult to see by fishers.
- It was noted that there was some uncertainty in determing the risk rating as the GSV bycatch survey had not been finalised and the highest risk rating considered was adopted. This risk may be reduced through reducing the uncertainty in the assessment through finalisation of the by-catch report or information on the level of post-release mortaility of syngnathids.
- Consequence: 2, Likelihood: 2, Risk rating: 4 (Low)

Dolphins, Turtles, Seals, White Shark

- The ESD workshop participants suggested the bycatch reduction grid may prevent catches of these species based on their size.
- Consequence: 0, Risk rating: 0 (negligible)

Main Commercial Species

Blue Swimmer Crab

- The GSV stock status of Blue Swimmer Crab is monitored by Blue Crab Fishery. The 2012/13 Blue Crab Fishery stock assessment report published by SARDI showed the GSV stock has experienced some decline, and is currently classified as 'transitional recovering'. Transitional recovering is defined as a recovering stock.
- Management measures are in place to promote stock recovery. In the GSV these recent management changes included decreasing the recreational bag limit, reducing TACC and implementing a temporal closure. The latest scientific monitoring has indicated some signs of recovery in the stock.
- GSVPF doesn't impact on the sustainability of the Blue Crab Fishery.
- 2013/14 Blue Swimmer Crab TACC in GSV = 196.1 t.
- Bycatch reduction grid reduces catches of Blue Swimmer Crabs.
- Capture is expected to be less than 50 per cent and they do not have vulnerable life history traits.
- Considered to have a good post capture mortality.
- Consequence: 2, Likelihood: 3, Risk rating: 6 (moderate)

Whiting, Snapper, Octopus, Sand Crab, Octopus, Whaler Shark, Gummy Shark, Australian Sardines, Elephant Fish, Australian Anchovies and Southern Garfish

- All species in this group are monitored through other fisheries
- The Marine Scalefish Fishery ESD risk assessment[1], using a five risk scale, listed
    - Yellow Fin Whiting = low risk
    - King George Whiting = low risk
    - Snapper = high risk
    - Octopus = low risk
    - Sand Crab = low risk
    - Whaler Shark = moderate risk
    - Southern Garfish = high risk
- The Sardine Fishery ESD risk assessment, using a four risk scale, listed
    - Australian Sardine = medium risk
    - Australian Anchovy = negligible risk
- The Commonwealth Southern and Eastern Scalefish and Shark Fishery monitors Gummy Shark and Elephant Fish, both species as listed as having a sustainable stock.
- Catches of all species were considered to be small compared to the total take in the fishery and they are explicitly covered elsewhere.
- Whiting, Snapper, Octopus, Sand Crab, Octopus - Consequence: 1, Likelihood: 1, Risk rating: 1 (negligible).
- Whaler Shark, Gummy Shark, Australian Sardines, Elephant Fish, Australian Anchovies and Southern Garfish - Consequence: 0, Risk rating: 0 (negligible).

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1 http://www.pir.sa.gov.au/__data/assets/pdf_file/0010/217666/ESD_Risk_Assessment_Report_for_the_South_Australian_Commercial_Marine_Scalefish_Fishery_-_July_2011.pdf

5.1.3 Ecosystem effects

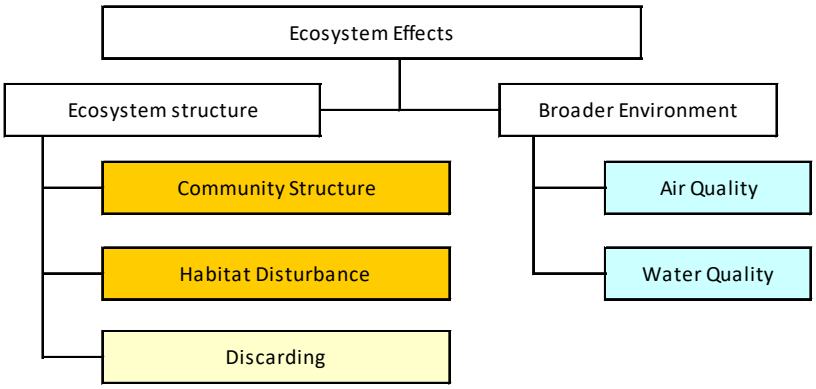

Figure 6: Ecosystem effects component tree for the Gulf St Vincent Prawn Fishery. See Table 7 for explanation of colour-coded risk categories.

Ecosystem structure, community structure

- Fishery management arrangements allow for the fishery to be managed in an ecological sustainable way for the purposes of wildlife trade provisions (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Part 13A accreditation[2])
- Prawn fishing effort (fishing nights) is limited in GSV under the GSVPF management framework
- Approximately 7 vessels fishing
- Trawled area where prawns are found are also inhabited by scavengers
- It is suspected that a significant amount of bycatch is consumed by scavengers
- Impact of fishing is sustainable as long there is a control on effort or similar
- Consider structure without trawling
    - Decrease in scavenger species
    - No evidence of structure prior to trawling
    - Clear difference in ecosystem structure but level is unknown
- Some stakeholders suggested there has been some historical damage on brain coral beds by trawling
- Consequence: 2, Likelihood: 4, Risk rating: 8 (moderate)

Ecosystem structure, habitat disturbance

- Some damage has already occurred in trawled areas.
- Prawn fishing effort (available fishing nights) is limited in GSV under the GSVPF management framework
- Some stakeholders suggested there has been some historical damage on brain coral beds by trawling
- Spatial closure in all waters less than 10 metres deep
- There has been a public nomination of 'Posidonia seagrass meadows' for listing as an 'Endangered' ecological community under the *Australian Government's Environment Protection and Biodiversity Conservation Act 1999*[3]. If this happens this listing would be considered in future risk assessments
- Some licence holders consider trawling grounds increases productivity, this is not agreed by all licence holders
- Effort has reduced from the historical levels
- Consequence: 2, Likelihood: 4, Risk rating: 8 (moderate)

Ecosystem structure, discarding

- Driving scavenger community
- Relative to other prawn fisheries, this fishery does not have a large discard rate
- Discarding is driving change is trophic structure – more scavengers moving in (e.g. prawns, crabs, fish)
- Bycatch reduction device (BRD) grid and T90 reduces bycatch and therefore discard level

[2] http://www.environment.gov.au/topics/marine/fisheries/sa-prawn-trawl

[3] http://www.environment.gov.au/node/34821

- Hopper systems decrease the post-mortality of discarded catch
- Consequence: 1, Likelihood: 4, Risk rating: 4 (low)

Broader environment, air quality

- Environmental Protection Authority regulate vessel discharge
- Vessels are surveyed by the Department of Planning, Transport and Infrastructure
- Maximum 10 boats with limited effort
- Consequence: 0, Risk rating: 0 (negligible)

Broader environment, water quality

- Environmental Protection Authority regulate vessel discharge
- Vessels are surveyed by the Department of Planning, Transport and Infrastructure
- Maximum 10 boats with limited effort
- The workshop participants considered oil spills were unlikely
- Consequence: 0, Risk rating: 0 (negligible)

5.1.4 General community

It has been identified through the application of this ecologically sustainable development risk assessment process, some participants that have not regularly been involved with the application can find it difficult to apply the consequence and likelihood tables for certain component trees. Fletcher & Bianchi (2014) developed a toolbox of approaches to simplify the application of the ecosystem approach to fisheries. One tool that has been applied to simplify the development of these risks is the application of risk categories for the social and economic components, promoting higher stakeholder participation (Fletcher & Bianchi 2014).

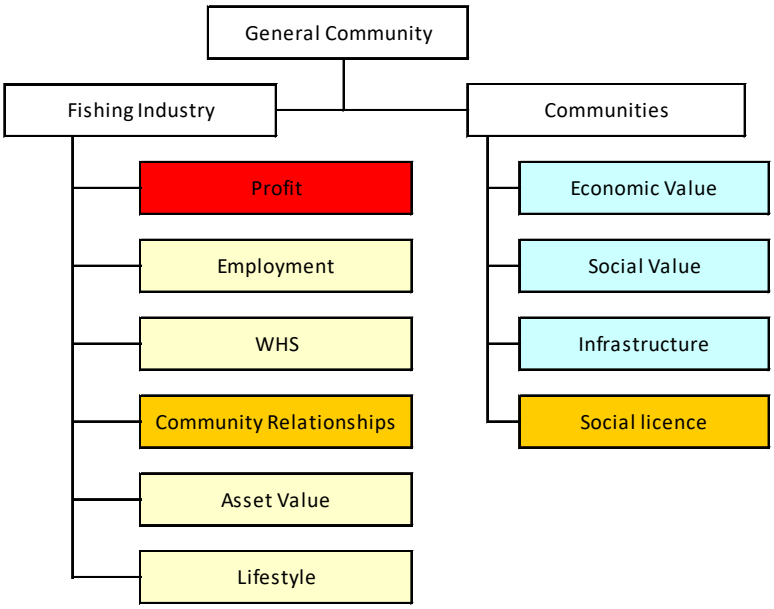

Figure 7: General community component tree for the Gulf St Vincent Prawn Fishery. See Table 7 for explanation of colour-coded risk categories.

It was evident from discussing the components of the general community that there are numerous differing views between licence holders, fish processors and fishery managers.

Fishing industry, profit

- The economic performance of the fishery declined prior to the fishery being closed in December 2012 due to declining catches, the high Australian dollar, prawn price decreases due to the increased competition from imported farmed prawns and increasing operation costs.
- The new management framework is designed to allow the fishery to rationalise and restructure to improve its economic viability
- The ESD workshop participants could not agree in allocating a risk, with both moderate and high being supported by some participants. The higher of the two proposed risks was adopted
- Risk rating: high

Fishing industry, employment

- The fishery is small (ten licences)
- Framework is set up to restructure the fishery
- The fishery is based out of Adelaide
- Quality of employees has reduced due to profitability and mining sector
- Most employees have other jobs due to the nature of fishing in this fishery in the last three years
- Risk rating: low

Fishing industry, work, health and safety

- Companies are aware of work, health and safety legislation and have safety procedures in place

- Low risk fishery due to the area they work and management arrangements allowing them to not fish and use effort later in the season
- The consequence of having a death or injury on board a boat due to the lack of safety is extreme
- Risk rating: low

Fishing industry, community relationships

- Due to a lack of education of the community, commercial fishing can be perceived unfavorably
- The community doesn't rely on the fishery
- The ESD workshop participants were split in allocating a risk, with both low and moderate being supported by some participants. The higher of the two proposed risks was adopted
- Risk rating: moderate

Fishing industry, asset value

- The fishery has had a low value in recent years due to a high Australian dollar
- By restructuring the fishery the value of licences should increase
- The asset value would not change in other sectors if the fishery was closed
- Risk rating: low

Fishing industry, lifestyle

- Fishers choose to fish due to the lifestyle
- Could be difficult on family due to time away from home
- Risk rating: low

Communities, economic value

- The community other than the fishing industry has many industrial businesses and there are other commercial fisheries working out of Adelaide, therefore there wouldn't be a large impact on the economic value of the community if there was no fishery
- Gross value production was $1,759,000 in 2011/12 (Econsearch 2013)
- The fishery has been closed twice previously
- Risk rating: negligible

Communities, social value

- Minimal impact on social value from the fishery
- Risk rating: negligible

Communities, infrastructure

- Limited unloading points
- No issue from communities
- Risk rating: negligible

Communities, social licence

- Good knowledge of fishery and associated research
- High visibility to metropolitan Adelaide
- Social concerns with trawling
- More education of the general public and improving public perceptions and public acceptance is required
- The ESD workshop participants were spilt in allocating a risk, with both low and moderate being supported by some participants. The higher of the two proposed risks was adopted
- Risk rating: moderate

5.1.5 Governance

It has been identified through the application of this ecologically sustainable development risk assessment process, some participants that have not regularly been involved with the application can find it difficult to apply the consequence and likelihood tables for certain component trees. Fletcher & Bianchi (2014) developed a toolbox of approaches to simplify the application of the ecosystem approach to fisheries. One tool that has been applied to simplify the development of these risks is the application of risk categories for the social and economic components, promoting higher stakeholder participation (Fletcher & Bianchi 2014).

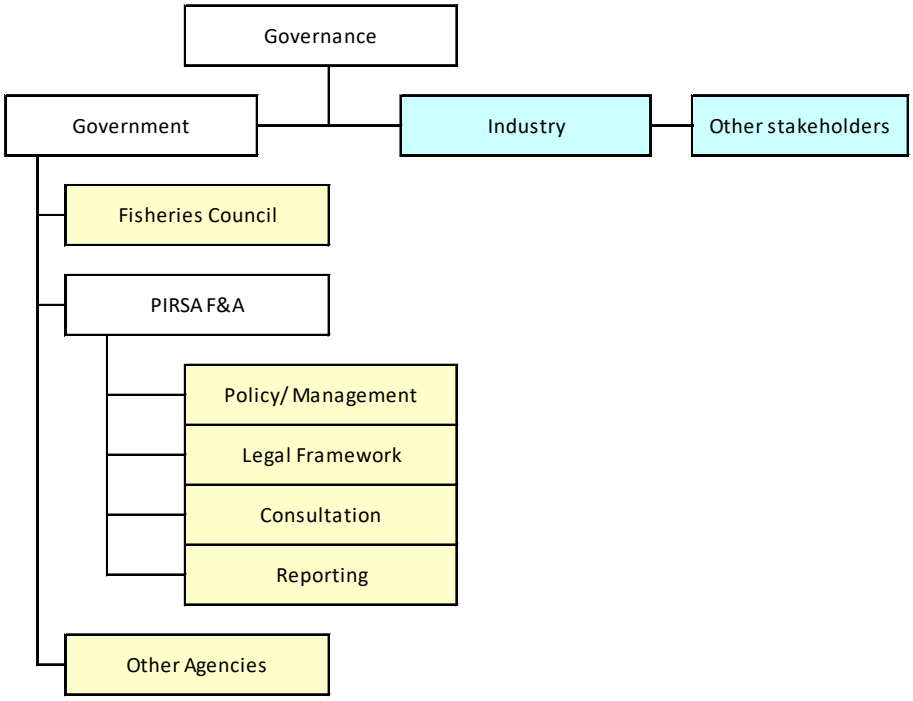

Figure 8: Governance component tree for the Gulf St Vincent Prawn Fishery. See Table 7 for explanation of colour-coded risk categories.

Governance, Fisheries Council[4]

- Development of a new management plan and harvest strategy is underway by the Fisheries Council of South Australia (SA)
- Consultation needs to be balanced between stakeholders
- The Government of South Australia has stated they plan to abolish the Fisheries Council of SA
- The Act requires the Fisheries Council of SA develop management plans
- Stakeholders have not been informed how this process will be replaced and is very much an unknown
- Risk rating: low

Governance, PIRSA Fisheries and Aquaculture

Policy/ management, legal framework, consultation and reporting

- The GSVPF management plan is being developed, including a review of the harvest strategy
- Due to the harvest strategy not being finalised at the time of writing this report, some workshop stakeholders considered the risk to the governance of the fishery is increased. The harvest strategy needs to be developed and independently reviewed.
- Further research is required; including the finalisation on the bycatch report for the fishery and the application of the review of stock assessment processes (Dichmont et al. 2014)
- Some workshop participants suggested the new management framework needs to be monitored and reviewed

[4] The Fisheries Council of South Australia was abolished as of 30 June 2015.

- At the time of the workshop a new cost recovery model was yet to be developed, which was required with the move to ITE management regime, including the compliance program for the fishery
- Risk rating: low

Governance, other agencies

- The impact of marine parks on the GSVPF was negligible
- Posidonia seagrass meadows have been nominated for listing under EPBC Act
- Seafood labelling country of origin
- Risk rating: low

Governance, industry

- No issues
- Risk rating: negligible

Governance, other stakeholders

- No issues
- Risk rating: negligible

5.1.6 External factors

It has been identified through the application of this ESD risk assessment process, some participants that have not regularly been involved with the application can find it difficult to apply the consequence and likelihood tables for certain component trees. Fletcher & Bianchi (2014) developed a toolbox of approaches to simplify the application of the ecosystem approach to fisheries. One tool that has been applied to simplify the development of these risks is the application of risk categories for the social and economic components, promoting higher stakeholder participation (Fletcher & Bianchi 2014).

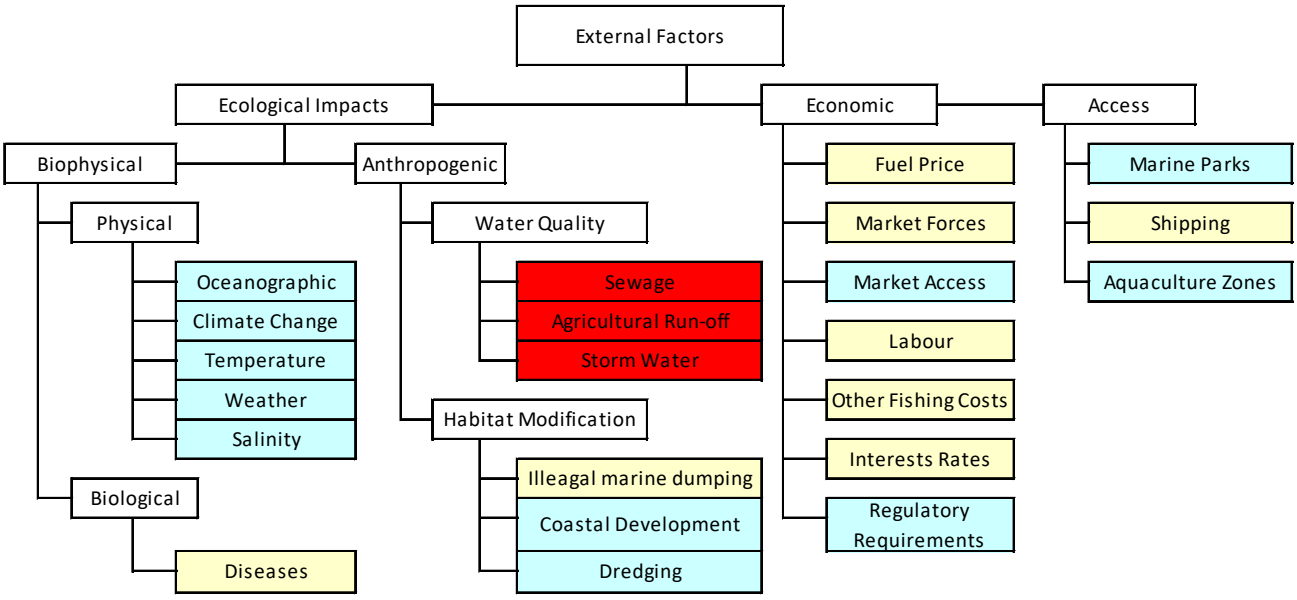

Figure 9: External factors component tree for the Gulf St Vincent Prawn Fishery. See Table 7 for explanation of colour-coded risk categories.

Ecological Impacts, biophysical, physical

Oceanographic, climate change, temperature, weather and salinity

- In the next five years it was considered these variables would have no impact on the fishery
- Risk rating: negligible

Ecological Impacts, biophysical, biological

Diseases

- The impact of disease is possible but considered a low risk
- Risk rating: low

Ecological Impacts, anthropogenic, water quality

Sewage, agricultural run-off and storm water

- Some licence holders consider these variables have had an impact of the fishery to date
- While this component can impact the fishery mitigating the risk is largely outside of PIRSA's capacity
- It was also considered unknown what will happen with water front land north of Adelaide in the next 5 years
- The ESD workshop participants were split in allocating a risk, with both moderate and high being supported by some participants. The higher of the two proposed risks was adopted
- Risk rating: high

Ecological Impacts, anthropogenic, habitat modification

Illegal marine dumping

- This is a concern for many licence holders as it removes available grounds
- There is high evidence of a large amount of illegal dumping while the fishery has been closed, since December 2012

- Not considered a moderate risk over the next five years
- Risk rating: low

Coastal development and dredging

- Not considered an issue for the next five years
- Risk rating: negligible

Economics

Fuel prices and market forces

- Considered a low risk for the next five years
- Risk rating: low

Market access

- Not considered an issue for the next five years
- Risk rating: negligible

Labour, other fishing costs and interest rates

- Considered a low risk for the next five years
- Risk rating: low

Regulatory requirements

- Not considered an issue for the next five years
- Risk rating: negligible

Access

Marine parks and aquaculture zones

- Not considered an issue for the next five years
- Risk rating: negligible

Shipping

- Considered a low risk for the next five years
- Risk rating: low

5.2 Summary of ESD reporting

In summary, the ESD reporting framework for all components of the fishery found that for the species components, the target species, Western King Prawns was found to be of high risk of maintaining the biomass at a sustainable stock level for the next five years.

For the non-species components of the fishery, there were 11 areas identified as of moderate risk or greater.

A summary table of identified risks is provided in Table 8 and Table 10.

Table 8: Summary of National ESD Reporting Framework outcomes.

Component Trees	High	Moderate	Low	Negligible	Total
Retained Species	2	0	1	0	3
Non-retained species	0	1	10	58	69
General Ecosystem	0	2	1	2	5
General Community	1	2	4	3	10
Governance	0	0	6	2	8
External Factors	3	0	8	11	22
Total	6	5	30	76	117

5.3 Performance reports for all high and moderate risks Identified

The performance report is a summary of the moderate and high risks to the fishery as well as their associated objectives and strategies that are linked to the Management Plan for the South Australian Commercial Gulf St Vincent Prawn Fishery.

Table 9: Risk scores of the moderate and high risks assessed from all of the components of fishery.

Component	Risk/Issue	Description	Risk/ Importance rating	Objective	Strategies
Retained species	Western King Prawn	The risk of maintaining the biomass at a sustainable level	High		
	Balmain Bug	The risk of maintaining the biomass at a sustainable level	High		
Non-retained species	Blue Swimmer Crab	The risk of fishery impacting on the biomass of by-catch species	Moderate		
Ecosystem effects	Ecosystem structure, community structure	The risk of fishery impacting on the ecosystem	Moderate		
	Ecosystem structure, habitat disturbance		Moderate		
General community	Fishing Industry, profit	The risk of fishery impacts on the general community	High		
	Fishing industry, community relationships		Moderate		
	Communities, social licence		Moderate		
External Factors	Anthropogenic, water quality, sewage	The risk of external factors impacting on the fishery	High		
	Anthropogenic, water quality, Agricultural run-off		High		
	Anthropogenic, water quality, storm water		High		

5.3.1 Overview for all the components considered in the workshop

A full ESD performance report in the context of specific management objectives including current operational objectives, indicators, and preferred strategies for all of the identified risks is provided below.

Table 10: Overview of the ESD risk assessment for the South Australian Gulf St Vincent Prawn Fishery (field definitions described in Fletcher et al. 2002); actions - * Review on-going/ annual or ** Review at next ESD assessment.

Issue	Risk/ Priority	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	Actions
RETAINED SPECIES							
Western King Prawns	H	Y	Y	Y	Acceptable	Medium	*
Balmain Bugs	H	Y	Y	Y	Acceptable	Medium	*
Southern Calamari	L	Y	Y	Y	Acceptable	Medium	*
NON-RETAINED SPECIES							
Gurnards / Latchets	N	Y	Y	N	N/A	Low	**
Stargazer	N	Y	Y	N	N/A	Low	**
Cowfish	N	Y	Y	N	N/A	Low	**
Beaked Salmon	N	Y	Y	N	N/A	Low	**
Goatfish	N	Y	Y	N	N/A	Low	**
Flathead	N	Y	Y	N	N/A	Low	**
Seamoth	N	Y	Y	N	N/A	Low	**
Anglerfish	N	Y	Y	N	N/A	Low	**
Velvet Fish	N	Y	Y	N	N/A	Low	**
Leatherjacket	N	Y	Y	N	N/A	Low	**
Stink Fish	N	Y	Y	N	N/A	Low	**
Trevally	N	Y	Y	N	N/A	Low	**
Bullseye	N	Y	Y	N	N/A	Low	**
Toad Fish	N	Y	Y	N	N/A	Low	**
Flounder / Sole	N	Y	Y	N	N/A	Low	**
Silverbelly	N	Y	Y	N	N/A	Low	**
Red Cod	N	Y	Y	N	N/A	Low	**
Cardinal Fish	N	Y	Y	N	N/A	Low	**

Goblin Fish	N	Y	Y	N	N/A	Low	**
Soldier Fish	N	Y	Y	N	N/A	Low	**
Barracouta	N	Y	Y	N	N/A	Low	**
Grubfish	N	Y	Y	N	N/A	Low	**
Boarfish	N	Y	Y	N	N/A	Low	**
Porcupine Fish	N	Y	Y	N	N/A	Low	**
Mackerels	N	Y	Y	N	N/A	Low	**
Trumpeter	N	Y	Y	N	N/A	Low	**
Sprats	N	Y	Y	N	N/A	Low	**
Prawns (excluding Western King Prawns)	N	Y	Y	N	N/A	Low	**
Sponge Crabs	N	Y	Y	N	N/A	Low	**
Rock Crabs	N	Y	Y	N	N/A	Low	**
Spider Crab	N	Y	Y	N	N/A	Low	**
Sea Cucumber	L	Y	Y	N	N/A	Low	**
Brittle Star	L	Y	Y	N	N/A	Low	**
Sea Star	L	Y	Y	N	N/A	Low	**
Sea Urchin	L	Y	Y	N	N/A	Low	**
Cuttlefish	L	Y	Y	N	N/A	Low	**
Scallops	L	Y	Y	N	N/A	Low	**
Triton Shells	N	Y	Y	N	N/A	Low	**
Nudibranch	L	Y	Y	N	N/A	Low	**
Saw Sharks	N	Y	Y	N	N/A	Low	**
Angel Sharks	N	Y	Y	N	N/A	Low	**
Melbourne Skate	N	Y	Y	N	N/A	Low	**
Port Jackson Shark	N	Y	Y	N	N/A	Low	**
Shovelnose Ray	N	Y	Y	N	N/A	Low	**
Smooth Stingray	N	Y	Y	N	N/A	Low	**
Sevengill Shark	N	Y	Y	N	N/A	Low	**
Black Ray	N	Y	Y	N	N/A	Low	**
Numbfish	N	Y	Y	N	N/A	Low	**
Wobbegong	N	Y	Y	N	N/A	Low	**
Eagle Ray	N	Y	Y	N	N/A	Low	**
Stingarees	L	Y	Y	N	N/A	Low	**
Southern Fiddler Ray	L	Y	Y	N	N/A	Low	**
Catsharks	N	Y	Y	N	N/A	Low	**

Syngnathids	L	Y	Y	Y	Acceptable	Medium	*
Dolphins	N	Y	Y	Y	Acceptable	High	*
Turtles	N	Y	Y	Y	Acceptable	High	*
Seals	N	Y	Y	Y	Acceptable	High	*
White Sharks	N	Y	Y	Y	Acceptable	High	*
Blue Swimmer Crab	M	Y	Y	Y	Acceptable	Medium	*
Whiting	N	Y	Y	Y	Acceptable	Medium	*
Snapper	N	Y	Y	Y	Acceptable	Medium	*
Octopus	N	Y	Y	Y	Acceptable	Medium	*
Sand Crab	N	Y	Y	Y	Acceptable	Medium	*
Whaler Shark	N	Y	Y	Y	Acceptable	Medium	*
Gummy Shark	N	Y	Y	Y	Acceptable	Medium	*
Australian Sardines	N	Y	Y	Y	Acceptable	Medium	*
Australian Anchovies	N	Y	Y	Y	Acceptable	Medium	*
Southern Garfish	N	Y	Y	Y	Acceptable	Medium	*
Elephant Fish	N	Y	Y	Y	Acceptable	Medium	*
ECOSYSTEM EFFECTS							
Ecosystem structure, community structure	M	Y	Y	N	Acceptable	Low	**
Ecosystem structure, habitat disturbance	M	Y	Y	N	Acceptable	Low	**
Ecosystem structure, discarding	L	Y	Y	N	Acceptable	Low	**
Broader environment, air quality	N	N	N	N	N/A	Low	**
Broader environment, water quality	N	N	N	N	N/A	Low	**
GENERAL COMMUNITY							
Fishing industry, profit	H	Y	Y	Y	Acceptable	High	*
Fishing industry, employment	L	N	N	N	Acceptable	High	*
Fishing industry, work, health and safety	L	N	N	N	N/A	Low	**
Fishing industry, community relations	M	N	N	N	N/A	Low	**
Fishing industry, asset value	L	N	N	N	Acceptable	High	*
Fishing industry, lifestyle	L	N	N	N	N/A	Low	**
Communities, economic value	N	Y	Y	Y	Acceptable	High	*
Communities, social value	N	N	N	N	N/A	Low	**
Communities, infrastructure	N	N	N	N	N/A	Low	**
Communities, social licence	M	N	N	N	N/A	Low	**
GOVERNANCE							
Government, Fisheries Council of SA	L	N	N	N	N/A	Low	**

Government, PIRSA Fisheries and Aquaculture	L	N	N	N	N/A	Low	**
Government, other agencies	L	N	N	N	N/A	Low	**
Government, industry	N	N	N	N	N/A	Low	**
Government, other stakeholders	N	N	N	N	N/A	Low	**
EXTERNAL FACTORS							
Ecological impacts, biophysical, physical	N	N	N	N	N/A	Low	**
Ecological impacts, biophysical, biological	L	N	N	N	N/A	Low	**
Ecological impacts, anthropogenic, water quality – sewage – Agriculture run-off – Storm water	H	N	N	N	N/A	Low	**
Ecological impacts, anthropogenic, habitat modification, illegal dumping	L	N	N	N	N/A	Low	**
Ecological impacts, anthropogenic, habitat modification, coastal development	N	N	N	N	N/A	Low	**
Ecological impacts, anthropogenic, habitat modification, dredging	N	N	N	N	N/A	Low	**
Economic, Fuel price	L	N	N	N	N/A	Low	**
Economic, market forces	L	N	N	N	N/A	Low	**
Economic, market access	N	N	N	N	N/A	Low	**
Economic, labour	L	N	N	N	N/A	Low	**
Economic, other fishing costs	L	N	N	N	N/A	Low	**
Economic, interest rates	L	N	N	N	N/A	Low	**
Economic, regulatory requirements	N	N	N	N	N/A	Low	**
Access, marine parks	N	N	N	N	N/A	Low	**
Access, shipping	L	N	N	N	N/A	Low	**
Access, aquaculture zones	N	N	N	N	N/A	Low	**

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7. Acronyms

BRD	Bycatch reduction device
CL	Carapace length
ESD	Ecologically sustainable development
EBFM	Ecosystem based fisheries management
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ERAEF	Ecological risk assessment for the effects of fishing
ERD	Environment, Resources and Development
ITE	Individual transferrable effort
ITQ	Individual transferrable quota
GPS	Global positioning system
GSV	Gulf St Vincent
GSVPF	Gulf St Vincent Prawn Fishery
MSY	Maximum sustainable yield
PIRSA	Primary Industries and Regions South Australia
PSA	Productivity-susceptibility analysis
SA	South Australia
SARDI	South Australian Research and Development Institute
TACC	Total allowable commercial catch
TACE	Total allowable commercial effort
TEPS	Threatened, endangered and protected species
The Act	the Fisheries Management Act 2007

8. Appendices

8.1 Participants of ESD stakeholder workshop

Table 11: Participants of the ESD stakeholder workshop held in Adelaide on 4 March 2015.

Participants	Representative body
Dr Brent Wise	Independent facilitator
Mr Brad Milic	PIRSA Fisheries and Aquaculture
Ms Crystal Beckmann	SARDI Aquatic Sciences
Mr Bradley Page	DEWNR Strategy and Advice
Ms Angela Crimes	DEWNR Conservation and Land Management
Mr Neil MacDonald	Executive Officer, St Vincent Gulf Prawn Boat Owner's Association
Ms Merilyn Nobes	Representative, St Vincent Gulf Prawn Boat Owner's Association
Mr Nathan Bicknell	Executive Officer, Marine Fishers Association
Mr Maurice Corigliano	Licence holder, Gulf St Vincent Prawn Fishery
Mr Shaun Corigliano	Skipper, Gulf St Vincent Prawn Fishery
Non-attendees	
Mr James Brook	Conservation Council of South Australia
Mr David Ciaravolo	Recfish SA
Mr Stephen Mayfield	SARDI Aquatic Sciences
Mr Marty Matinovic	Licence holder, Gulf St Vincent Prawn Fishery
Mr Florian Valcic	Licence holder, Gulf St Vincent Prawn Fishery
Mr Garry Barnes	Licence holder, Blue Crab Fishery

8.2 Consequence and likelihood tables for ESD component trees

Table 12: Consequence categories for the retained species. The default objective is - maintain the biomass at a sustainable stock status for the length of the management plan (the next 5 years).

Level	Ecological (Retained Species)
Negligible (0)	No measureable decline Exploited Stock Abundance Range 100% to 90% unfished levels
Minor (1)	Either not detectable against background variability for this population; or if detectable, minimal impact on population size and none on dynamics. Exploited Stock Abundance Range < 90% to 70% unfished levels
Moderate (2)	Fishery operating at, or close to, full exploitation rate that will deliver MSY. Exploited Stock Abundance Range < 70% to > Bmsy
Major (3)	Stock has been reduced to levels below MSY and may also be getting into the range where recruitment overfishing may occur (limit reference point). Exploited Stock Abundance Range < Bmsy to > Blim
Extreme (4)	Stock size or significant species range contraction > 50% have occurred and recruitment levels reduced affecting future recruitment and their capacity to increase from a depleted state (i.e. recruitment overfishing) Exploited Stock Abundance Range < Blim

Table 13: Consequence categories for non-retained species. The default objective is - to maintain appropriate levels of biomass of by-catch species to minimize any significant impact on their dynamics in the next 5 years.

Level	Ecological (by-product/general by-catch)
Negligible (0)	Very few individuals are captured in relation to likely population size (<1%)
Minor (1)	Take in this fishery is small (< 10%), compared to total take by all fisheries and these species are covered explicitly elsewhere. Take and area of capture by this fishery is small, compared to known area of distribution (< 20%).
Moderate (2)	Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits.
Major (3)	No information is available on the relative area or susceptibility to capture or on the vulnerability of life history traits of this type of species AND The relative levels of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly
Extreme (4)	N/A Once a consequence reaches this point it should be examined using target species table.

Table 14: Consequence categories for the by-catch of TEPS. The default objective is - to maintain levels of catch of these species at acceptable levels during the next 5 years.

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, no general level of public concern
Moderate (2)	The fishery catches or impacts these species at the maximum level that is accepted
Major (3)	The catch or impact by the fishery on the protected species is above that accepted by broader community but there are few/no additional stock implications
Extreme (4)	The catch or impact is well above the acceptable level and this is may be having significant additional impacts on the already threatened status.

Table 15: Consequence categories for impacts on the ecosystem. The default objective is - to maintain any extent of ecosystem impacts from the fishing activity to within acceptable levels during the next 5 years.

Level	Ecological (ECOSYSTEM)
Negligible (0)	No measurable change in community structure would be possible against background variations
Minor (1)	Some relatively minor shifts in relative abundance may be occurring but it may be hard to identify any measurable changes at whole of trophic levels outside of natural variation.
Moderate (2)	Clear measurable changes to the ecosystem components without there being a major change in function. (i.e. no loss of components or real biodiversity), these changes are acceptable. None of the main captured species play a 'true' keystone role
Major (3)	Ecosystem function altered significantly and some function or components are locally missing/declining/increasing &/or allowed new species to appear. The level of change is not acceptable to enable one or more high level objective to be achieved. Recovery measured in many years to decadal.
Extreme (4)	An extreme change to ecosystem structure and function. Very different dynamics now occur with different species/groups now the major targets of capture and/or dominating the ecosystem. Could lead to a total collapse of ecosystem processes. Long-term recovery period may be greater than decades

Table 16: Consequence categories for habitat outcomes. The default objective is – to maintain any extent of habitat impacts from the fishing activity to within acceptable levels during the next 5 years.

Level	Ecological (HABITAT)
Negligible (0)	No measurable impact on the habitat would be possible.
Minor (1)	Barely measurable impacts on habitat(s) which are very localised compared to total habitat area. (Suggestion – these impacts could be < 5%; < 3%; <2%) 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% and for critical habitats less than 5%)
Major (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; whilst for critical habitats this would be < 10%)
Extreme (4)	Too much of the habitat is being affected, which may endanger its long-term survival and result in severe changes to ecosystem function and the entire habitat is in danger of being affected in a major way/removed. (Suggestion this may equate to 70 - 90% of the habitat being affected or removed by the activity; for more fragile habitats this would be > 30% and for critical habitats 10-20%)

Table 17: Consequence categories for social disruptions. The default objective is – maintenance or enhancement of appropriate social structures and outcomes in the next 5 years.

Level	Social Implications
Negligible (0)	Not measurable or no direct involvement
Minor (1)	Direct impacts may be measurable but minimal concerns
Moderate (2)	Some direct impacts on social structures but not to the point where local communities are threatened or social dislocations will occur
Major (3)	Severe impacts on social structures, at least at a local level.
Extreme (4)	Changes will cause a complete alteration to some social structures that are present within a region of a country

Table 18: Consequence levels for economic outcomes. The default objective is - maintenance or enhancement of economic activity over the next 5 years.

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.
Major (3)	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 (4)	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 19: Likelihood Definitions – these are usually defined for the likelihood of a particular consequence level actually occurring within the assessment period.

Level	Descriptor
Likely (4)	A particular consequence level is expected to occur (Probability of 40 - 100%)
Possible (3)	Evidence to suggest this consequence level is possible and may occur in some circumstances (Probability of 10 - 35%)
Unlikely (2)	The consequence is not expected to occur but it has been known to occur elsewhere (Probability of 2 -10%)
Remote (1)	The consequence has never been heard of in these circumstances, but it is not impossible (Probability < 2%)
Negligible (0)	The consequence is not possible or not detectable in these circumstances