

Ecological Assessment of the South Australian Sardine (*Sardinops sagax*) Fishery

REASSESSMENT REPORT

PREPARED FOR THE DEPARTMENT OF THE ENVIRONMENT FOR
THE PURPOSES OF PART 13 AND 13(A) OF THE ENVIRONMENT
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Ecological Assessment of the South Australian Sardine (*Sardinops sagax*) Fishery reassessment report prepared for the Department of the Environment for the purposes of part 13 and 13(a) of the *Environment Protection and Biodiversity Conservation Act 1999*

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All enquiries

Primary Industries and Regions SA
Level 14, 25 Grenfell Street
GPO Box 1671, Adelaide SA 5001
T 08 8226 0900

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1. Purpose

This report has been prepared by the Fisheries and Aquaculture Division of the Department of Primary Industries and Regions SA (PIRSA).

The purpose of this report is to provide an assessment of the management arrangements in place for the South Australian Sardine Fishery (SASF). This report updates information provided to the then Australian Government Department of Environment, Water, Heritage and Arts (now the Department of the Environment, DotE) in 2009 for assessment against the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The report has been prepared in accordance with the *Guidelines for the Ecologically Sustainable Management of Fisheries 2nd Edition*, and particularly addresses the level of change that has occurred in the fishery since the 2009 assessment.

2. Background

The regulations that govern the management of the SASF under the *Fisheries Management Act 2007* are the *Fisheries Management (Marine Scalefish Fisheries) Regulations 2006*, the *Fisheries Management (General) Regulations 2007*, the *Fisheries Management (Vessel Monitoring Scheme) Regulations 2007*, the *Fisheries Management (Demerit Points) Regulations 2009* and the *Fisheries Management (Fish Processors) Regulations 2007*.

The first Management Plan *A Management Plan for the Experimental Pilchard Fishery* (Mackie 1995) now known as SASF, was first established under the *Fisheries Act 1982* to provide the policy framework to guide management decision-making for the fishery. This management plan was replaced in 2005 with the current *Management Plan for the South Australian Pilchard Fishery* (Shanks 2005). In 2007 an addendum to the 2005 plan was released to update the harvest strategy. A new management plan for the SASF is currently being developed under the *Fisheries Management Act 2007* and is planned for implementation in late 2014.

These management plans provide a reference for the broader community in relation to the management measures introduced to ensure the long-term sustainability of South Australia's sardine resources.

The *Fisheries Management Act 2007* provides a number of requirements for fishery management plans, including that they must:

- Describe the biological, economic and social characteristics of the fishery
- Identify potential impacts of the fishery on its associated ecosystems
- Identify any ecological factors that could have an impact on the performance of the fishery
- Assess any identified risks to determine the most serious risks and set out strategies for addressing those risks
- Set out methods for monitoring the performance of the fishery and the effectiveness of the plan, including performance indicators, trigger points for review or action and progress reporting
- Specify the share of aquatic resources to be allocated to each fishing sector under the plan
- Prescribe a method, or establish a process for determining the method, for adjusting allocations of aquatic resources between the different fishing sectors during the term of the plan.

The draft management plan and harvest strategy for the SASF has been developed in consultation with fishing industry stakeholders, South Australian Research and Development Institute Aquatic Sciences (SARDI) through an independently-chaired working group. The draft management plan including the harvest strategy was released for public comment on 7 November 2013 for two months.

3. Level of Assessment

The SASF was last assessed in 2009 and the list of exempt native specimens was amended to include specimens that are derived from fish taken in the SASF, excluding specimens listed under Part 13 of the EPBC Act. Since last assessment there have not been significant changes in most areas of interest as outlined in page 5 of the *Guidelines for the Ecologically Sustainable Management of Fisheries 2nd Edition (2007)*. The changes noted in Table 1, below, refer to changes to management arrangements that have been communicated to DotE.

Table 1: Level of assessment required by the SASF

Issue	Area of Interest	Yes	No
Fishery	Has there been any change to management arrangements, and/ or fishing practices?	X	
External Influences	Has there been any change to an environmental issue/influence outside of the fishery management agencies control?		X
Interaction with protected species	Has there been any change in the nature, scale, intensity of impact, and/or management response?		X
Ecosystem impact	Has there been any change in the nature, scale or intensity of impact, and/or subsequent management response?		X
Target Stock Status	Has there been any change in the target stock status?		X
By-product/ by-catch status.	Has there been any change in the by-product and/or by-catch stock status?		X

Considering the above, the level of submission requirement for the SASF is 'Standard' plus ancillary level of information.

4. Biology

Sardines are found in the northern and southern hemisphere. In Australia, sardines are found between Rockhampton, Queensland and Shark Bay, Western Australia, including northern Tasmania (Ward et al. 2012) and along with Australian Anchovy, commonly dominate the fish biomass in upwelling regions (Ward et al. 2012). Waters off South Australia are the centre of the sardine's Australian distribution and support the largest component of the Australian population (Ward et al. 2012). Sardine is the dominant Clupeid off South Australia, occurring from the southern parts Spencer Gulf and Gulf St Vincent to past the continental shelf (Ward et al. 2001a).

Australian Sardines have a complex schooling behaviour that varies over space and time (Ward et al. 2012). Schooling behaviours vary within and among locations, days, months and years, and complicate the application of acoustic techniques for stock assessment (Ward et al. 2012). There is also some evidence that spawning influences schooling behaviour, with spawning females underrepresented in commercial catches (Ward et al. 2012). Sardines have two feeding modes depending on food density – filter feeding on microzooplankton and phytoplankton and particulate feeding on macrozooplankton (Ward et al. 2012).

Sardine size and age to sexual maturity varies between locations and ranges between 100 mm to 180 mm fork length, and 1.8 to 2.8 years. Despite difficulties in using certain ageing methodologies, sardines found in South Australian waters have shown higher growth rates than sardines in other parts of Australia (Ward et al. 2012).

A sizeable stock of Australian Anchovy occurs in South Australian waters (Dimmlich et al. 2004, Dimmlich et al. 2009) When sardine biomass is high, the Australian Anchovy occurs mainly in the northern gulfs, but when sardine biomass is low this species has the capacity to increase in abundance and expand its distribution into shelf waters (Ward et al. 2013a).

5. Fishery

The SASF targets Australian Sardine (*Sardinops sagax*) using a sardine net, however take of Australian Anchovy (*Engraulis australis*) is also permitted. This class of fishing activity is part of the Marine Scalefish Fishery formally constituted by the *Fisheries Management (Marine Scalefish Fisheries) Regulations 2006*.

5.1 Commercial fishery

The area of the fishery includes all the waters adjacent to South Australia to the edge of the 200 nautical mile Australian Fishing Zone (Figure 1), with the exception of closed areas. The legislative instrument defining the area of jurisdiction for the sardine fishery is the 1996 Offshore Constitutional Settlement arrangements for scalefish species between South Australia and the Commonwealth of Australia. The agreement sets out that sardines are managed by South Australia while the Commonwealth has retained access to sardines for live bait purposes in the Southern Bluefin Tuna Fishery.

5.1.1 Fishery area

The Great Australian Bight contains a broad continental shelf (up to 200 km wide) that is the location of the world's only northern boundary current upwelling ecosystem (Goldsworthy et al. 2011). The area where the continental shelf waters and the southern Spencer Gulf meet forms a complex oceanographic system (Goldsworthy et al. 2011). At the mouth of the gulf, thermal and salinity fronts limit the exchange between cool, low-salinity water (outside the gulf) and the warmer, higher salinity water (inside the gulf). The system is not greatly understood but is thought to play an important ecological role in the region (Goldsworthy et al. 2011).

Figure 1: The area of waters of the SASF.



5.1.2 Historic fishing effort

At inception of the (then) pilchard fishery, total catch was very low as few took up sardine fishing on a full-time basis. Total catch and effort increased until 1994 but then remained at relatively low levels for the remainder of the 1990's and was influenced significantly by two mass mortality events in 1995 and 1998 that. The fishery expanded rapidly from the 1998 mortality event with significantly increased catch and effort between 2000 and 2005 as demand for feed for ranched Southern Bluefin Tuna grew. Catch and effort in the fishery peaked in 2005 when total catch reached 40,000 tonnes and effort was 1,233 boat-nights. Since 2007, catch has stabilised considerably at around 30,000 to 32,000 tonnes. (Ward et al. 2012).

Recent performance of the fishery is reported in the most recent stock assessment reports published by the SARDI and is attached to this report.

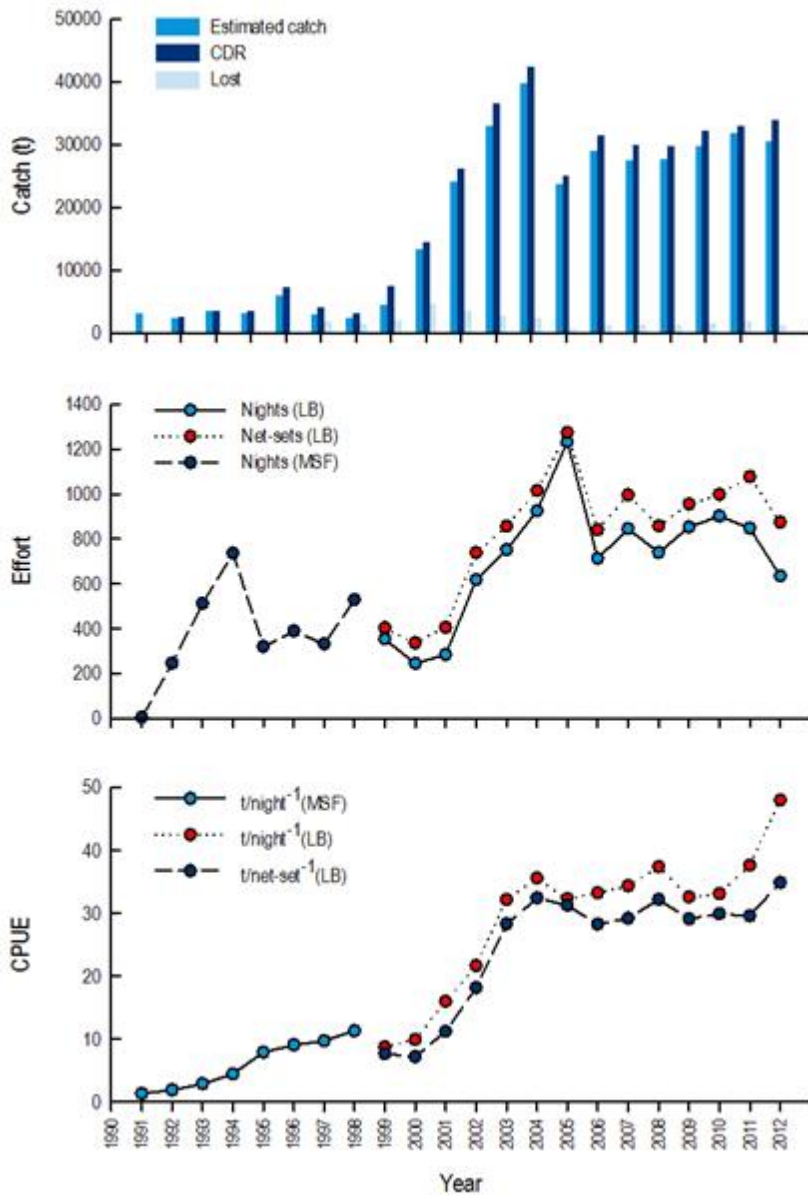


Figure 2: Catch and effort information for the Sardine Fishery of South Australia

5.1.3 Economics

The SASF is South Australia's largest volume, single species fishery. In 2011/12 36,962 tonnes of sardines, with a value of \$20.7 million, were harvested (Econsearch 2013), with a total of 117 full time employees (directly and indirectly) in the same period. The fishery provides economic and social benefits to the regional area of Eyre Peninsula.

A time series of economic information in relation to the sardine fishery has been collected since 1997-98 and presented in reports entitled *Economic Indicators for the South Australian Sardine Fishery*. The most recent report at the time of making this management plan relates to 2011-12 (Econsearch 2013).

5.2 Recreational Fishery

Recreational fishing for Australian Sardines has historically been negligible (Jones 2009), but as fishers may use permitted devices, recreational catches will continue to be monitored. The next recreational fishing survey is currently underway and will inform monitoring of recreational take of sardines.

6. Management Arrangements for the Fishery

The commercial fishery is managed through setting of a total allowable commercial catch (TACC) and input controls aimed at matching harvesting capacity with resource availability (Table 2).

Table 2: Management arrangements and monitoring tools for the sardine fishery for the 2014 fishing season

Management tool	Current restriction
Permitted species	<i>Sardinops sagax</i> and <i>Engraulis australis</i>
Quota year	1 January – 31 December
Licensing year	1 July – 30 June
Limited entry	14 licences
Licence transferability	Permitted
Corporate ownership	Permitted
Closed areas	Yes
Method of capture	Purse seine
Quota scheme (ITQ)	Yes
TACC	34,000 tonnes
Quota transferability (in quota year)	Yes
Maximum number of boats	2
Total number of nets	2 per licence
Maximum vessel length	None
Maximum vessel power	None
Vessel monitoring system (VMS)	Operational vessel monitoring system units required on all vessels while fishing with a sardine net.
Monitoring tool	Requirement
Catch and effort data	Daily logbook submitted monthly
Catch disposal records	Daily records submitted upon landing
Prior landing reports	1 hour before unloading to registered premises 2 hours before unloading to a boat

6.1 Harvest Strategy

Harvest strategies offer an effective fisheries management tool to integrate the ecological, social and economic dimensions of fisheries management into a single framework for fisheries management decision making (Sloan et al. 2014).

Essential components of the Sardine Harvest Strategy are:

- A monitoring strategy for collection of data to estimate performance of the sardine fishery.
- A process for conducting assessments of the status of the sardine fishery relative to the objectives.

- Decision rules that control the level of exploitation of sardines according to the status of the sardine fishery and relative to target and limit reference points.
- Decision rules that control the spatial distribution of the catch.
- A process for periodic review.

This harvest strategy includes a set of decision rules that provide for fixed exploitation rates to allow for removal of a fixed fraction of the stock during a set period (normally annually).

Consistent with the *National Guidelines to Develop Fishery Harvest Strategies* (Sloan et al. 2014), the Sardine Harvest Strategy is defined as a framework that sets out the management actions necessary, using fixed exploitation rates and maintaining biomass above agreed levels, to control the exploitation of sardines in order to achieve ecological, economic and social objectives of the sardine fishery.

6.1.1 Current harvest strategy

The current harvest strategy is described in the addendum (PIRSA 2007) to the Shanks (2005) management plan. The harvest strategy identifies a primary performance indicator as the sardine spawning biomass (SpB) using the daily egg production method (DEPM) (Lasker 1985). The DEPM is recognised internationally as being a practical and cost-effective method for estimating the SpB of small pelagic fishes (Stratoudakis et al. 2006, Ward et al. 2011).

Using the most recent SpB value, the recommended TACC for the sardine fishery is determined as a proportion of the SpB (exploitation rate) within sustainable limits. Although SpB estimates derived from the DEPM are considered to be accurate, they can be relatively imprecise, mainly due to uncertainties associated with estimation of total daily egg production (Fletcher et al. 1996, McGarvey & Kinloch 2001, Ward et al. 2001b, Gaughan et al. 2004, Stratoudakis et al. 2006). Despite concerns regarding the precision of DEPM-derived SpB estimates, the DEPM is currently considered the best technique available to assess the status of the sardine fishery. Imprecision of the DEPM is partly addressed in the current harvest strategy by establishing a conservative baseline TACC over a relatively wide SpB target range.

Supporting the DEPM assessment is a recently developed age-structured population model for the SASF. This model is also used to inform the status of the stock by producing SpB estimates but uncertainty regarding natural mortality rates, recruitment variability and biases in the age samples mean the DEPM-derived SpB estimate is preferred (Ward et al. 2005). In years when there is no DEPM survey completed, the stock assessment model results are used to inform the status of the stock. This age-structured model revealed that DEPM-derived SpB estimates are likely to be conservative relative to the actual SpB (Ward et al. 2010a).

The current harvest strategy established that a precautionary baseline TACC of 30,000 tonnes be maintained while the latest SpB estimate remained between 150,000 and 300,000 tonnes, corresponding to exploitation rates of 20% and 10%, respectively. The harvest strategy allows for increased exploitation rates (and TACCs) as the level of understanding of the sardine stock improves by increasing the frequency of surveys and stock assessments in three tier levels. The required monitoring for each of the three tier levels is:

- Tier 3 - biennial stock assessment and biennial fishery survey (alternating each year)
- Tier 2 - biennial stock assessment and an annual fishery survey
- Tier 1 - annual stock assessment and annual fishery survey.

Once the SpB estimate has been calculated and stock status assigned, the corresponding harvest decision rules that guide the appropriate levels of exploitation (and therefore the TACC) across the three tiers can be considered.

The decision rules are provided in the harvest decision table, which outlines the relationship between SpB, stock status, level of exploitation and TACC recommendations is in Table 3, including the frequency of fishery surveys and assessments. The graph at Figure 3 graphically represents the TACC setting decision rules.

Table 3: Harvest decision table for the sardine harvest strategy to guide levels of exploitation (and TACC) and frequency of surveys and assessment for each tier following the most recent spawning biomass (SpB) estimate. Abbreviations: TRP, target reference point; LRP, limit reference point

Spawning Biomass			Reference Points	Stock Status	Tier 1				Tier 2				Tier 3			
					TACC (t)	Maximum Exploitation	DEPM Survey	Stock Assessment	TACC (t)	Maximum Exploitation	DEPM Survey	Stock Assessment	TACC (t)	Maximum Exploitation	DEPM Survey	Stock Assessment
190000 t <	SpB		>TRP	Sustainable	47,500 t	25%	Annual	Annual	42,750 t	22.5%	Annual	Biennial	38,000 t	20%	Biennial	Biennial
170000 t <	SpB	≤ 190000 t	>TRP	Sustainable	42,500 t	25%	Annual	Annual	38,250 t	22.5%	Annual	Biennial	34,000 t	20%	Biennial	Biennial
150000 t <	SpB	≤ 170000 t	>TRP	Sustainable	37,500 t	25%	Annual	Annual	33,750 t	22.5%	Annual	Biennial	30,000 t	20%	Biennial	Biennial
100000 t <	SpB	≤ 150000 t	LRP - TRP	Transitional	20% of SpB	20%	Annual	Annual	17.5% of SpB	17.5%	Annual	Biennial	15% of SpB	15%	Biennial	Biennial
75,000 t <	SpB	≤ 100000 t	LRP - TRP	Transitional	15% of SpB	15%	Annual	Annual	12.5% of SpB	12.5%	Annual	Biennial	10% of SpB	10%	Biennial	Biennial
	SpB	≤ 75000 t	<LRP	Overfished	Closed	0%	Annual	Annual	Closed	0%	Annual	Biennial	Closed	0%	Biennial	Biennial

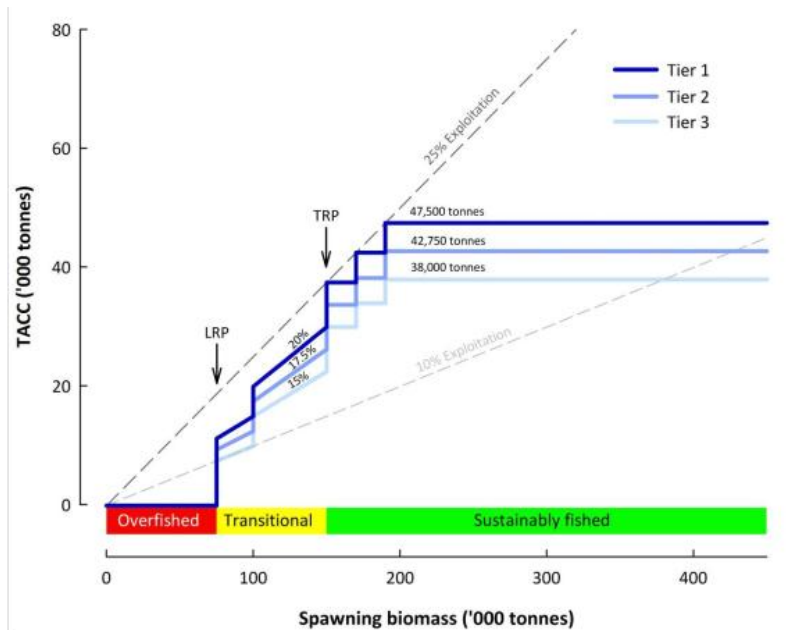


Figure 3: The relationship between spawning biomass, stock status, and level of exploitation (or TACC) of the sardine harvest strategy for each tier. Abbreviations: LRP – limit reference point; TRP - target reference point

6.1.2 Draft harvest strategy

The current harvest strategy (PIRSA 2007) has been reviewed in collaboration with industry stakeholders in developing a new management plan for the SASF. The draft harvest strategy includes the same three tiered approach for setting TACCs as in the current harvest strategy. In addition, to protect southern Spencer Gulf from adverse impacts on the ecosystem from depletion of adult fish the draft harvest strategy establishes a spatial management framework for the fishery. It is anticipated that the draft management plan will be implemented in 2014. The draft management plan is attached to this report.

Conservative exploitation rates are important for preventing ecosystem effects but may not be sufficient when fishing is highly concentrated in a small part of total area occupied by the stock. Because of the inherent difficulties and high costs of establishing strong evidence for the depletion of adult small pelagic

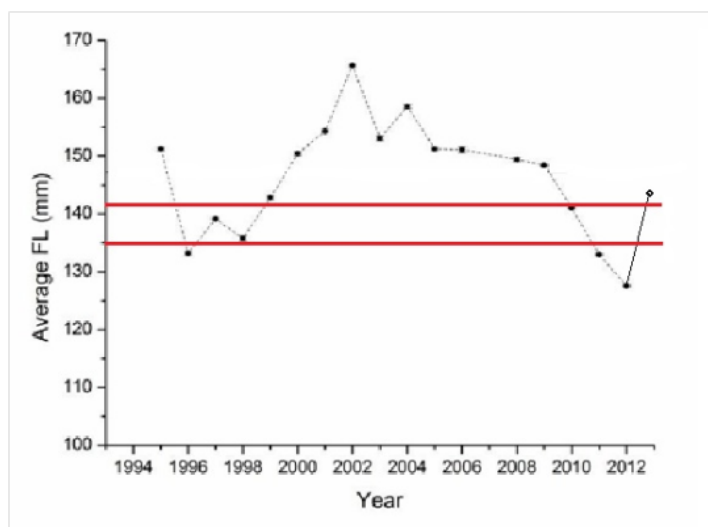


Figure 4: Mean fork length of catches from the Gulfs Zone by year (2013 is a partial data set) with the size based decision reference points (solid lines).

species and high levels of community concerns about fisheries that fish for low trophic level species, a precautionary approach has been adopted to address potential ecological impacts consistent with the “world’s best practice” adopted by Commission for the Conservation of Antarctic Marine Living Resources.

Ecosystem and trophic impacts from possible depletion of adult sardines in southern Spencer Gulf catches were first raised as concerns in 2004 and 2005 (Goldsworthy et al. 2011). Sardine size decreased from 2002 to 2012 in Spencer Gulf and Gulf St Vincent (termed the ‘Gulf’ zones), however then increased substantially in 2013 (Figure 4). It is unclear whether this reduction in fish size was attributed to reduced growth rates resulting from adverse environmental conditions, changes in size based distribution or movement patterns or the concentration of fishing effort in Spencer Gulf, or a combination of factors.

Sardine size as a proxy for the abundance of adult-sized sardines was considered the most practical option for monitoring changes in sardine size, with the least social and economic impact, to address the issue during the harvest strategy development in collaboration with industry.

The draft harvest strategy defines two zones in the sardine fishery for the purposes of spatial management decision rules; the Gulfs Zone (GZ) and the Outside Zone (OZ),

- Gulfs Zone (GZ) means the waters east Cape Carnot, Eyre Peninsula and north of latitude 35°52’00”S (extending to Kangaroo Island, in the vicinity of Vennachar Point). Then north of a line between Penneshaw, Kangaroo Island and Cape Jervis, Fleurieu Peninsula; enclosing the gulf waters.
- Outside Zone (OZ) means the South Australian waters excluding the GZ.

Once the fishery TACC has been determined, the maximum catch to come from the GZ will be determined on the basis of the mean size of the catch from the GZ to prevent the depletion of target size fish and maximise catches of optimal size sardines from the GZ. Under this spatial management framework no more than 30,000 tonnes of sardines will be taken from the gulfs in any single quota period (fishing season). Furthermore, where there is evidence of reductions in the mean size of fish taken from the GZ the maximum catch in the GZ will be reduced (i.e. to 27,000 or 24,000 tonnes depending on the mean size of fish taken in the previous quota period) (Table 4).

Table 4: Catch allocation decision table for the sardine harvest strategy to guide the maximum catch allowed from the GZ.

Mean Size of Sardines in GZ (MSS)	Maximum Catch Limits for GZ
142 mm < MSS	30,000 tonnes
135 mm < MSS ≤ 142 mm	27,000 tonnes
MSS ≤ 135 mm	24,000 tonnes

The reference point at which the TACC in the GZ is reduced from 30,000 to 27,000 tonnes is the point at which 50% of males and female sardines will be sexually mature (Ward et al. 2010a). The reference point at which the GZ TACC is reduced from 27,000 tonnes to 24,000 tonnes is considered a conservative lower level as below this size the numbers of fish that would be harvested would be substantially reduced.

The sardine harvest strategy only applies to the primary target species, Australian Sardine although the Australian Anchovy may be targeted in the sardine fishery, the level of exploitation of this species is considered to be at a developmental stage with a precautionary catch limit being set. Should expansion of anchovy fishing operations occur in the future, there is the potential to develop a harvest strategy for anchovy that is conceptually similar to the sardine harvest strategy.

6.2 Reporting

PIRSA monitors the catch in the fishery through catch disposal record (CDR) forms that record all landings of sardines. These forms are used to verify the volumes of sardines landed. In addition to completing the CDR form, each licence holder is required to complete a daily logbook (periodic return), with one record per net set. Information contained in the daily logbook is used to enhance research assessments by SARDI. The reporting requirements for the fishery are summarised in Table 2.

Licence holders from all South Australian commercial fisheries, including the SASF complete a wildlife interaction logbook each time an interaction occurs with a threatened, endangered or protected species (TEPS). In addition, the SASF report in real-time, interactions with TEPS to help improve transparency in industry TEPS reporting. A further detail about TEPS reporting is provided in section 7.

6.3 Allocation of shares of sardine and anchovy resources

The *Fisheries Management Act 2007* provides that, in determining the share of aquatic resources to be allocated to a particular fishing sector under the first management plan for an existing fishery, the share of aquatic resources to which that fishing sector had access at the time the Minister requested the management plan be prepared must be taken into account.

Sardine and anchovy TACCs will be allocated 100% to the commercial sector, reflecting the shares of the resource between the three sectors at the time the Minister requested the plan be prepared. The most recent recreational fishing survey reported no recreational take of sardines or anchovies (Jones 2009). Likewise, there is no record of these species being taken by Aboriginal traditional fishers and there have been no claims relating to sardines and anchovies in the native title claims for South Australia.

The shares to be allocated to each sector in relation to the South Australian sardine resource are set out in Table 5.

Table 5: Shares of sardine and anchovy resource to be allocated to each fishing sector.

Species	Commercial %	Recreational %	Aboriginal traditional %
Australian Sardines	100.0	0.0	0.0
Australian Anchovy	100.0	0.0	0.0

7. Interaction with Protected Species

In November 2004 an independent monitoring program was initiated to monitor interactions of the SASF with TEPS. The program was implemented to address recommendations from the (then) Australian Government Department of the Environment, Water, Heritage and the Arts for accreditation under the under the EPBC Act. The recommendations stipulated, among other things, that:

- mechanisms be established to allow fishers to record interactions with TEPS at a species level and at an appropriate level of accuracy
- if available information indicated that the sardine fishery was having significant interactions with any TEPS, that measures to mitigate those interactions should be implemented within 12 months.

To address these recommendations, a range of reporting activities have been put in place to monitor and record TEPS interactions in the SASF including:

- the 'Wildlife Interaction' identification and logbook;
- the SARDI 'SA Sardine Fishery Research' logbook (the catch and effort logbook);
- TEPS working group;
- an independent observer program; and
- industry real-time data collection.

In addition in 2005 industry implemented a code of practice (CoP) to mitigate against interactions with common dolphins by introducing an avoidance and delay approach and more recently implemented a real-time monitoring program.

An ecologically sustainable development (ESD) risk assessment for the SASF has recently been conducted and assessed the fishery's interactions with dolphins plus others including sygnathids, Mako Shark and other cetaceans (PIRSA in prep). The ESD risk assessment used the 'National Ecologically Sustainable Development Reporting Framework for Fisheries' developed by Fletcher et al. (2002) as the basis for conducting this assessment. All TEPS species considered were assessed as having a negligible risk, except for the risk to the fishery from interacting with Australian sea lion, which had a low risk rating and the social risks to the fishery from interacting with common dolphins, which had a medium risk rating. The ESD also reported that the current interaction levels with common dolphins in the SASF are having a minimal impact on the population, partly due to the new techniques employed by sardine fishers to release fishing nets when dolphins have been encircled (PIRSA, in prep).

7.1 Reporting

7.1.1 Wildlife Interaction identification and logbook

Since 2007 licence holders from all South Australian commercial fisheries, including the SASF complete a wildlife interaction logbook each time an interaction occurs with TEPS and provide the returns to SARDI with their monthly SA research logbook returns.

Wildlife interaction logbook returns of TEPS interactions are summarised and reported annually in reports entitled '*Interactions with Threatened, Endangered or Protected Species in South Australian Managed Fisheries*' which are available on the SARDI website. The latest version of this report is attached to this report.

According to the logbook returns submitted between 2007/08 and 2012/13 by the sardine fishery a number of TEPS interactions have occurred in the sardine fishery, including with seals, dolphins, and sharks (Tsolos and Boyle 2014) and are summarised in Table 6.

Table 6: Summary of wildlife interactions from 2007/08 to 2012/13. (Tsolos and Boyle 2014)

Species Name	# of Animals	Nature of Interaction				Status			Fate			
		Caught	Entanglement	Impact	Other	Alive	Alive/Injured	Dead	Released	Retained	Discarded	Other
Australian sea lion	4	1			3	4			1			3
Australian fur seal	1	0	1	0	0	0	0	1	0	1	0	0
New Zealand fur seal	2	2	0	0	0	1	0	1	1	1	0	0
Common seal	133	51	1	0	81	130	2	1	76	1	0	56
Common Dolphin	282	257	4	0	21	278	1	3	279	3	0	0
Dolphin	860	641	37	0	182	819	6	35	825	29	4	2
Great White Shark	11	8	0	0	3	11	0	0	9	0	0	2
Shearwater	2	0	2	0	0	0	0	2	0	0	2	0
TOTALS	1295	960	45	0	290	1243	9	43	1191	35	6	63

7.1.2 'SA Sardine Fishery Research' logbook

The sardine fishery logbook records information from each net set and are monitored by SARDI in assessing the performance of the fishery. In particular, these records provide a measure of the effort (fishing days and net sets) in the fishery. Fishers also record interactions with Seals, Sharks and Dolphins in this logbook.

7.1.3 TEPS working group

In 2008 the South Australia Sardine Industry Association (SASIA) and PIRSA agreed on a meeting schedule including quarterly TEPS Working Group meetings to monitor TEPS interactions reported in logbooks and by observers, and to review international standards for mitigation of interactions with marine mammals. The TEPS Working Group includes representatives from PIRSA Fisheries Policy and Compliance, South Australian Department of Water and Natural Resource, SARDI and industry. The group also monitors the industry CoP and considers refinements to existing practices. The group meets four times a year and more frequently if required.

Quarterly statistics about TEPS interactions are made available to TEPS Working Group for regular review. These reports/summaries include performance indicators which have been identified to assess the progress of the fishery in minimising interactions. These performance indicators are:

- encirclement rate;
- mortality rate; and
- difference between observer and logbook encirclements and mortalities.

7.2 Independent observer coverage

The current level of observer coverage in the fishery is 10% of net-sets and this coverage provides information on the rates of interactions independent to industry reports in the wildlife interaction logbooks.

The results from an independent program to monitor interactions of the sardine fishery with TEPS, specifically common dolphins, in 2004 revealed that the fishery was having high interaction rates with common dolphins and an independent observer program was put in place to independently monitor interactions. Initially observer coverage was set at 10% of fishing nights but increased to 30% in July 2007 due to the level of interactions (Hamer et al. 2009). In July 2010 the required level of observer coverage returned to 10% due to industry's improved ability to reduce the number of dolphin interactions. In 2013 observer coverage changed from being based on nights fished to the number of net sets, to improve the effectiveness and transparency of the program.

7.3 Industry Initiatives

The industry CoP was developed to mitigate against interactions with common dolphins and raise awareness with industry. In 2008 the CoP was reviewed and refined, including operators delaying the commencement of fishing prior to setting the net and dropping the front of the net when a dolphin is found to be enclosed in the net. This, together with improved implementation of the CoP, saw an increase in the effectiveness of the sardine industry to mitigate against interactions (Hamer et al. 2009).

A project undertaken in 2010 to analyse the effectiveness of the CoP, found it highly effective and successful in mitigating interactions with common dolphins (Ward et al. 2010b). The project also noted that observer data and logbook data were statistically different, with observer encirclements being 15 times higher and observer mortalities being 24 times higher than their respective logbook rates in the 2006/07 financial year (Ward et al. 2010b). This difference in interaction rates decreased and in 2009/10 to 2.9 times higher and 2 times higher, respectively, attributed to the industry's avoidance procedures, reaction times and the success of the adopted release procedures (Ward et al. 2010b). However, the discrepancy between the observer interaction rates and the logbook interaction rates was still apparent (Ward et al. 2010b). The level of reporting of interactions in logbooks has improved considerably since the observer program commenced in 2004 with the encirclement and mortality rates recorded in observer data and the logbook data now very similar (Ward et al. 2013b).

In late October 2011 the SASIA developed a process and began collecting real-time information on interactions to help improve transparency and remove discrepancy between interaction rates. In the most recently published TEPs data (Tsolos & Boyle 2014) there were five dolphin mortalities recorded in logbooks during 2011-12; over the same period one mortality was recorded by observers with approximately 7% observer coverage (Ward et al. 2013b) In comparison unpublished data from 2012-13 suggests there were four logbook mortalities (Tsolos & Boyle 2014) and one mortality recorded by observers (Ward et al. 2013b) with approximately 11% observer coverage. Compared to dolphin mortalities recorded in 2007/08, the level of interactions recorded in recent years indicates that the CoP has been effective at mitigating interactions with dolphins.

8. External Influences

The Great Australian Bight contains a broad continental shelf (up to 200 km wide) that is the location of the world's only northern boundary current upwelling ecosystem (Goldsworthy et al. 2011). The area where the continental shelf waters and the southern Spencer Gulf meet forms a complex oceanographic system (Goldsworthy et al. 2011). At the mouth of the gulf, thermal and salinity fronts limit the exchange

between cool, low-salinity water (outside the gulf) and the warmer, higher salinity water (inside the gulf). These conditions are suitable for the spawning, survival and growth of small pelagic fish, including sardines.

The impact of climatic and associated environmental drivers on the spatial distribution of adult sardines in the region remains poorly understood. Using information collected since 1998 on the distribution of sardines of different sizes and environmental parameters, industry with help from PIRSA and SARDI has gained support to undertake a research project to better understand the influence of environmental parameters (oceanographic factors) in driving variability in sardine size distributions.

9. Target Stock Status

The primary measure for stock status is the SpB, determined by both the DEPM and stock assessment model. The most recent SpB estimates are 180,000 tonnes (stock assessment model in 2012) and between 135,438 and 162,645 tonnes (DEPM survey in 2013). The estimated spawning area in the 2013 survey was lower than previous years as it may not have covered the entire area over which spawning occurred (Ward et al. 2013a) and therefore the DEPM survey has been undertaken again in 2014 (the results are not yet available).

The sardine stock is considered to be above the limit reference point of 75,000 tonnes, around the target reference point of 150,000 tonnes and is being fished sustainably (Ward et al. 2013a). The maximum exploitation rate is 25% of the spawning biomass and maintaining biomasses of low trophic level species, such as sardines, above 75% unfished biomass protects ecosystem function and biodiversity and considered to be particularly conservative for Australian ecosystems (Ward et al. 2013a).

The most recent stock assessment report for the sardine fishery has been completed by the SARDI for the 2012 fishing season (Ward et al. 2012). This report is available from the SARDI website and is attached to this report.

In 2000 the DEPM surveys conducted for sardines were extended into the northern part of the gulfs so a spawning biomass estimate of anchovy could be completed (Dimmlich et al. 2009). In 2000 the spawning biomass for Australian Anchovy in South Australian waters was over 126,000 tonnes (Dimmlich et al. 2009). The setting of the TACC for this species uses this information to set a precautionary TACC for the species. There is no recorded catch of anchovy and therefore it is considered that the fishery currently has no impact on the anchovy stocks in South Australia. No formal stock status for anchovy is available.

9.1 By-product and by-catch stock status

There is no provision under the SASF license conditions to retain any species other than the target species being Australian Sardines and Australian Anchovy and therefore there are no other by-product species.

The purse seine method for catching small pelagics is widely recognised as having very low by-catch rates (Kelleher 2005). Observer data collected in previous years supported this notion and was discontinued due to by-catch being so low. Under the new management plan the collection of by-catch information is planned to recommence.

Industry and observer reporting of interactions with TEPS identifies dolphins as the species with which the fishery has had the most interactions (Tsolos and Boyle. 2014), however other species have been reported as interacting with the fishery including seals, sea lions and sharks. At a workshop conducted as part of the ESD risk assessment of the fishery, fishery noted that common dolphins are very abundant in numerous regions across the world (PIRSA in prep.). There are no published estimates of population size

for common dolphins in Australian waters. Research by Flinders University has provided a preliminary estimate of stock abundance of common dolphins in certain areas surveyed off southern Australia up to approximately 20,000 individuals but the analysis was highly simplified for expediency (G. Parra 2013 pers. comm. cited in PIRSA in prep.).

Analysis of data collected through logbook records and the independent scientific observer program indicates that seal and sea lion interactions with the purse seine gear are common. However, it is extremely rare for these interactions to result in injury or mortality (only one mortality has ever reported from the observer program). This is due to the Australian sea lions ability to glide over the purse seine net when it is deployed. For this reason, the impact of the SASF on seals and sea lions is considered negligible. Interactions will continue to be monitored through the observer program for any changes. Interactions with sharks have been recorded but the incidence of interaction is extremely low.

While Australian sea lions and White Sharks are listed under the EBPC Act as Vulnerable, based on the level of interactions for these species, it is not considered that the sardine fishery significantly impacts on these populations in South Australia. The pup production of Australian sea lion colony at Dangerous Reef, the closest colony to the highest effort area of the sardine fishery, has been increasing exponentially (Goldsworthy et al. 2010) and only one mortality has been recorded in the fishery. Anecdotal evidence suggests that there has also been an increase in White Shark numbers around southern Eyre Peninsula.

10. Additional information

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11. Recommendations and conditions

Recommendation 1: Operation of the fishery will be carried out in accordance with the Management Plan for the South Australian Pilchard Fishery 2005 in force under the South Australian Fisheries Management Act 2007, the Fisheries Management (General) Regulations 2007 and the Fisheries Management (Marine Scalefish Fisheries) Regulations 2006.

The *Fisheries Management Act 2007* and regulations made under the Act, namely *Fisheries Management (Marine Scalefish) Regulations 2007*, the *Fisheries Management (General) Regulations 2007*, the *Fisheries Management (Demerit Points) Regulations 2009* and the *Fisheries Management (Fish Processor) Regulations 2007*, provide for the management of SASF.

A draft management plan for the 'South Australian Commercial Marine Scalefish Fishery – Part B – management arrangements for the taking of sardines' have been developed in accordance with the *Fisheries Management Act 2007*. The draft plan provides the broad policy framework to guide management decision-making for the fishery. This plan is due for implementation in 2014.

Progress: ONGOING

Recommendation 2: PIRSA to advise DotE on any material change to the SASF's management arrangements, including to the Code of Practice for Mitigation of Interactions of the South Australian Sardine Fishery with Threatened, Endangered and Protected Species, that may affect the assessment of the fishery against the criteria on which EPBC decisions are based, within 3 months of that change being made. :

PIRSA understands the importance of maintaining regular and open lines of communication with DotE, and will continue to communicate any changes in the management arrangements of the SASF that may affect the assessment of the fishery against the criteria on which EPBC Act decisions are based. PIRSA has and will continue to communicate these changes as they arise, and through the annual reporting process.

Progress: ONGOING

Recommendation 3: PIRSA to produce and present reports to DotE annually as per Appendix B to the Guidelines for the Ecologically Sustainable Management of Fisheries - 2nd Edition

PIRSA has produced and presented reports to DotE on annual basis since 2005. The information provided in these reports is consistent with that recommended in Appendix B to the *Guidelines for the Ecologically Sustainable Management of Fisheries - 2nd Edition*. PIRSA will continue to produce and present reports to DotE on annual basis to ensure this recommendation is achieved.

Progress: ONGOING

Recommendation 4: PIRSA to

- a. **Review common dolphin interactions quarterly and provide annual reports to DotE.**
- b. **Should new information determine that the fishery is having an increasing amount of interactions with protected species, PIRSA to develop appropriate measures to mitigate those interactions. Measures should be implemented within 12 months of the information becoming available.**

The TEPs Working Group has been established by the SASIA which meets quarterly to monitor and report to PIRSA on the level of interactions/encirclements and differences between the interaction/encirclement rates recorded in logbooks and by observers, and review international standards for mitigating interactions with marine mammals. The TEPS Working Group is an Association subcommittee with representatives from PIRSA Fisheries Policy and Compliance, The Department of Environment, Water and Natural Resources of South Australia, SARDI and the industry (representative owners and skippers). A summary of quarterly statistics on TEPS interactions are presented to TEPS Working Group for regular review. The group monitors reported interactions from the various sources as well as the implementation of the CoP. The group meets four times a year and more frequently if required.

As new information becomes available, the TEPS Working Group considers refinements to existing practices if required. For example, in response to discrepancies between observer and industry reported dolphin interactions, the SASIA developed a process of real-time reporting on interactions to help improve transparency and remove discrepancy between interaction rates. There has been a subsequent decrease

in the difference between reported interaction rates indicating that this industry-led initiative has improved transparency of reporting frameworks. In addition, this has resulted in the ability of the fishery to respond to interactions with TEPS in appropriate timeframes if necessary.

An annual published report on interactions and implementation of the CoP is prepared by SARDI and provided to DotE with the annual progress reports. It is also attached to this report.

Progress: ONGOING

Recommendation 5: PIRSA to revise the current format of Wildlife Interaction Identification and Logbook to include species specific identification of the dolphin and whale species that occur within the SASF.

All sardine operators have been provided with AFMA Species Identification guides to be carried onboard vessels to provide for species specific identification. In addition, ongoing education and awareness by fishers through the SASIA and TEPS Working Group is improving reporting to species level by fishers. PIRSA plans to include improved identification guides for high priority TEPS in the Wildlife Interaction Logbooks when these are to be reprinted, but given the level of other education activities, this is viewed as less of a priority at this time.

Progress: SUBSTANTIAL

Recommendation 6: PIRSA to conduct an assessment of the risks to target species, by-product by-catch (including protected species) and the marine environment resulting from activities in the SASF. PIRSA to then implement measures to ensure that risks identified through this process are addressed and minimised as appropriate.

An ESD risk assessment for the SASF has been conducted and assessed the fishery's interactions with these species plus others including syngnathids, Mako Shark and other cetaceans (PIRSA in prep). All TEPS species were assessed as negligible risk except for the risk to the fishery from interacting with Australian sea lion, which had a low risk rating and the social risks to the fishery from interacting with common dolphins, which had a medium risk rating.

The ESD risk assessment found that the current interaction levels with common dolphins in the sardine fishery are having a minimal impact on the population. This is partly due to the new techniques employed by sardine fishers to release their fishing net when dolphins have been encircled in a shot. A draft of the ESD risk assessment report is attached to this report.

The outcomes from the ESD risk assessment were fundamental in developing the draft management plan for the fishery which is currently being finalised. The draft management plan was released for public comment in November 2012 and is currently being finalised with planned implementation in 2014.

Progress: COMPLETE

Recommendation 7: PIRSA to

- a. **determine a reference point beyond which a recovery strategy would need to be developed to ensure long term sustainability of the SASF;**
- b. **and within 3 months of becoming aware of a breach of a limit reference point, PIRSA to finalise a clear timeframe for the implementation of an appropriate management response.**

Development of a new management plan for the sardine fishery has included a review of the harvest strategy for the fishery to be consistent with the guidelines for national harvest strategies described in Sloan et al. (2014).

The draft harvest strategy clearly sets out a structured framework for decision-making that ensures the ecologically sustainable development objectives of the *Fisheries Management Act 2007* are achieved. The decision-making framework involves two main steps and will be undertaken each year prior to the start of the new fishing season.

- Step 1 uses the frequency of stock assessments and fishery DEPM to set the appropriate exploitation rate. Using this exploitation rate and the most recent spawning biomass estimate of sardines, the TACC is calculated for the following fishing season.
- Step 2 uses the mean size of sardines caught in a fishing year to maintain the spawning biomass of sexually mature sardines in the gulfs above 50%, by controlling the TACC in the gulfs the following year. Under this spatial management framework no more than 30,000 tonnes of sardines will be taken from the gulfs in any single quota period (fishing season). Furthermore, where there is evidence of reductions in the mean size of fish taken from the GZ the maximum catch will be reduced even further (i.e. to 27,000 or 24,000 tonnes depending on the mean size of fish taken in the previous quota period).

The draft harvest strategy has prescribed a limit reference point at 75,000 tonnes, under the first decision rule if the spawning biomass falls below this figure the fishery would be closed to sardine fishing. The draft harvest strategy decision rules allows for timely implementation of appropriate management responses where the limit reference point is breached. The draft management plan and harvest strategy is currently being finalised with planned implementation in 2014.

Progress: SUBSTANTIAL

Recommendation 8: PIRSA to continue to cooperate with relevant jurisdictions to pursue complementary research and ensure that the management arrangements for the fishery continue to take into account the results of research conducted.

All reports produced about the SASF are made available to other jurisdictions.

PIRSA and SARDI continue to monitor and maintain communication with the South East Management Advisory committee and the Small Pelagic Fishery Resource Assessment Group.

Progress: ONGOING

Condition 1: Primary Industries and Regions South Australia to:

- a. ensure that SASF participants adopt appropriate measures to mitigate interactions with common dolphins (*Delphinus delphis*);**
- b. continue to investigate, develop and implement measures that seek to reduce the level of interactions between SASF and common dolphins; and**
- c. continue to monitor the level of interactions with all protected species in the SASF**

In response to the interactions industry implemented a CoP was developed by the SASIA in 2005 to mitigate against interactions with common dolphins by introducing an avoidance and delay approach. In 2008 the CoP was reviewed and refinements were made, including operators delaying the commencement of fishing prior to setting the net and dropping the front of the net when they notice a

dolphin enclosed in the net. This, together with improved implementation of the CoP, saw an increase in the effectiveness of the sardine industry to mitigate against interactions (Hamer et al. 2009).

In response to reported discrepancies between observer and industry reported rates of dolphin interactions, the SASIA began collecting real-time information on interactions in 2011 to help improve transparency and remove the discrepancy between interaction rates. The level of reporting of interactions has improved considerably since introduction of the real-time monitoring has been introduced and observed rate of encirclement was similar to logbook rate in 2011/12 (Ward et al. 2013b). PIRSA expects this trend to continue.

During 2014 SASIA recently met with Professor Steve Kennelly, of IC Independent Consulting, to review international bycatch management advancements for purse seine fishing around the world.

PIRSA continues to monitor the levels of interactions quarterly through the TEPS Working Group that monitors the level of interactions and differences between the two interaction rates and review international standards for mitigation of interactions with marine mammals.

Progress: ONGOING

Contact Officer: Brad Milic

Phone: (08) 8204 9987 Email: brad.milic@sa.gov.au.

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13. Attachments:

Interactions with Threatened, Endangered or Protected Species in South Australian Managed Fisheries – 2012/13 (Tsolos and Boyle 2014) Report to PIRSA Fisheries and Aquaculture. Summarises interactions with TEPs by fishery and by gear type and can be found at [http://www.sardi.sa.gov.au/data/assets/pdf_file/0015/220092/Wildlife Interactions in SA Fisheries 2013 - FINAL.pdf](http://www.sardi.sa.gov.au/data/assets/pdf_file/0015/220092/Wildlife_Interactions_in_SA_Fisheries_2013_-_FINAL.pdf)

South Australian Sardine (*Sardinops sagax*) Fishery: Stock Assessment Report 2012. Report by SARDI assessing the status of the SASF (Ward et al. 2012). Can be found at [http://www.sardi.sa.gov.au/data/assets/pdf_file/0006/178620/2012 Sardine Fishery Stock Assessment Report.pdf](http://www.sardi.sa.gov.au/data/assets/pdf_file/0006/178620/2012_Sardine_Fishery_Stock_Assessment_Report.pdf)

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Effectiveness of an industry Code of Practice in mitigating the operational interactions of the SASF with the short-beaked common dolphin (*Delphinus delphis*). Most recent report reviewing effectiveness of industry CoP (Ward et al. 2013b). Can be found at [http://www.sardi.sa.gov.au/data/assets/pdf_file/0004/214573/Sardine Fishery Interactions Report - FINAL.pdf](http://www.sardi.sa.gov.au/data/assets/pdf_file/0004/214573/Sardine_Fishery_Interactions_Report_-_FINAL.pdf)

Draft Management plan for the South Australian Commercial Marine Scalefish Fishery, Part B – management arrangements for the taking of sardines. Draft of the management plan currently in development (PIRSA in prep.). As of 1 August 2014 a previous draft can be located at [http://www.fisheriescouncil.sa.gov.au/data/assets/pdf_file/0006/212946/Draft Management Plan - Sardine Fishery.pdf](http://www.fisheriescouncil.sa.gov.au/data/assets/pdf_file/0006/212946/Draft_Management_Plan_-_Sardine_Fishery.pdf)

ESD risk assessment of the South Australia's Sardine Fishery. Describes outcomes of an ESD risk assessment of the SASF conducted in preparation of the draft management plan (PIRSA in prep.). As of 1 August 2014 a previous draft can be located at [http://www.fisheriescouncil.sa.gov.au/data/assets/pdf_file/0008/212948/Draft ESD Risk Assessment - Sardine Fishery.pdf](http://www.fisheriescouncil.sa.gov.au/data/assets/pdf_file/0008/212948/Draft_ESD_Risk_Assessment_-_Sardine_Fishery.pdf)