

MSC ASSESSMENT REPORT The Lakes and Coorong Fisheries Southern Australia

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1 INTRODUCTION

The Marine Stewardship Council (MSC) is a non-profit organization dedicated to the long-term protection or “sustainability” of marine fisheries and related habitats. First started as a joint initiative between Unilever and the World Wildlife Fund (WWF), the MSC is now a fully independent organization that is governed by an independent Board of Directors advised by a panel of scientific, economic, and fishery experts.

The MSC’s original mission statement promoted responsible, environmentally appropriate, socially beneficial, and economically viable fisheries practices, as well as the maintenance of biodiversity, productivity and ecological processes of the marine environment. The current MSC mission statement (redrafted in 2001) provides a slightly more focused mission and reads,

“To safeguard the world’s seafood supply by promoting the best environmental choice”.

Dedicated to promoting “well-managed” or “sustainable” fisheries, the MSC initiative intends to identify such fisheries through means of independent third-party assessments and certification. Once certified, fisheries will be awarded the opportunity to utilize an MSC promoted eco-label to gain economic advantages in the marketplace. Through certification and eco-labelling, the MSC intends to promote and encourage better management of world fisheries, many of which have been suggested to suffer from poor management.

The Marine Stewardship Council developed standards for sustainable fisheries management in a three-step process (May, Leadbitter, Sutton, and Weber, 2003): 1) Assemble a group of experts in Bagshot (UK) to draft an initial set of Principles and Criteria; 2) Conduct an 18-month process to review the standard in 8 major international venues; and 3) Convene a second set of experts in Warrenton, Virginia (Airlie Conference Center, USA) to revise and finalize the MSC Principles and Criteria.

The final MSC Fisheries Certification standard was issued in 1998, and has since been used as the basis by which fisheries are evaluated under the MSC program.

1.1 THE FISHERY PROPOSED FOR ASSESSMENT

The fisheries evaluated in this report are:

Species:	Lakes and Coorong Commercial Fisheries A small-scale, multi-species, multi-method fishery
Geographic Area:	Lakes and Coorong, Southern Australia
Fishing Method:	Mesh Nets, Swinger Nets, Hauling nets, Drum Net, Cockle Rake, Cockle Net
Fishery Management:	The Minister of Fisheries, PIRSA, Inland Fisheries Management Committee, SAFIC, SARDI, SFA

Scope of Assessment: Mulloway, Goolwa Cockle, Golden Perch, Yellow Eyed Mullet

2 LAKES AND COORONG FISHERIES

2.1 Geographic and Environmental Context

The lower Murray lakes and Coorong region is situated at the tail end of the largest freshwater catchment in Australia, the Murray-Darling Basin, where the river system meets the Southern Ocean. The entire catchment spans across four state management jurisdictions and has been significantly modified since European settlement because of its importance in supporting human existence and industrial development. The introduction of various water flow management measures, water extraction systems, the associated barriers to fish migration, the proliferation of a number of exotic fish species and pollution from agricultural run-off have collectively served to modify the structure, productivity and function of the entire ecosystem.

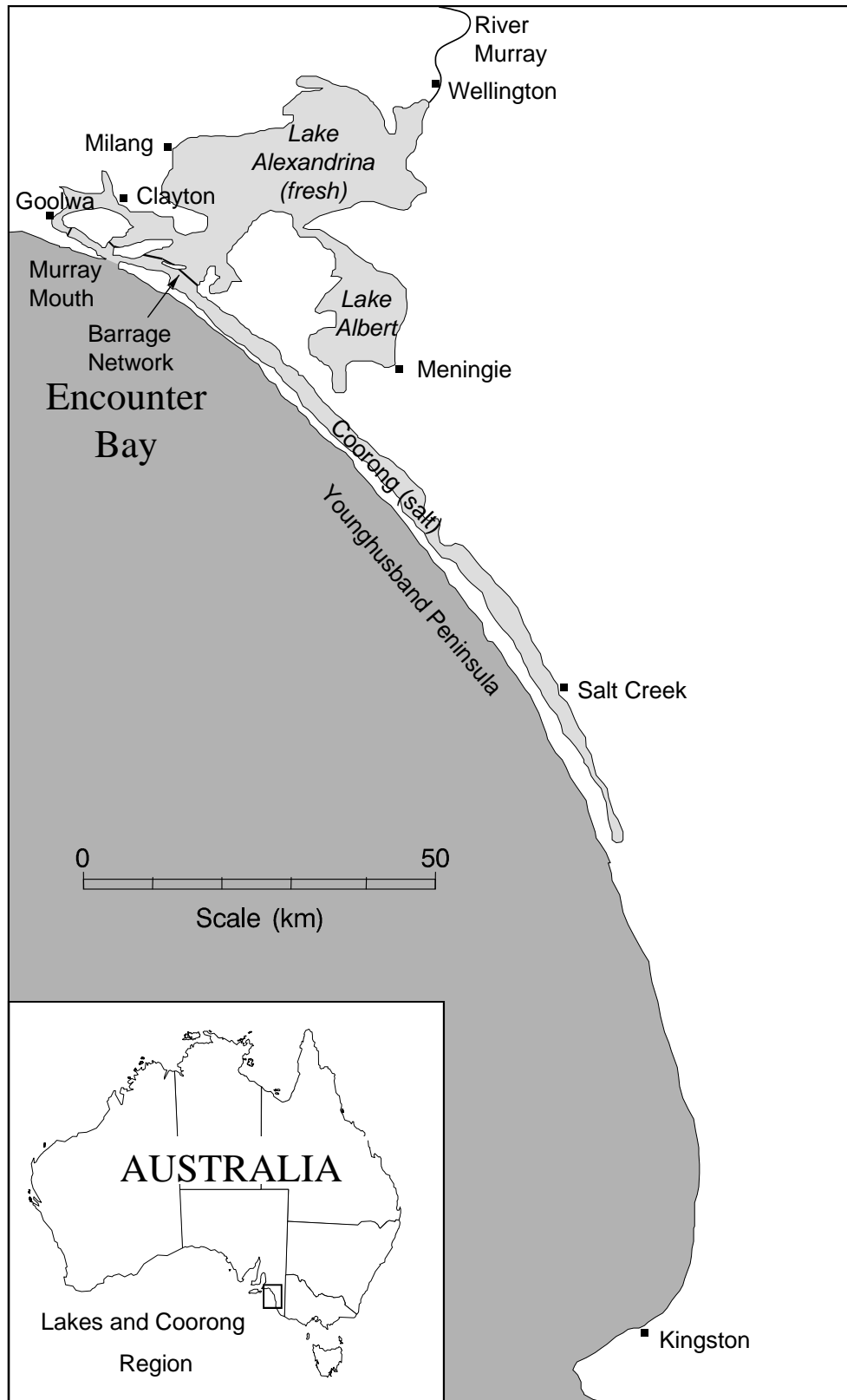
The fishery includes area of the waters of three separate, but closely linked, freshwater, estuarine and marine ecosystem components including:

- The lower River Murray lakes (Lake Alexandrina and Lake Albert);
- The Coorong lagoons; and
- Coastal marine waters adjacent to the Sir Richard and Youngusband Peninsulas, out to three nautical miles from the low water mark.

The fishery operates within an area designated as wetland of international importance under the Ramsar Convention, and within the boundaries of the Coorong National Park, an area recognised primarily for its wetland habitats and importance for a variety of migratory waterbirds.

The fishery operates within a very dynamic ecosystem, which is influenced by high natural variation in river flooding and periods of extended drought. This presents challenges to management, with respect to matching total harvesting capacity and exploitation rates with annual changes in fish stock abundance, particularly during extended periods of drought.

Figure 1. MAP OF LAKES AND COORONG REGION



2.1.1 The Coorong National Park

The Lower Murray Lakes and Coorong provide one of the most significant wetland habitats in Australia. The area provides an important refuge for migratory waders and waterfowl, particularly during periods of drought. A National Park Management Plan for the Coorong was finalised in 1990, in accordance with the *National Parks and Wildlife Act 1972* to deliver conservation outcomes consistent with the following broad National Park objectives (DEP 1990):

The commercial fishery operates within the boundaries of the Coorong National Park. The above objectives have been taken into account in the development of the harvest strategy for the Lakes and Coorong Fishery, to achieve where possible, complementarity between management of the fishery and management of the National Park.

2.1.2 Ramsar

The waterbird habitats of the Lower Murray Lakes and Coorong region were designated as wetland of international importance under the Ramsar Convention in 1985. These wetlands provide habitat for many local species as well as for migratory wading birds. A Ramsar Management Plan for the Lower Lakes and Coorong was prepared in 2000 to fulfil the Australian Government obligations under the Convention agreement. The 'Coorong and Lakes Alexandrina and Albert Ramsar Management Plan' provides an integrated management framework to promote wise use and conserve the ecological character in the Lakes and Coorong wetlands, while taking into account the social, cultural and economic values attached to the area (DEH 2000).

2.1.3 Water Regulation Authorities

The Murray-Darling Basin *Initiative* is the partnership between the governments and the community which has been established to give effect to the 1992 Murray-Darling Basin Agreement. The purpose of the Agreement (Clause 1) is 'to promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin'. The *Initiative* is the largest integrated catchment management program in the world, covering the watersheds of the Murray and Darling rivers, an area of over one million square kilometres.

The Commission is the executive arm of the Murray-Darling Basin Ministerial Council and is responsible for:

- managing the River Murray and the Menindee Lakes system of the lower Darling River, and
- advising the Ministerial Council on matters related to the use of the water, land and other environmental resources of the Murray-Darling Basin.

The Commission is an autonomous organisation equally responsible to the governments represented on the Ministerial Council as well as to the Council itself. It is not a government department or a statutory body of any individual government.

The Murray-Darling Basin Commission Native Fish Strategy (NFS) identifies flow regulations as one of eight key threats to the native fish management across the Basin. The NFS aims to promote a co-ordinated Basin-wide approach to address these issues (MDBC, 2003b). To address this issue, the South Australian Department of Water, Land and Biodiversity Conservation Environmental Flows Program is currently developing a barrage operating strategy as part of the Living Murray Asset Management Plan for the Lower Lakes, Coorong and Murray Mouth. This operating strategy will take into account the diverse environmental needs of the Lakes and Coorong environment, including fish stocks.

The Department of Water, Land and Bio-diversity Conservation Environmental Flows Program develop policy and initiates projects for the management and use of environmental flows. Environmental flows are flows for the specific purpose of maintaining and enhancing ecological assets of the region.

2.1.4 Barrages

The natural ecosystems supporting fisheries resources throughout the River Murray and lower lakes and Coorong region have been dramatically modified since early European settlement in South Australia. Most of these modifications have been directed at water flow control and water extraction. An extensive barrage network was constructed near the Murray Mouth in 1940 (see fig 1) to:

- Reduce salinity levels in the lower Murray River and lakes;
- Stabilise the river level to provide for irrigation and human consumption; and
- Concentrate releases to the ocean to a small area and so scour a channel for navigation, during periods of low water flow (MDBC, 2005).

Completion of the Coorong Barrage network converted 89% of the original estuarine habitat of Australia's most important river into permanently impounded freshwater changing the natural flow regime, which has altered the morphology of the Murray Mouth and imposed significant impediments to natural fish passage.

This had a generally negative impact on the overall health of the ecosystem, in particular the habitat available for a range of estuarine dependant fish species, native plants and waterbirds. Use of the barrage network has significantly reduced the flow of water into and out of the river mouth under tidal influence. Because of this, the Murray Mouth approaches closure more frequently than would have occurred naturally. Flow management can result in abrupt changes to salinity levels and overall water quality in the Coorong estuary, which disrupts the natural reproductive cycles and movement patterns of many fish species. The net result of these factors and other external impacts on the fishery is that there are varied and acute pressures placed on fish stocks and the ecosystem that supports them, particularly during periods of drought.

2.1.5 Fishways

The construction of the barrages formed a barrier between the fresh water Lakes and Coorong estuary and prevented fish from moving between freshwater and sea water as part of their natural life cycle, except when the barrage gates were open. The frequency of barrage gate opening has been reduced over time due to the ongoing competing demands for water use, reducing the habitat available for fish to complete their life cycle.

Natural fish passage in the Lakes and Coorong is affected by the barrage network, which restricts fish passage between the Lakes and the Coorong Lagoons and the Murray mouth. When the mouth is threatened by closure, this can restrict natural movement between the ocean and the Coorong lagoons and hence between the River Murray Lakes and the Sea.

The Murray-Darling Basin Ministerial Council have recognised the impact that barriers to fish passage have caused and have funded a \$25m project to provide fish passage from the Sea to Hume Dam, through the Living Murray Implementation Program. Part of this program includes fish passage at the River Murray barrages. Four fish passages are being trailed to test their effectiveness under estuarine conditions, two at the Goolwa Barrage and two at the Tauwichee Barrage.

2.2 History of Fishing and the Fishery

The lower Murray Lakes and Coorong region has been important to Aboriginal people throughout the entire period of their habitation of Australia. Archaeological evidence to support this is provided by middens containing cockle shells and the remains of fish and terrestrial animals, traditional camp sites, meeting places, rock formations and burial sites (Leubbers, 1981). These sites are found throughout the Lakes and Coorong region in a greater frequency than other locations throughout Australia (Leubbers, 1981).

The physical character, natural resource base and overall health of the Lakes and Coorong region, including the River Murray Mouth, harbours significant cultural and spiritual importance for the Ngarrindjeri people (Hemming, Trevorrow and Rigney, 2002). Ngarrindjeri people still practice traditional fishing and food gathering in the Lakes and Coorong region. Camp Coorong also engages in cultural and traditional fishing for educational purposes.

The State is currently engaged in negotiations with native title claimant representative bodies and the commercial fishing industry in relation to resolving native title claims through negotiated agreements. Both the Act review process and the agreement negotiation process will inform the way that access to fisheries resources by Aboriginal communities is defined and implemented in the Lakes and Coorong Fishery.

Fishing enterprises have been carried out in the lower Murray lakes and Coorong region since early European settlement and have been documented from as early as 1846. During this early period of development, the fishery was characterised by artisanal and subsistence operations, with most fishers operating on a seasonal basis.

Large catches of mulloway were taken mainly for their swim bladders which were dried to produce isinglass for use in early brewing procedures (Olsen, 1991). As commercial fishing developed in the region, Goolwa and Milang served as bases for commercial fish landings. Fresh and preserved fish were consigned for sale at the Adelaide fish markets (Olsen, 1991).

The main species taken from the region during this period were mulloway, bream, yellow-eye mullet, Australian salmon and Tommy-ruff. Fishing equipment used included locally built, naturally aspirated wooden vessels, set lines and various net designs with different lengths and mesh sizes, all constructed from natural fibres (Olsen, 1991).

In 1896, there were approximately 30 full time commercial fishers operating in the lakes and Coorong region, based mainly at Goolwa and Milang. The South Australian Government introduced a requirement in 1906 for all commercial fishers to hold a commercial fishing licence. In 1915, there were 15 licensed commercial fishers operating in the lakes and Coorong region, however, the number of unlicensed fishers may have been significantly greater at times, particularly during the depression years and when the steamer trade through Goolwa slowed due to low river flows.

In 1940, following barrage construction in the Coorong, there were 64 fishing licences issued in the lakes and Coorong region. This number dropped to 13 by 1970, evidently due to military enlistments and regulations on the number of additional agents (persons assisting fishing operations) permitted. Following this, records indicate that the number of licensed commercial fishers in the fishery rose to a maximum of 106 fishers in 1972 (Olsen, 1991), before being substantially reduced with the introduction of new licensing criteria.

2.3 Current Lakes and Coorong Fishery

Although modern technologies and materials (such as motor powered aluminium fishing vessels and synthetic fibres used to construct fishing nets) have been adopted, changes to fundamental fishing practices have been relatively superficial, when compared to the advances made in many other commercial fisheries. This reflects the unique characteristics of the lakes and Coorong region and a desire from the commercial industry and Government to contain effective fishing effort levels within historical and sustainable limits.

Production from the estuarine component remains dominated by mulloway, bream, yellow-eye mullet and occasional marine species as well as cockles. Mulloway harvest data demonstrates the over-riding impact of habitat loss on this valued native fish. Some freshwater species such as golden perch, bony bream and carp have benefited from the creation of larger areas of freshwater habitat in the lower lakes. Consequently production from the freshwater region is dominated in unit-value by native callop (golden perch) and in abundance by European carp and bony bream.

European carp have become a dominant in this man-modified system after their illegal release into the Murray catchment circa 1970. For a considerable period post-impoundment, yabby production continued at high levels meeting both local and international market demands.

However, this fishery has subsequently virtually disappeared leaving little evidence as to the cause of its demise.

Fish recruitment levels in the Lakes and Coorong Fishery are primarily driven by variation in environmental conditions, in particular the frequency of flooding and the extent of drought periods (Pierce and Doonan, 1999). As such, the biological productivity of most major fish species and the economic productivity of the fishery will continue to fluctuate in line with variations in environmental conditions such as freshwater outflows (regulated both naturally and artificially).

2.3.1 Harvest

Thirty-seven commercial fishers target a diversity of native and exotic finfish species (Table 1) throughout the fishery, predominantly using mesh nets. A species of surf clam (*Donax deltoides*) is harvested from the ocean beaches using manual raking methods. The primary species taken in the fishery include mulloway (*Argyrosomus japonicus*), Goolwa cockle (*Donax deltoides*), yellow-eye mullet (*Aldrichetta forsteri*), golden perch (*Macquaria ambigua*), greenback flounder (*Rhombosolea tapirina*), black bream (*Acanthopagrus butcheri*) and bony bream (*Nematalosa erebi*), the harvest value of which is shown in Figure 2. Important exotic fish taken in the fishery include European carp (*Cyprinus carpio*) and redfin (*Perca fluviatilis*). A number of other marine, estuarine and freshwater species (native and exotic) are also harvested. (see Table 1).

Figure 2: Gross Value of Production for Key Species

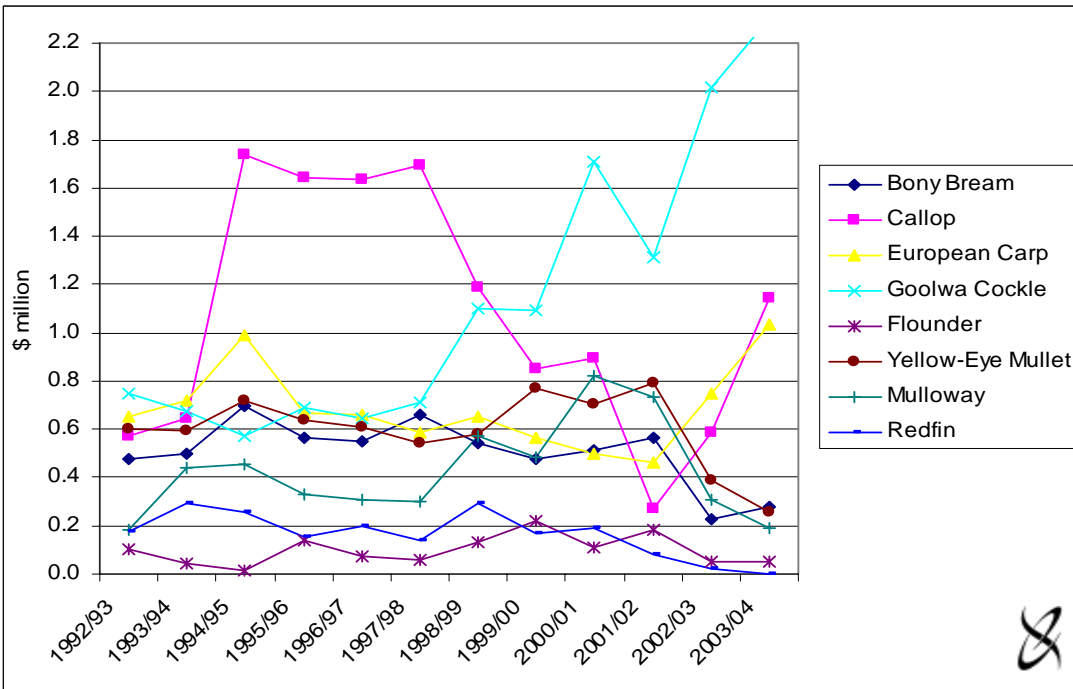


Table 1. Commercial Species

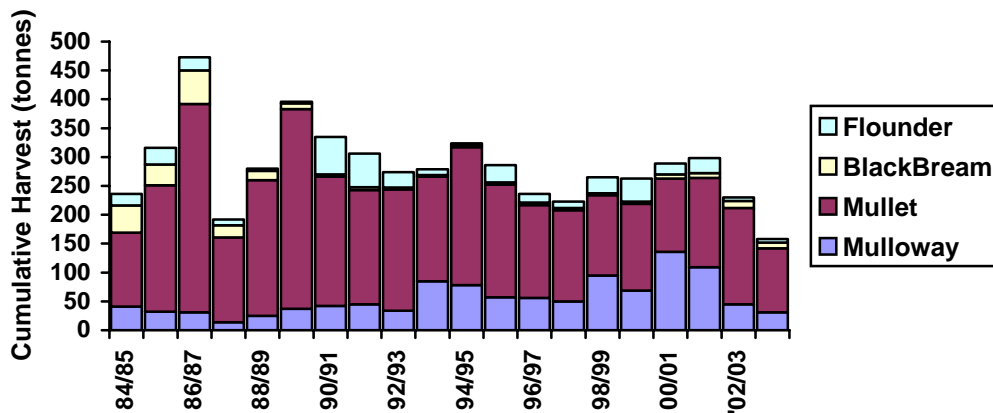
Scalefish
Anchovy (<i>Engraulis australis</i>)
Barracouta (<i>Thyrsites atun</i>)
Bluethroated wrasse (<i>Notolabrus tetricus</i>)
Bony bream (<i>Nematalosa erebi</i>)
Black bream (<i>Acanthopagrus butcheri</i>)
Carp (all species) (Family Cyprinidae)
Freshwater catfish (<i>Tandanus tandanus</i>)
Cod (marine species) (Family Moridae)
Congolli (<i>Pseudaphritis urvilli</i>)
Dory (Family Zeidae)
Flathead (Family Platycephalidae)
Flounder (Family Pleuronectidae)
Southern sea garfish (<i>Hyporhamphus melanochir</i>)
River garfish (<i>Hyporhamphus regularis</i>)
Mullet (all species) (Family Mugilidae)
Mulloway (<i>Argyrosomus japonicus</i>)
Murray cod (<i>Maccullochella peeli</i>)
Nannygai, Red snapper, Swallowtail (Family Berycidae)
Perch, golden (callop) (<i>Macquaria ambigua</i>)
Redfin (<i>Perca Fluviatilis</i>)
Silver perch (<i>Bidyanus bidyanus</i>)
Pilchard (<i>Sardinops neopilchardus</i>)
Salmon (<i>Arripis truttacea</i>)
Snapper (<i>Chrysophrys auratus</i>)
Snook (<i>Sphyræna novaehollandiae</i>)
Sole (<i>Aserragodes haackeanus</i>)
Sweep (<i>Scorpiæ aequipinnis</i>)
Tommy ruff (<i>Arripis georgiana</i>)
Trevalla (<i>Hyperoglyphe antarctica</i>)
Trevally (<i>Usacaranx georgianus</i>)
Trout, brown (<i>Salmo trutta</i>)
Rainbow (<i>Oncorhynchus mykiss</i>)
Whiting (Family Sillaginidae)
Crustaceans
Freshwater shrimp (<i>Macrobrachium australiensis</i>)
Crabs (Family Portunidae)
Yabbies (<i>Cherax destructor</i>)
Molluscs
Cockle (Suborder Teledonta)
Squid, calamary (<i>Sepioteuthis australis</i>)

Squid, arrow (<i>Nototodarus gouldi</i>)
Mussels (Family Hyriidae)
Mussels (<i>Mytilus</i> spp.)
<i>Annelids</i>
Bloodworm (Class Polychaeta)
Tubeworm
<i>Shark, Skate and Rays</i>
All species other than white pointer shark (<i>Carcharodon carcharias</i>) (Class Elasmobranchii)

2.3.1.1 Coorong Lagoon and Ocean Beach

The annual commercial harvest by Lakes and Coorong Fishery licence holders for the target species harvested in the Coorong Lagoon (flounder, black bream, yellow-eye mullet and mulloway) and the ocean beach component (mulloway) is provided in Figure 3. The size of the combined harvest did not change substantially between 1988/89 and 2001/02, however, it has decreased significantly in the past two years. Over the period of stable total harvests, the relative proportion of the harvest of mulloway increased, but mullet, black bream and greenback flounder harvest decreased. In the last two years, the harvest of yellow-eye mullet was proportionally the largest for all finfish species targeted in the Coorong lagoon.

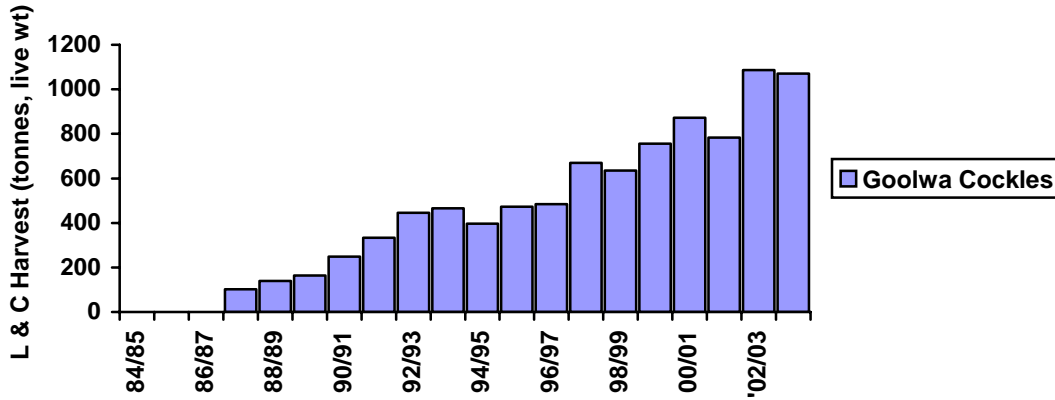
Figure 3: Commercial harvest of greenback flounder, black bream, mullet and mulloway by Lakes and Coorong Fishery licence holders from 1984/85 to 2003/04.



Commercial fishers use cockle rakes (sometimes referred to as cockle nets) to manually harvest Goolwa cockles from the Coorong ocean beaches. No mechanised harvesting methods are permitted in the fishery. The commercial sector has established an industry position opposing the use of mechanised cockle harvesting techniques to minimise the risk of overexploitation. Commercial catch and effort levels have increased substantially since the early 1980s, due mainly to increased demand for cockles associated with the development of a

market for human consumption (Fig. 4). Goolwa cockles have become the most important species in the Lakes and Coorong Fishery, in terms of both production and value.

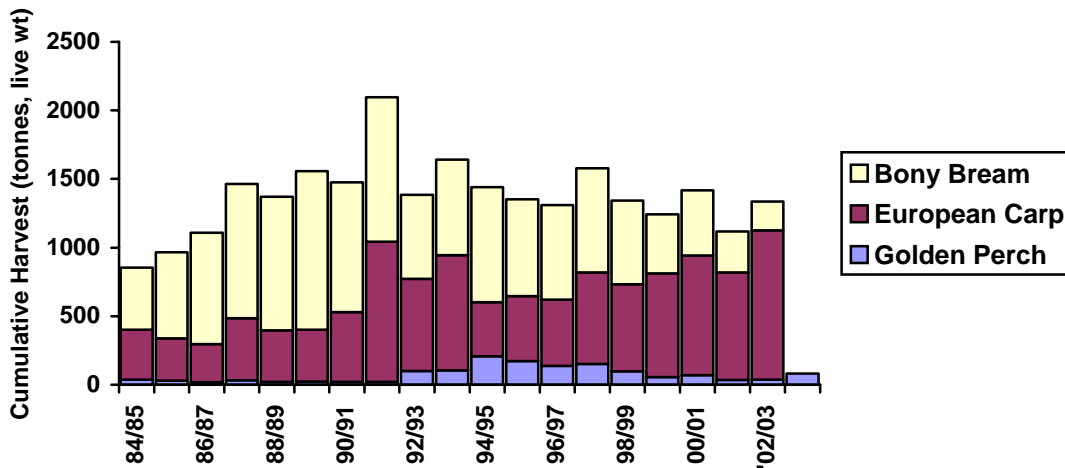
Figure 4: Annual commercial harvest of Goolwa cockles by Lakes and Coorong Fishery licence holders from 1984/85 – 2003/04



2.3.1.2 Lakes Fishery

Commercial fishing in Lake Alexandrina and Lake Albert largely comprises the target species European carp and bony bream, with the proportion of the harvest of carp increasing and that for bony bream decreasing (Fig. 5). During the 1990’s, a small but highly valued component of the lakes fishery consisted of golden perch, however the size of this harvest has declined in recent years. This has been mainly due to increase in effort on cockles.

Figure 5: Commercial harvest of bony bream, European carp and golden perch by Lakes and Coorong Fishery licence holders from 1984/85 to 2003/04.



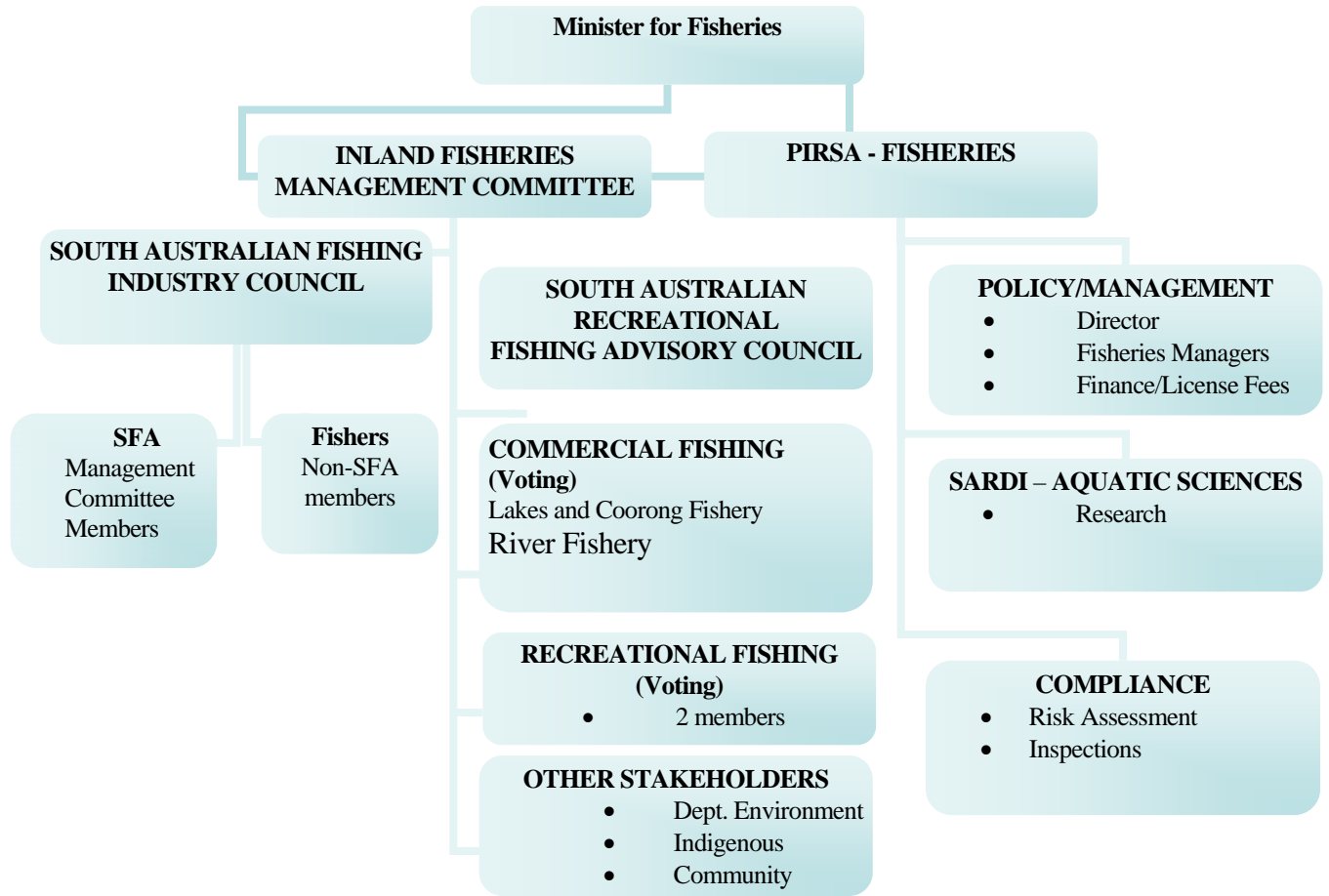
2.4 Lakes and Coorong Fishery Consultation and Co-Management

2.4.1 Management Bodies

The Fisheries Act 1982, provides a broad statutory framework to ensure the ecologically sustainable management of South Australia's marine, estuarine and freshwater fisheries resources, in addition to the regulations contained in both the *Fisheries (Scheme of Management - Lakes and Coorong Fishery) Regulations 1991* and *Fisheries (General) Regulations 2000*.

Decisions about the fishery are made by the Minister for Fisheries under advice from PIRSA and other committees or bodies chosen to advise on specific issues. (See fig. 6) PIRSA Fisheries is made up of Policy (managers) / Licensing and Compliance (fisheries officers) / South Australian Research and Development Institute (SARDI) – Aquatic Sciences (Research).

FIG. 6 MANAGEMENT STRUCTURE FOR THE LAKES AND COORONG COMMERCIAL FISHERY



The Fisheries Director delegates a Fisheries Manager to carry out the day to day administrative tasks. Fisheries Management Committees (FMC) are there to represent the interests of stakeholders and provide advice and direction to the Fisheries Minister.

Southern Fishermen's Association Inc. is the body representing the fishers and recognised by PIRSA to liaise with in regard to management decisions about the fishery. However all license holders are advised in writing by PIRSA of any changes affecting license holders.

The Management Plan will operate for a five year period from 2005 to 2010 inclusive, subject to annual review and amendments that are considered necessary by the Inland FMC, the Director of Fisheries or the Minister for Agriculture, Food and Fisheries. The Inland FMC will use the management plan to guide annual processes for providing advice to the Minister and Director of Fisheries on management and research for the fishery. The Inland FMC will use the reporting framework established in the harvest strategy to prepare an annual report on the performance of the fishery against all performance indicators and reference points.

The management plan will be periodically reviewed and improved over time as major advances in knowledge are made. In 2010, PIRSA Fisheries will undertake a major review of the management plan, including the strategic research and monitoring plan, in association with the Inland FMC and key stakeholders.

It is important to note that PIRSA is currently undertaking a comprehensive review of the *Fisheries Act 1982*, in consultation with key stakeholder groups and the broader community. This review is likely to result in significant changes to the broad sustainability framework established for administering and managing South Australia's fisheries resources. If necessary, the management plan will be updated to make it consistent with the requirements of the new legislation.

2.4.2 *Commercial License Regulation*

Access to the fishery is limited to holders of a current Lakes and Coorong Fishery license, renewed annually by the Director of Fisheries under section 34 of the Fisheries Act, subject to certain requirements. There are currently 37 licenses issued in the Lakes and Coorong Fishery, all of which have a variety of different gear entitlements. (Table2) All licenses issued in the fishery are fully transferable. Prior to February 2004, the scheme prevented the Director from granting more than one license to an individual operating in the fishery.

All license holders must be present when fishing operations are being undertaken, consistent with the owner operator provisions in place for the fishery, except in circumstances where the holder of a license also holds another license in the Lakes and Coorong Fishery or another fishery. In this case, the license holder must be the registered master on at least one of the licenses. Historically, the owner operator provisions have had the dual role of limiting effort expansions and maintaining the regional development nature of the fishery. All license holders may nominate a relief master for up to 28 days each year.

Table 2. Maximum gear entitlements that may be endorsed on a licence following a licence transfer or amalgamation

Type of Device	Number
mesh nets (coastal waters)	1
mesh nets (inland waters)	Maximum of 25 per licence upon transfer; or a maximum of 100 per licence on amalgamation, subject to approval by the Director of Fisheries
swinger nets	1
hauling nets	1
bait net	1
drop/hoop nets	As per licence conditions
dab net	1 per licensee and agent/s
drum net	The number endorsed on the original licence
cockle rake	1 per licensee and agent/s
cockle net	1 per licensee and agent/s
crab rake	1 per licensee and agent/s
yabby trap	maximum of 50 per licence upon transfer; or a maximum of 100 per licence on amalgamation, subject to approval by the Director of Fisheries
shrimp trap	The number endorsed on the original licence
Set line (long line)	The number endorsed on the original licence, subject to a 400 hook limit when used in coastal waters
razor fish tongs	1 per licensee and agent/s
fish spear	1 per licensee and agent/s
electro-fishing gear	No transfer or amalgamation unless specifically applied for. All applications will be considered on their individual merits, subject to consultation with the Southern Fishermen's Association.

The commercial fishery is managed using a complex mix of input and output controls aimed at matching harvesting capacity with resource availability and controlling growth in aggregate harvesting capacity. Existing controls include limitations on the number of licenses, a wide range of gear restrictions, spatial and temporal closures, restrictions on the number of commercial agents permitted to assist fishing operations and legal size limits for individual species. (Appendix 1)

2.4.3 Recreational Fishing

The Lakes and Coorong region has evolved to become an important location for recreational fishers due to its picturesque natural environment, its close proximity to the capital city of Adelaide.

Larger mulloway are targeted by recreational fishers on the ocean beaches of the Sir Richard and Younghusband Peninsulas, particularly adjacent to the River Murray Mouth during the

warmer months of spring and summer when mulloway aggregate around the Mouth. Smaller mulloway are targeted in the Coorong estuarine lagoons all year round.

Yellow-eye mullet are targeted by recreational fishers all year round using rod and line and a limited number of small mesh nets. Goolwa cockles are harvested by recreational fishers on the ocean beaches of the Coorong, but predominantly along the Sir Richard Peninsula (the Goolwa beach). Previously, cockles were mainly targeted for bait purposes but in more recent times cockles have been harvested for personal consumption.

Initially controls such as size limits and measures aimed at controlling total harvesting capacity (eg. gear restrictions and spatial and temporal closures etc.) were generally introduced to be consistent with those in place for commercial fishers and were not specifically targeted at the recreational sector. However, over time the need for specific management arrangements for recreational activity developed due to increases in the popularity of fishing. Recreational Fishery Management Committees (RFC's) is a mechanism in place to develop recommendations for the development of the recreational fishery. This feeds into the FMC process.

2.5 Contribution To The Community

Most licence holders were aged between 26 years old and 60 years old in 2003, with the highest number of licence holders in the 36-40 year age bracket (38 per cent). Meningie has the largest concentration of fishers with the rest residing around the Lakes and Coorong region including Murray Bridge, Clayton, Goolwa and Port Elliot.

In addition to the economic contribution made to the regional and state economies, the Lakes and Coorong fishery also contributes to the social, environmental and heritage values of the region, through involvement in community-support activities and contribution to the provision, maintenance or expansion of local and regional services and businesses (Table 3).

Table 3: The economic impact of the Lakes and Coorong fishing industry in South Australia, 2002/03. Source: EconSearch analysis.

Sector	Output		Value Added		Employment		Household Income	
	(\$m)	%	(\$m)	%	(jobs)	%	(\$m)	%
Direct effects								
Fishing	4.9	27.5%	3.4	35.8%	73	49.9%	2.2	42.8%
Processing	1.4	7.9%	0.4	4.0%	5	3.2%	0.2	4.6%
Transport	0.9	5.3%	0.5	5.0%	4	3.0%	0.2	4.7%
Retail	0.5	2.9%	0.3	2.7%	5	3.7%	0.2	3.2%
Food services	0.9	4.9%	0.4	4.3%	9	6.3%	0.2	4.1%
Total Direct^a	8.7	48.6%	4.9	51.8%	97	66.1%	3.0	59.4%
Flow-on effects								
Total Flow-on^a	9.2	51.4%	4.5	48.2%	50	33.9%	2.1	40.6%
Total^a	17.8	100.0%	9.4	100.0%	146	100.0%	5.1	100.0%
Total/Direct	2.29		2.10		1.67		1.81	

^a Totals may not sum due to rounding.

Source: EconSearch analysis.

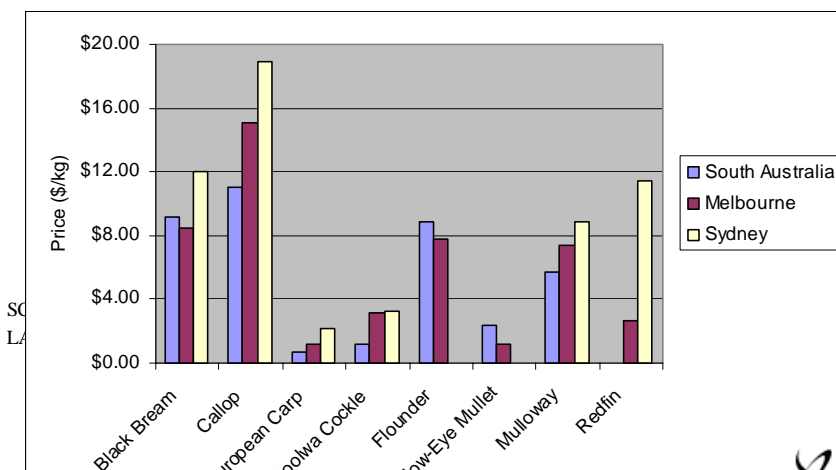
2.6 Prices and Markets

Lakes and Coorong Fishery licence holders surveyed for the 2003/04 economic indicators report sold their product to the local; Kingston; Adelaide; Sydney; Melbourne; Brisbane; and Perth markets (Clark *et al.*, 2005). Figure 7 shows the price for Lakes and Coorong product in local markets.

For the fishery as a whole, 39 per cent of all product caught was sold in Adelaide markets. Twenty per cent was sold in the Kingston SE region, reflecting the substantial quantities of bait (i.e. European carp and bony bream) caught in the fishery. Eighteen per cent was sold in Melbourne and 15 per cent was sold locally. The remainder was sold in Sydney, Brisbane and Perth.

A majority of callop, redfin and flounder were sold in Melbourne markets, with the remainder sold mostly in Sydney and Adelaide markets. Most of the mulloway were sold in Adelaide markets, with the remainder sold mostly in Melbourne markets. Only a small proportion of finfish, with the exception of yellow-eye mullet, were sold locally.

Figure 7: Prices for Lakes and Coorong fishery species; wholesale prices in South Australia and the Melbourne and Sydney fish markets, 2002/03 ^a



Source: SARDI Aquatic Sciences, Sydney Fish Market (www.sydneyfishmarket.com.au) and Melbourne Fish Market (www.chsmith.com.au).

Yellow-eye mullet is sold exclusively within South Australia. A majority of sales of Coorong yellow-eye mullet for human consumption were in the local region (86 per cent) with the remainder of whole fish sales to the SAFCOL Adelaide market for distribution throughout the metropolitan area. Many fishing families specialised in processing yellow-eye mullet which is considered a regional delicacy. They sold from the door as well as to wholesale customers in major population areas such as the Southeast, Fleurieu Peninsula, Murraylands, Adelaide Hills and Barossa Valley. This practice has reduced over the past decade, but there is still a considerable quantity of mullet fillets being sold around South Australia. Additional value adding such as smoked fish still takes place and continues to be popular.

Goolwa cockles for human consumption were sold in a number of markets, including Adelaide, Sydney, Melbourne, Brisbane and Perth. Almost 60 per cent of cockles for human consumption were sold in Melbourne. Approximately two-thirds of all Goolwa cockles harvested were sold as bait in Adelaide markets. An export market is slowly developing with several businesses taking advantage of increasing world wide demand for clean, green product.

3 PROCESSING AND TRANSHIPMENT

For the Lakes and Coorong fishery, all landings are recorded and reported. Processing occurs on shore.

This report does not cover transshipments or processing beyond the point of landing the fish on the deck of a vessel and preparing it for processing. This report acknowledges that sufficient monitoring takes place to identify the fishery of origin for all landed fish and invertebrates. Although SCS did not specifically look into Chain of Custody, it appears that there is sufficient information available to allow an MSC Chain of Custody to be developed.. MSC chain of custody certifications were not undertaken in this project, and therefore, need to be undertaken on a separate and individual basis for those entities that may wish to identify and/or label products derived from the fishery.

4 THE ASSESSMENT PROCESS

Scientific Certification Systems, Inc. conducted a pre-assessment of the Lakes and Coorong fishery as required by the MSC program. After review of the pre-assessment, the applicants for certification authorized the formal, full assessment of the fishery. All aspects of the assessment process were carried out under the auspices of Scientific Certification Systems, Inc., an accredited MSC certification body, and in direct accordance with MSC requirements (MSC Fisheries Certification Methodology, Version 5).

In order to ensure a thorough and robust assessment process, and a process in which all interested stakeholders could participate, SCS took the approach of allowing additional time as needed for both industry and stakeholders to respond to requests for information and participation.

4.1 EVALUATION TEAM

Project Manager: Dr. Chet Chaffee, SCS (USA)
MSC Principle 1: Dr. Norm Hall, Murdoch University, Western Australia
MSC Principle 2: Dr. Trevor Ward, University of Western Australia
MSC Principle 3: Mr. Noel Taylor-Moore, Econfish Services

4.2 OTHER FISHERIES IN THE AREA AND SUMMARY OF PREVIOUS CERTIFICATION EVALUATIONS

There are no other fisheries that operate specifically in the Lakes and Coorong. There are however, a number of species caught that are not covered in this assessment. Similarly, there are fisheries for some of the same species, Mulloway in specific, that occur along the coast and are not the specific subject of this assessment.

4.3 THE MSC STANDARD

The Marine Stewardship Council standards for sustainable fisheries management were developed through an 18-month process (May, Leadbitter, Sutton, and Weber, 2003). An original draft was developed by an expert working group, which met in Bagshot, UK in 1996. The draft standard was then presented through a series of 8 workshops that lasted 3 days each. Comments from the workshops, and from written submissions to the MSC were compiled and made available to a second expert working group at Airlie House in Virginia, USA.

The final MSC standard (see below) was issued in 1998, and has since been used as the basis by which fisheries are evaluated under the MSC program. The Lakes and Coorong Fishery was evaluated using this same standard.

The scope of the MSC Principles and Criteria relates to marine fisheries activities up to but not beyond the point at which the fish are landed. The MSC Principles and Criteria apply at this stage only to marine fishes, fresh water fishes, and invertebrates (including, but not

limited to shellfish, crustaceans and cephalopods). Aquaculture and the harvest of other species are not currently included. Issues involving allocation of quotas and access to marine resources are considered to be beyond the scope of these Principles and Criteria.

MSC Principles and Criteria

MSC PRINCIPLE 1

A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Intent:

The intent of this principle is to ensure that the productive capacities of resources are maintained at high levels and are not sacrificed in favor of short term interests. Thus, exploited populations would be maintained at high levels of abundance designed to retain their productivity, provide margins of safety for error and uncertainty, and restore and retain their capacities for yields over the long term.

MSC Criteria

1. The fishery shall be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity.
2. Where the exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level consistent with the precautionary approach and the ability of the populations to produce long-term potential yields within a specified time frame.
3. Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity.

MSC PRINCIPLE 2

Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

Intent:

The intent of this principle is to encourage the management of fisheries from an ecosystem perspective under a system designed to assess and restrain the impacts of the fishery on the ecosystem.

MSC Criteria:

1. The fishery is conducted in a way that maintains natural functional relationships among species and should not lead to trophic cascades or ecosystem state changes.

2. The fishery is conducted in a manner that does not threaten biological diversity at the genetic, species or population levels and avoids or minimizes mortality of, or injuries to endangered, threatened or protected species.
3. Where exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level within specified time frames, consistent with the precautionary approach and considering the ability of the population to produce long-term potential yields.

MSC PRINCIPLE 3

The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Intent:

The intent of this principle is to ensure that there is an institutional and operational framework for implementing Principles 1 and 2, appropriate to the size and scale of the fishery.

MSC Criteria:

A. Management System:

The fishery shall not be conducted under a controversial unilateral exemption to an international agreement.

The management system shall:

1. demonstrate clear long-term objectives consistent with MSC Principles and Criteria and contain a consultative process that is transparent and involves all interested and affected parties so as to consider all relevant information, including local knowledge. The impact of fishery management decisions on all those who depend on the fishery for their livelihoods, including, but not confined to subsistence, artisanal, and fishing-dependent communities shall be addressed as part of this process;
2. be appropriate to the cultural context, scale and intensity of the fishery – reflecting specific objectives, incorporating operational criteria, containing procedures for implementation and a process for monitoring and evaluating performance and acting on findings;
3. observe the legal and customary rights and long term interests of people dependent on fishing for food and livelihood, in a manner consistent with ecological sustainability;
4. incorporates an appropriate mechanism for the resolution of disputes arising within the system;
5. provide economic and social incentives that contribute to sustainable fishing and shall not operate with subsidies that contribute to unsustainable fishing;
6. act in a timely and adaptive fashion on the basis of the best available information using a precautionary approach particularly when dealing with scientific uncertainty;
7. incorporate a research plan – appropriate to the scale and intensity of the fishery – that addresses the information needs of management and provides for the dissemination of research results to all interested parties in a timely fashion;

8. require that assessments of the biological status of the resource and impacts of the fishery have been and are periodically conducted;
9. specify measures and strategies that demonstrably control the degree of exploitation of the resource, including, but not limited to:
10. setting catch levels that will maintain the target population and ecological community's high productivity relative to its potential productivity, and account for the non-target species (or size, age, sex) captured and landed in association with, or as a consequence of, fishing for target species;
11. identifying appropriate fishing methods that minimize adverse impacts on habitat, especially in critical or sensitive zones such as spawning and nursery areas;
12. providing for the recovery and rebuilding of depleted fish populations to specified levels within specified time frames;
13. mechanisms in place to limit or close fisheries when designated catch limits are reached;
14. establishing no-take zones where appropriate;
15. contains appropriate procedures for effective compliance, monitoring, control, surveillance and enforcement which ensure that established limits to exploitation are not exceeded and specifies corrective actions to be taken in the event that they are.

B. MSC Operational Criteria:

Fishing operations shall:

16. make use of fishing gear and practices designed to avoid the capture of non-target species (and non-target size, age, and/or sex of the target species); minimize mortality of this catch where it cannot be avoided, and reduce discards of what cannot be released alive;
17. implement appropriate fishing methods designed to minimize adverse impacts on habitat, especially in critical or sensitive zones such as spawning and nursery areas;
18. not use destructive fishing practices such as fishing with poisons or explosives;
19. minimize operational waste such as lost fishing gear, oil spills, on-board spoilage of catch, etc.;
20. be conducted in compliance with the fishery management system and all legal and administrative requirements; and
21. assist and co-operate with management authorities in the collection of catch, discard, and other information of importance to effective management of the resources and the fishery.

4.4 INTERPRETATION OF MSC PRINCIPLES FOR PERFORMANCE EVALUATIONS

Along with developing a standard for sustainable fisheries management, the MSC also developed a certification methodology that provides the process by which all fisheries are to be evaluated. The MSC accredits certification bodies (businesses) that can show that the expertise and experience necessary to carry out MSC evaluation is present in the organization. In addition, each certification body must demonstrate its fluency with the MSC standards and evaluation methods through the use of these in a fishery evaluation

The methods are provided in great detail through documents that can be downloaded from the MSC website (www.msc.org). At present, the Fisheries Certification Methodology is in its 5th version, issued April 2004.

The MSC Principles and Criteria are general statements describing what aspects need to be present in fisheries to indicate that they are moving toward sustainable management. The certification approach or methodology adopted by the MSC requires that any assessment of a fishery or fisheries move beyond a management verification program that simply provides third-party assurances that a company's stated management policies are being implemented. The MSC's 'Certification Methodology' is designed to be an evaluation of a fishery's performance to determine if the fishery is being managed consistent with emerging international standards of sustainable fisheries.

Using its expertise in fisheries management, fisheries biology and ecology, ecosystem monitoring, and stock assessments, the assessment team developed a set of performance indicators (see Section 9) to be consistent with the intent and extent of the MSC Principles and Criteria.

The performance indicators developed for MSC Principles 1 and 2 are structured such that all the Subcriteria and Performance Indicators are directly associated with a single MSC Criterion within a Principle. There is no duplication of Performance Indicators among MSC Criteria or MSC Principles.

The structure of the Subcriteria and Performance Indicators developed under MSC Principle 3 is somewhat different. Under MSC Principle 3, the Evaluation Team noted significant difficulty in developing a logical hierarchy of measures that remained unique to each MSC Criterion but also maintained a logical connection between indicators. Much of the difficulty stemmed from the fact that the 17 MSC Criteria under MSC Principle 3 vary in nature from general objectives to specific measures, but are not presented in a hierarchical framework from the very broad to the specific. Instead, the 17 MSC Criteria under MSC Principle 3 describe factors with significant redundancy. As a result, the Evaluation Team felt it would be better to construct a logical hierarchy that incorporates all the requirements spelled out by the 17 MSC Criteria and note the relationship of each Performance Indicator to the various MSC Criteria, as many of the Performance Indicators proposed can be linked to a more than one MSC Criterion.

The performance indicators and scoring guideposts adopted in this evaluation are based on the evaluation team's interpretation of the MSC Principles and Criteria, as applied to the particular case of the Lakes and Coorong Fishery. The standards set may not be identical to those used for other MSC certified fisheries, although the types of indicators considered are very similar. The MSC has made it clear that each fishery should be judged according to its particular circumstances and requirements, in line with the principles and criteria that they have set. In particular the performance indicators and scoring guideposts used to judge this fishery are meant to be similar to, but not necessarily identical to, those used to judge similar fisheries elsewhere. It is also worth noting that the standards for MSC certification may not correspond exactly to the standards required by the fishery management plan or by the national legislation under which it operates. Therefore, if the assessment points out areas where the fishery management does not meet the MSC standards, it is not suggestive of poor management, it is only a reflection of how well the fishery management system complies with

the standards for well-managed and sustainable fisheries set by the Marine Stewardship Council.

Also, it is important to remember when reading the scoring guideposts under each performance indicator that the scoring criteria established are regarded as cumulative. Thus, the fishery must first satisfy the criteria specified for a score of 60, before being assessed against those required for the 80 level. In turn, those required for the 80 level must be attained before attempting to assess the fishery against the criteria specified for 100.

4.5 SUBMISSION OF DATA ON THE FISHERY

One of the most significant, and difficult, aspects of the MSC certification process is ensuring that the assessment team gets a complete and thorough grounding in all aspects of the fishery under evaluation. In even the smallest fishery, this is no easy task as the assessment team typically needs information that is fully supported by documentation in all areas of the fishery from the status of stocks, to ecosystem impacts, through management processes and procedures. Indeed, in smaller fisheries it is often more difficult to obtain all the necessary documentation on a fishery as the resources are more limited than in some of the larger fisheries in developed nations.

Under the MSC program, it is the responsibility of the applying organizations or individuals to provide the information required by the assessment team. It is also the responsibility of the applicants to ensure that the assessment team has access to any and all scientists, managers, and fishers that the assessment team identifies as necessary to interview in its effort to properly understand the functions associated with the management of the fishery. Last, it is the responsibility of the assessment team to make contact with stakeholders that are known to be interested, or actively engaged in issues associated with fisheries in the same geographic location.

In the Lakes and Coorong fishery, the The Southern Fishermen's Association worked with scientists and managers in the fishery to gather data for the assessment team. In addition, SFA facilitated meetings with all the necessary professionals, allowing the assessment team to better understand the circumstances of the fishery

In contrast to the applicant's role in MSC assessments, the stakeholders in the fishery are under no specific obligation, other than personal responsibility, to provide the assessment team with information. During this fishery assessment, SFA and WWF helped facilitate those contacts as well.

5 ASSESSMENT TEAM MEETINGS AND INTERVIEWS

5.1 JUSTIFICATION FOR SELECTION OF ITEMS/PERSONS INSPECTED.

The sites and people chosen for visits and interviews were based on the assessment team's need to acquire information about the management operations of the fisheries under

evaluation. Agencies and their respective personnel responsible for fishery management, fisheries research, fisheries compliance, and habitat protection were identified and contacted with the assistance of the client group and stakeholders.

5.2 INTERVIEWS AND MEETINGS

The assessment team discussed with the client on more than one occasion various aspects of the fishery. A number of meetings/phone calls were simply held to organize additional meetings and to clarify issues relating to data submissions to the evaluation team. All significant meetings were held with personnel at the South Australian Fishing Industry Council (SAFIC) Boardroom in Adelaide,. Table 4 provides a general list of the people met and interviewed during the assessment process.

Table 4. People Interviewed for the Lakes and Coorong Assessment Process

Full Assessment	<ul style="list-style-type: none"> • Management • Ecosystem • Stock Assessment and Stock Status 	PIRSA, SARDI	Sean Sloan Jason Highham Tim Ward Greg Ferguson
		University of Adelaide	Mike Geddes
		Fisheries Innovation Strategies	Bryan Pierce
		Inland Fisheries Management Committee; a formal meeting was held, with open discussions amongst the team and several of the members	Jeanette Long (Chair)
		SA Fishing Industry Council	Neil McDonald

- - **Stakeholders**
 - SA Fishermen's Association Garry Hera-Singh
 - Department of Environment and Heritage
 - Tim Wilson
 - Russel Seaman
 - Jacquie Symonds
 - Simon Oster
 - Brad Lay
 - Kerry Steinbecker

 - Ngarrindjeri Lands Progress Association, Meningie
 - Francis Lovegrove

 - Conservation Council of SA, board member
 - Richard Owen

 - Marine and Coastal Community Network, SA
 - Tony Flaherty

6 ASSESSMENT TEAM PERFORMANCE EVALUATIONS

After completing all the reviews and interviews, the assessment team is tasked with utilizing the information it has received to assess the performance of the fishery. Under the MSC program, the process for assessing the fishery is performed by prioritizing and weighting the indicators relative to one another at each level of the performance hierarchy established when the assessment team developed the set of performance indicators and scoring guideposts for the fishery. Subsequent to this, the assessment team assigns numerical scores between 0 and 100 to each of the performance indicators. All of this is accomplished using decision support software known as Expert Choice, which utilizes a technique known as AHP (Analytical Hierarchy Process). A full description of the AHP process can be found on the MSC web site (www.msc.org). In essence, the process requires that all team members work together to discuss and evaluate the information they have received for a given performance indicator and come to a consensus decision on weights and scores. Scores and weights are then combined to get overall scores for each of the three MSC Principles. A fishery must have normalized scores of 80 or above on each of the three MSC Principles to be recommended for certification. Should an individual indicator receive a score of less than 80, a 'Condition' is established that when met, would bring the fishery's performance for that indicator up to the 80 level score representing a well-managed fishery.

Below is the assessment team's evaluation of the information it received and the team's interpretation of the information as it pertains to the fishery's compliance with the MSC Principles and Criteria.

MSC Principle 1:

A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Criterion 1.1 (MSC Criterion 1):

The fishery shall be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity.

Intent: There are effective harvest strategies that control the level of exploitation of each target stock such that it is sustained at an appropriate level of productivity. To be assured of this, it is essential that (1) the stock has been identified and that there is sufficient knowledge of the biology of the species and its abundance to be able to assess the impact of fishing, (2) the fishery is well monitored such that the impact of fishing on the target stock is known, and (3) effective strategies to manage the fishery have been established and are highly likely to ensure that the target population is sustained at a level that is considered appropriate to maintain its high productivity, and that of its associated ecological community, relative to its potential productivity. Note that the direct ecological impact of the fishery on other fauna and on the environment is considered under MSC Criterion 2. While the performance indicators and scoring guidelines are common to all four species of the Lakes and Coorong Fishery that are being reviewed, each species must be considered separately under MSC Criterion 1 as the scores achieved for each performance indicator may vary among the different species.

SC 1.1.1 There is adequate knowledge about each target stock.**Intent:**

This sub-criterion is intended to assess whether information about the stock and the biology of the species is adequate and is considered by fishery managers when determining the appropriate level of exploitation that may be permitted if the stock is to be sustained. Indices of abundance and other indicators of stock status should reflect available knowledge of the biology of the species, the size and age composition of catches taken from the target stock, and data on catches, effort and catch per unit of effort collected from the different fishing sectors or fisheries that exploit that stock.

Indicator 1.1.1.1 There is adequate knowledge of the identity of each target stock.**Scoring Guidepost 60**

The species can be reliably identified. The distribution of the target species is broadly known. Fisheries or fishing sectors that exploit the target species have been identified.

Scoring Guidepost 80

Appropriate management units, consistent with broad qualitative knowledge of the distribution of each stock, have been defined and are applied when managing the fishery for that target species. Catches by each fishing sector or fishery that exploits the target species can be broadly attributed to the specific management unit from which they were taken.

Scoring Guidepost 100

Management units are consistent with a broad understanding of stock identity, based on genetic and/or other studies.

Score

Mulloway	80
Golden perch	90
Goolwa cockles	85
Yellow-eye mullet	85

CommentMulloway

Mulloway *Argyrosomus japonicus* is readily identified. It is found in both the northern and southern hemispheres in waters off eastern South Africa, China, Korea and Japan and in southern Australia from the North West Cape in Western Australia to the Burnett River in Queensland (Kailola *et al.* 1993; Ferguson and Ward 2003). The species is exploited throughout its range in Australia by both commercial and recreational fishers (Kailola *et al.* 1993) and the presence of otoliths of mulloway in middens in the Coorong area suggest that it was once an important component of the diet of the traditional fishers, the Ngarrindjeri (Higham *et al.* 2005). In Victoria, the commercial fishery is focused on the west coast, while the recreational fishery for this popular species extends over the entire coast (Kailola *et al.* 1993). It is noted, however, that the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) recorded a harvest of only 5,421 mulloway from Victorian waters, compared with the harvest of 27,004 fish in South Australia, and that, in its annual report for 2003-2004, the Fisheries Co-management Council Victoria reported no commercial mulloway catches (Smith 2004). In South Australia, the species is targeted by both recreational and commercial fishers and is taken as a by-product by some commercial fishers when targeting other species (Ferguson and Ward 2003). The majority (> 90% since 1998/99) of the South Australian commercial catch of mulloway is taken in the Lakes and Coorong Fishery, *e.g.* 95.7% of the 2001/02 catch (Ferguson and Ward 2003). Other commercial fisheries taking mulloway in South Australia include the Marine Scalefish Fishery (4% of 2001/02 commercial catch for SA, taken mainly from the Coorong region but also from the far west coast of South Australia) and small quantities of the species are taken as by-catch by rock lobster fishers and fishers operating in the shark fishery, which is managed by the Australian Fisheries Management Authority (Ferguson and Ward 2003). While some recreational net and line fishers operate within the Coorong lagoons, others target mulloway in waters off the ocean beaches outside the Coorong and along the far west coast (Ferguson and Ward 2003). Traditional fishing and food gathering is still undertaken by the Ngarrindjeri people, whose fishing activities are currently managed within the recreational category of regulations (Sloan 2005)

The results of electrophoretic studies conducted in the 1980s by Dixon (1988) indicated the presence of two genetically-distinct sub-populations, a Western Australian stock extending

from Carnarvon to Mandurah and an eastern stock extending from South Australia to New South Wales (Ferguson and Ward 2003). However, the data also suggested that more detailed data might reveal further population sub-structure. A subsequent study by Black and Dixon (1992), reported by Ferguson and Ward (2003), which employed mitochondrial DNA and isoelectric focusing, failed to support the earlier findings of Dixon (1988). A further genetic study is currently being undertaken by a Western Australian PhD student but results are not yet available.

For the purposes of fishery management, mulloway in South Australia are managed as “a self-recruiting population, with recruitment considered to be dependent upon local spawning within South Australian waters” (Sloan 2005). Mulloway caught in South Australian waters are attributed automatically to this management unit. It was considered that, with the current poor knowledge of stock structure for mulloway, this definition of the management unit would be precautionary. The “Management Plan for the South Australian Lakes and Coorong Fishery” (Sloan 2005) provides the policy framework for commercial, recreational, and traditional fishing within the lower Murray Lakes and Coorong Fishery. A draft management plan for the Marine Scalefish Fishery has been released for public comment and plans for the South Australian rock lobster fishery have been published.

The Southern Fishermen’s Association (2004) has proposed that the management unit for mulloway should encompass the entire range occupied by the species in Australian waters. In support of this view, they note that the genetic studies of stock structure have been inconclusive and that, noting the distances that have been traveled by tagged mulloway over a relatively short time period, it is likely that significant genetic exchange occurs among different regions. They also note that the aggregation of fish at the Murray Mouth has not been demonstrated to be a spawning aggregation, and that it is likely that mulloway spawn at numerous locations around Australia.

Is the management unit appropriate.? In South Australia, adults tend to (re-)aggregate in the nearshore zone and around the mouth of the Murray River in spring-summer (Ferguson and Ward 2003), suggesting that at other times the adults are dispersed. In South Africa, there appears to be a migration of adults along the coast to warmer waters near East Cape, where the fish spawn (Ferguson and Ward 2003). Adult fish are large and capable of swimming extended distances. There is thus potential that, as proposed by the Southern Fishermen’s Association, mulloway in South Australia could form part of a broader population that is exploited in other states. Under this hypothesis, trends in exploitation and abundance from other regions should also be considered when assessing and managing mulloway in South Australia. However, as pointed out by Sloan (2005), in the absence of genetic evidence to the contrary, it would be precautionary to consider the population of mulloway in South Australia as a self-recruiting population. There is no evidence to distinguish between the two hypotheses, thus it is appropriate that the precautionary view should prevail when making decisions regarding the management of the mulloway stock.

Golden perch

Golden perch (or callop) *Macquaria ambigua* can be reliably identified. This native species occurs throughout the Murray-Darling River system (except at higher altitudes), the Lake Eyre-Bulloo drainage system and the Dawson-Fitzroy River system (Ye 2004). Since European settlement, habitat degradation and construction of dams and weirs have led to a decline in the distribution and abundance of the species (Ye 2004). Genetic studies have identified six minor genetically-distinct stocks and a larger central stock within the Murray-Darling Basin (Ye 2004). The two stocks that contribute to the Lakes and Coorong Fishery are the Lakes stock, which extends upstream to Renmark, and the sympatric central River Murray stock, which extends from the Lakes into New South Wales. While genetically closely related to the central stock, the Lakes stock appears to represent a distinct genotype that has increased in abundance in response to the increased availability of freshwater habitat that resulted from the construction of the barrages in 1940 (Ye 2004). Unfortunately, no details are provided by Ye (2004) of the proportions of fish within the Lakes region that are of the Lakes and central genotypes, respectively.

In South Australia, until 1 July 2003 when commercial fishing of native species was prohibited on the River Murray, golden perch was exploited by commercial and recreational fishers operating in defined “reaches” of the River Murray, i.e. the River or “Reach” fishery (Ye 2004). It has also been fished, and continues to be exploited, by commercial fishers in Lakes Alexandrina and Albert, the freshwater component of the Lakes and Coorong Fishery (Ye 2004). Ye (2004) reports that, over the past 19 years, 56% of the commercial catch of golden perch was derived from the River and 44% from the Lakes and Coorong Fishery. All recreational fishing for golden perch recorded in the National Recreational and Indigenous Fishing Survey was from the River Murray and no recreational catch was reported from the Lakes and Coorong (Ye 2004). The species is also fished in New South Wales.

Ye (2004) records that, due to their similar morphology and sympatry, “the golden perch resource of the lower Murray River and Lakes is managed as a unit stock in South Australia”. There is, however, no definition of the meaning of the “lower Murray River”, either by Ye (2004) or Sloan (2005). Clarification is required, especially as the commercial fishery operating in the Murray River upstream from Wellington was managed until 2003 as the River Murray Fishery (Ye 2004). With closure of the Murray River to commercial fishing for native species, the attribution of commercial catches of golden perch to the lower Murray River and Lakes stock is simple. However, attribution of historical commercial, recreational and illegal catches from the River Fishery to the lower Murray River and Lakes management unit requires a more detailed specification of its geographical extent.

The appropriateness of the management unit needs to be assessed taking into account the possible exploitation of the central stock by fishers in New South Wales.

Goolwa cockles

Goolwa cockles *Donax deltooides*, which are caught on the ocean beaches outside the Coorong, can be readily identified. The species is recognised as the most common large bivalve found in the surf zone along Australian beaches (Murray-Jones and Johnson 2003). The population of this species in the Coorong region is considered by King (1976), as

reported by Murray-Jones and Johnson (2003), to be one of the most abundant in Australia. A genetic study by Murray-Jones and Ayre (1997) found no genetic differences among samples taken from populations of this species ranging over 1200 km of coastline from Fraser Island in Queensland to southern New South Wales. However, no samples from the Coorong were examined in this study and thus there is no genetic information on the stock structure of the population of cockles in this region. In the absence of data on stock structure, “the Coorong population of *D. deltooides* is managed as a self recruiting population distinct from other stocks distributed throughout other South Australian ocean beaches” (Sloan 2005). Sloan (2005) describes the Coorong population as extending along the Sir Richard and Youngusband Peninsulas, and thus, if their location of capture is known, catches that are taken from these Peninsulas can be readily attributed to the management unit.

Both commercial and recreational fishers exploit Goolwa cockles and the species was the target of traditional fishers for thousands of years prior to European settlement (Murray-Jones and Johnson 2003). Commercial fishers, operating within the Lakes and Coorong Fishery, the Marine Scalefish Fishery, or the rock lobster fisheries, employ cockle rakes (or nets) to catch the species, while recreational fishers either use cockle rakes (or nets) or collect the cockles by hand (Sloan 2005). The majority of the commercial catch is taken along the oceanic beaches of the Youngusband Peninsula by the 29 of the 37 Lakes and Coorong fishers who are entitled to use cockle gear (Murray-Jones and Johnson 2003), of which only 14 appear to fish for cockles on a regular basis. The majority of the recreational catch is taken from along the Sir Richard Peninsula, *i.e.* the Goolwa Beach (Sloan 2005).

Yellow-eye mullet

Fish can be reliably identified as *Aldrichetta forsteri*, a species that is distributed around southern Australia from Kalbarri in Western Australia to Newcastle in New South Wales and is also found in New Zealand (Higham *et al.* 2005). Two distinct populations of the species, *i.e.* an eastern and western population, have been distinguished using counts of lateral scales and gill rakers and differences in the timing of breeding (Higham *et al.* 2005). South Australian fish are considered to form part of the western stock, which ranges from Western Australia to South Australia. Given current knowledge of population structure, the population of yellow-eye mullet in South Australian waters is managed as a single stock (Higham *et al.* 2005). Thus, yellow-eye mullet caught in South Australian waters are attributed automatically to this management unit.

The species is caught by both commercial and recreational fishers, and the presence of otoliths of yellow-eye mullet in middens in the Coorong area suggest that it was once a major component of the diet of the traditional fishers, the Ngarrindjeri (Higham *et al.* 2005). Four commercial fishing sectors with access to yellow-eye mullet are identified: the Lakes and Coorong Fishery (~69% of the commercial catch), the Marine Scalefish Fishery (~29% of the commercial catch) which operates along the entire coast of South Australia, and the northern and southern zone rock lobster fisheries (relatively small catches) (Higham *et al.* 2005). Data from the recent National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003, Jones and Doonan 2005) identifies that the majority of the recreational harvest of yellow-eye mullet was taken from the Kangaroo Island/Gulf St Vincent region (56%), with the second

highest harvest coming from the south-eastern region (22%), which includes the Lakes and Coorong Fishery (Higham *et al.* 2005).

The extent of movement of individuals of yellow-eye mullet among different regions within this range is unknown, but South Australian fisheries scientists suspect that it is likely that population sub-structure exists which may distinguish among the fish on the west coast, Spencer Gulf, Gulf St. Vincent, Coorong Lagoons and the south-east of South Australia (Higham *et al.* 2005). If such sub-structure exists, the decision to manage the entire South Australian fishery as a single population is not precautionary. The potential existence of such population sub-structure may need to be recognised in management of the fishery, to ensure that the “sub-population” of yellow-eye mullet within each region is sustained.

Indicator 1.1.1.2 **There is knowledge of the life history and biology of the species.**

Scoring Guidepost 60

There are serious gaps in information but the basis of the life history is understood adequately to support a rudimentary evaluation of the fishery.

For example: The life cycle of the species is broadly known from other fisheries of the same or similar species. Broad details of the population biology of this species, i.e. its growth, age/size at maturity and natural mortality are drawn from the scientific literature, FishBase, or empirical studies.

Scoring Guidepost 80

The life history of the species is clearly documented and understood well enough to support a high degree of confidence in the evaluation of the fishery.

For example: A qualitative description of the life cycle of the target stock is available for the fishery. Approximate growth curves have been determined, although these may be based on an unvalidated ageing method. Spawning periods have been established, and the relationships between the proportion of fish that are mature and body size and age have been determined. There is a sound understanding of the spatial distribution of the various size groups.

Scoring Guidepost 100

All aspects of the life history of the species are clearly documented and understood so as to support a very high degree of confidence in the evaluation of the fishery.

For example: This might require the above plus a method for ageing individuals that has been validated and growth curves have been derived that are based on validated ages. The range of feasible values of the instantaneous rate of natural mortality, and a point estimate of this parameter, has been estimated.

Score

Mulloway	75
Golden perch	90
Goolwa cockles	75
Yellow-eye mullet	80

Comment

Mulloway

Studies of the life history of mulloway in South Africa are available, which indicate that, in this region, although the species spawns throughout the year, spawning peaks in winter-spring (Ferguson and Ward 2003). As noted above, adult fish tend to migrate to areas in which the waters are of an appropriate temperature and it is believed that spawning occurs nearshore. Early juveniles recruit and remain within estuarine habitats but larger juveniles have been found in the surf zone (Ferguson and Ward 2003). Tagging studies have demonstrated that, in South Africa, juveniles do not move far from their location of release (Ferguson and Ward 2003).

The life history of mulloway in South Australia appears similar to that described for South Africa, although it is important to note that the South African coast is of a different structure with a shorter distance from shore to deeper waters which may affect some aspects of the life history of the local populations/stocks. Adults tend to aggregate in the surf zone near the mouth of the Murray River in October-December. Small juveniles (~150 mm TL) enter the Coorong several months later and Ferguson and Ward 2003 report that they remain there for 2-5 years. Further information provided by SFA (pers. Com.) suggest that this may not be the case. It is pertinent to note that construction of the barrages in the River Murray in 1940 reduced the area of the estuary to 11% of its original area and the flow of fresh water, thereby raising salinity and increasing the likelihood that the connection between the lagoons and the open ocean might close completely in periods of low water flow. The potential impact that such closure of the river mouth might have on the entrance of juvenile mulloway to the estuary has led fishers to call for continued dredging to maintain the opening and the release of sufficient water flow to ensure the maintenance of those environmental conditions likely to influence the formation of the aggregations of mulloway adjacent to the mouth of the Murray that have occurred in the past.

Details of growth and size at maturity of mulloway are available for the South African stock, but there are limited published data for the species in South Australia (Ferguson and Ward 2003). The growth curve derived for South Australian mulloway (combined sexes) was based on scales rather than otoliths and is considered likely to be unreliable (Ferguson and Ward 2003). The single published estimate that is available for the length at maturity of mulloway in South Australia is considerably lower (700 mm TL) than that for males and females in South Africa (920 and 1070 mm TL, respectively) and does not appear to take the possibility of gender differences into account (Ferguson and Ward 2003). A PhD study, entitled 'The Biology and Ecology of Mulloway in South Australian Waters', was initiated in 2001 to improve the data on age, growth and reproduction of mulloway and preliminary results of this study are starting to become available (Ferguson and Ward 2003). Details of the size compositions of the commercial gill net catches and from the catches taken by multi-panel research gill nets from within the lagoons, from the swinger net catches of commercial fishers, from a commercial haul net catch from the west coast of South Australia and from recreational line fishers are available (Ferguson and Ward 2003).

The contribution that the juvenile fish from within the Coorong lagoons make to the number of adult fish subsequently found off the beaches and in the waters adjacent to the mouth of the Murray River outside the Coorong is unknown. Whether these adults represent a large proportion of juveniles from locations other than the Coorong (and, if so, which locations) is an important issue for fisheries and environmental managers, as the utility of the Coorong lagoons for the juvenile mulloway depends upon their ability to access the lagoon through the channel from the open ocean.

It is noted that the current PhD study will resolve a number of the deficiencies currently present in the biological data.

Condition 1:

A reliable assessment should be made of the extent to which the juvenile mulloway within the Coorong lagoons and the adult assemblage found off the beaches and in the waters adjacent to the mouth of the Murray River outside the Coorong are interdependent. Data should be collected and analysed to provide reliable estimates of growth and size and age at maturity.

Golden perch

Golden perch spawn during the austral spring and summer, in response to the stimulus of a rise in water level or flood (Ye 2004). Maturity is attained at ~2-3 years for males and ~4-5 years for females, however Ye (2004) notes that there is uncertainty in the data concerning the reproductive biology of golden perch that needs to be resolved. The use of sectioned otoliths in determining a reliable estimate of age has been validated (Anderson *et al.* 1992, reported by Ye 2004) and reliable growth estimates have been obtained with females typically growing to a larger size than males. However, as Ye (2004) reports, growth is highly variable among sites and years and it is therefore not appropriate to develop a generalized age-length key or to attempt to assess year-class abundance from length-composition data. The longevity of golden perch has been assessed as 26 years, based on ages determined from sectioned otoliths (Ye 2004). Golden perch are opportunistic carnivores and larvae and juveniles benefit from food resources that become available following floods.

Goolwa cockles

Goolwa cockles occupy the surf zone at high tide, emerging from the sand and using the surf to relocate up and down the beach (Murray-Jones and Johnson 2003). Murray-Jones and Johnson (2003) report that they are typically buried 6-8 cm deep and are in greatest numbers just below the low tide level, with juveniles likely to be found at higher levels than larger individuals. The cockles are of separate sexes, and fertilisation is external. Murray-Jones and Johnson (2003) report that the reproductive data for the Goolwa cockles reveal some uncertainty as to the timing of spawning as it is at least partially affected by seasonal upwelling and river flows and subsequent recruitment, and whether the latter is likely to be continuous or to reveal peaks. Murray-Jones and Johnson (2003) also report high mortalities of juveniles and that only two year adult year classes are generally present in the cockles of the Goolwa region. The Goolwa cockles attain maturity at ~13 months of age and ~ 36 mm

shell length, and typically do not grow to greater than 60 mm shell length (King 1976). Growth is seasonal and has been described by King (1976). The species experiences considerable inter-annual variability in recruitment, which King (1976) suggests is likely to be primarily associated with natural variability in oceanic conditions during the larval phase.

Peak concentrations of the Goolwa cockles are known to shift along the beaches over the fishing season, and the species tends to become aggregated in certain regions, which thus become the target of fishing activity (Murray-Jones and Johnson 2003). However, there is limited knowledge regarding the distribution and movement of cockles at a spatial and temporal scale that is consistent with the activities of fishers. The species is known to have a patchy distribution but the proportion of the population that is located within the aggregations that are exploited by fishers is unknown. Similarly, at any specific fished location, the proportion of the population that is accessible to the cockle rakes of the fishers is unknown, *i.e.* the density profile across a transect leading out from the beach into the ocean is uncertain.

Murray-Jones and Johnson (2003) report results from King's (1976) short study but, because "the biology and ecology of *Donax deltooides* in South Australia has been little studied", were obliged to draw heavily on knowledge drawn from studies undertaken on the east coast of Australia for their stock assessment of the Goolwa cockles. Subsequently, in recognition that improved data are required of the life history of the Goolwa cockle, PIRSA has initiated a PhD study to study the population biology and recruitment processes of this stock.

Recognising that there has been limited study of the population biology of the cockles at Goolwa, and that there is a paucity of knowledge regarding the spatial distribution and movement of these cockles and the extent to which aggregations are exploited by fishers, it is considered that further study is required. Although the data currently available for the life history and biology of the stock appear adequate to manage the fishery at historical levels of exploitation, trends in prices paid and the potential for increased exploitation within the current management framework suggest that greater knowledge of the life history, biology, spatial distribution and recruitment processes is likely to be required if exploitation increases. The decision by PIRSA to enhance the available knowledge of the life history and biology of the Goolwa cockles is endorsed. Fishery managers are strongly encouraged to develop a sound understanding of the temporal and spatial scale of the aggregations of cockles that form, the dynamics of those aggregations, the ability of fishers to target these aggregations and the extent to which spatial redistribution of fishing effort may influence catch statistics.

Should exploitation continue to increase, a re-assessment under the MSC will be necessary to determine if adequate understanding and controls are in place to maintain the score currently assigned to this indicator.

Condition 2:

Reliable estimates of growth and of the size and age at which maturity are attained should be determined, together with a more detailed understanding of spatial distribution and recruitment processes.

Yellow-eye mullet

Yellow-eye mullet are estuarine-opportunists, but are not dependent on estuaries to complete their life cycle (Higham *et al.* 2005). They are known to spawn both in estuaries and in the open ocean. Spawning in the Coorong lagoons occurs from January to March and juveniles occupy the shallow banks of estuaries and beaches (Higham *et al.* 2005). Larger yellow-eye mullet prefer to occupy deeper habitat. Details of the length at age of yellow-eye mullet from the Coorong as described by Harris (1968) are recorded by Higham *et al.* (2005), but no information is given as to whether the methods used in this study for ageing were validated. Higham *et al.* (2005) note that there is a need to derive formal growth curves using otolith-based age estimates. Data describing the growth of yellow-eye mullet in other regions of South Australia are not presented by Higham *et al.* (2005). The caudal fork lengths (CFLs) at maturity of male and female yellow-eye mullet from the Coorong lagoons have been reported by Harris (1968) as 22 and 23 cm, respectively. Higham *et al.* (2005) note however that these were not derived using formal size at maturity ogives and recommend that such ogives be constructed to provide more reliable estimates of the sizes of maturity. Again, no details are presented by Higham *et al.* (2005) concerning the sizes of maturity of yellow-eye mullet from other regions of South Australia. In their Executive Summary, Higham *et al.* (2005) highlight the need for basic biological information on patterns of age, growth and reproduction to allow reliable assessments of the adequacy of the current minimum legal size and other management arrangements and to allow an assessment of the sustainability of current levels of exploitation. The minimum legal length for retention of yellow-eye mullet is currently 21 cm TL, but no information concerning the relationship between CFL and TL is provided by Higham *et al.* (2005) to allow precise determination as to the relationship of this value to the size of maturity of females determined by Harris (1968), *i.e.* 23 cm CFL.

Indicator 1.1.1.3 **There is information to measure trends in abundance of stocks.**

Scoring Guidepost 60

An index of abundance is available for each target stock. A time series of such indices is being maintained.

Scoring Guidepost 80

Indices of abundance are monitored on an annual basis. If based on fishery-dependent data, an appropriate and consistent measure of fishing effort is being used, which avoids changes in fishing power associated with changing fishing practices. Factors, e.g. environmental variables or changes in fishing practice, that may affect the index of abundance have been identified and are being monitored and incorporated into statistical analyses.

Scoring Guidepost 100

Fishery independent indices of abundance are available. Indices of abundance of mature fish are available.

Score

Mulloway	75
Golden perch	75

Goolwa cockles	70
Yellow-eye mullet	75

Comment

Mulloway

Statistics for the commercial fishery for mulloway from 1983/84 to 2001/02 are reported in Ferguson and Ward (2003). Commercial catch records extend back to 1951, and, from January 1972, commercial fishers were required to provide a monthly report on the catch, method of capture, duration of fishing time and location of fishing (Sloan 2005). However, estimates of commercial fishing effort (days fished) and target species have been collected only since 1983 (Ferguson and Ward 2003). Limited data on the recreational fishery for mulloway are available. However, recently, the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) has provided estimates of numbers of mulloway caught in South Australia by recreational fishers.

Thirty seven commercial fishers operating in the Lakes and Coorong Fishery take mulloway from the Coorong lagoons primarily using a large mesh (≥ 115 mm mesh), monofilament gill net and from the oceanic beaches adjacent to the Youngusband Peninsula using swinger nets (Ferguson and Ward 2003). These latter devices are large mesh (150 mm mesh) gill nets anchored to the shore by several hundred metres of rope, which are allowed to drift out through the surf with the aid of offshore and longshore currents and hauled manually (Ferguson and Ward 2003). The size range of fish caught in the lagoons ranges from 460-800 mm TL, with a modal size of 550 mm TL, while that of fish caught on the oceanic beaches is 800-1300 mm TL, with a mode of 1000 mm TL. Recreational fishers take mulloway from the ocean beaches near the Coorong using surf rods during the summer and from the lagoons using net and lines (Ferguson and Ward 2003). Currently, there are ~1996 (data 2005) recreational fishers with licences which permit use of a gill net in the Coorong, should fishers decide to exercise that right (Ferguson and Ward 2003). In addition to the release of undersize mulloway and fish in excess of bag limits, recreational fishers may release fish of lengths greater than the minimum legal length in catch and release activities.

Annual abundance indices for mulloway are derived from commercial fishery statistics. Two main indices are produced, one which represents the catch per unit of fishing effort (cpue) for the juvenile fish within the Coorong lagoons that are caught by large mesh gill nets, *i.e.* 460-800 mm TL and representing ~90% of recent annual commercial catches, and a second that represents the cpue for fish caught by the swinger nets on the oceanic beaches, *i.e.* 800-1300 mm TL and representing ~8% of recent commercial catches (Ferguson and Ward 2003). Other indices of abundance are calculated for the Marine Scalefish Fishery. Three effort measures have been used in calculating cpue, *i.e.* effort with no specific target, effort targeted at mulloway and effort targeted at species other than mulloway (Ferguson and Ward 2003). In each case, the effort is recorded as the number of fisher days. The most reliable of the three measures of abundance is considered to be the catch per unit of targeted effort.

Values of cpue recorded for the mulloway fishery reveal considerable inter-annual variability and are likely to be influenced by freshwater flows (Ferguson and Ward 2003). Thus, environmental factors and the management of the flow regime of the Murray River are likely to influence the values of cpue recorded for the fishery. The impact of freshwater flows on the relationship between abundance and the cpue recorded within the lagoons through, for example, changes in salinity, turbidity, food availability and distribution of mulloway is poorly understood. Analysis of the swinger cpue data by Ferguson and Ward (2003) suggested that the aggregation of adult mulloway at the Murray Mouth was influenced by freshwater flow, with the latter possibly serving as an attractant to a location providing favourable conditions for pre-spawning feeding or spawning. Analyses to determine the influence of the various factors on the relationship between cpue and abundance are being undertaken within the current PhD study, but as yet these factors are not being incorporated into statistical analyses.

In assessing indicator 1.1.1.3, there was concern that fisher day was a coarse measure of fishing effort and that lack of any ongoing attempt to understand and track effort might miss potential increases in efficiency *e.g.* increasing duration of fishing time within each day of fishing. There was also concern that the spatial distribution of cpue within the lagoons was not considered in the assessment, such that, for example, the measure of cpue might remain high but the area over which catches were being taken may have declined.

Condition 3:

An improved index of abundance, with finer temporal and spatial resolution, should be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations or other factors, such as environmental variables. Note that (1) existing indices of abundance should be maintained as these have been established as the indicator variables that are calculated and compared against reference points to trigger an appropriate management response; and (2) the refinement of existing fishery-dependent indices of abundance may require the collection of additional and more detailed spatial and environmental data by each type of fishing gear to enhance the catch and effort data currently supplied by fishers and will require appropriate statistical analyses of those data.

Golden perch

The assessment undertaken by Ye (2004) used the detailed catch and effort data reported by commercial fishers since 1984/85 to calculate several indices of abundance for golden perch. For the River Fishery, targeted catch per unit of effort was derived for golden perch caught using drum nets and for those caught using gill nets. Both fisher-days and net-days were employed in these calculations, however, the influence on the annual cpue of other factors such as the duration over which such nets were fished each time they were set, the number of sets, month of year, etc., appear not to have been considered. Ye noted, however, that drum nets become more effective under high flow conditions whereas gill nets are mainly employed in low flow conditions. For the Lakes Fishery, the abundance index that was calculated was targeted cpue for golden perch caught using gill nets.

Drum nets have been the primary method used by commercial fishers to capture golden perch in the River fishery (Ye 2004). However, gill nets account for 23% of the River catch and are virtually the only method used in the Lakes fishery (Ye 2004). While the number of gill nets operated by fishers in the River Fishery increased over time, and particularly in the last five years, the number operated by fishers in the Lakes has remained relatively constant (Ye 2004).

Condition 4:

An improved index of abundance with finer temporal and spatial resolution should be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations or other factors, such as environmental variables. (See the note appended above to Condition 3 for mulloway)

Goolwa cockles

The index of abundance used in assessing the status of the Goolwa cockles is the harvested commercial catch per unit of fishing effort, *i.e.* fisher-day (Murray-Jones and Johnson 2003). Although Murray-Jones and Johnson (2003) note that precise information on the number of people actually fishing is not available, there is information on the number of people fishing per day in commercial catch and effort data reports. The measure of abundance excludes catches of undersized animals that are returned to the ocean (by commercial and other fishers). There is concern that the index of abundance may fail to reflect changes in abundance because fishers move to new sections of beach when cpue declines. There is thus the potential that cpue may fail to indicate any spatial contraction of the population of cockles in response to exploitation. Monthly catch and effort data are reported daily by commercial fishers and are analysed to produce the estimates of annual cpue that are compared with the biological reference points in accordance with the management plan for the Lakes and Coorong Fishery. Murray-Jones and Johnson (2003) present a plot of the annual cpues from 1983/84 to 2000/01 but caution that, because the distribution of the cockles is patchy, cpue is likely to be a poor measure of abundance. They suggest that effort, and thus cpue data, would benefit from greater resolution in reporting to allow determination of traveling time, and time spent locating, catching, sorting, and sieving. An understanding of the temporal and spatial changes in the distribution of the Goolwa cockles and how this relates to fishing activity is needed if trends in cpue data are to be interpreted reliably.

Condition 5:

An improved index of abundance should, with finer temporal and spatial resolution, be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations, distribution of cockles, or other factors, such as environmental variables. (See the note appended above to Condition 3 for mulloway) The potential that catch per unit of effort may be sustained (*i.e.* that cpue is hyperstable) through movement of fishers to new sections of beach needs to be accounted for by appropriate collection and analysis of data.

Yellow-eye mullet

Statistics from the commercial fishery for yellow-eye mullet (statewide and for both the Lakes and Coorong Fishery and the Marine Scalefish Fishery) from 1983/84 to 2002/03 are reported in Higham *et al.* (2005). Commercial catch records extend back to 1951, however detailed estimates of commercial fishing effort (days fished) and target species have been collected from the Marine Scalefish Fishery and the Lakes and Coorong Fishery only since 1983 and 1984, respectively (Higham *et al.* 2005).

Approximately 92% of the commercial catch from the Lakes and Coorong fishery is taken by small mesh gill net (> 50 mm and ≤ 64 mm mesh), with large mesh gill nets (> 115 mm mesh) accounting for a further 5% (Higham *et al.* 2005). The principal method of capture used in the Marine Scalefish Fishery is the haul net, which take ~77% of this sector's catch, with ~22% being taken using gill nets (Higham *et al.* 2005). While the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) reported that line fishing was the principal method used by recreational fishers to take yellow-eye mullet, Higham *et al.* (2005) report that it is likely that net fishers were under-represented in this study. They note that there are currently 1996 recreational nets compared with 1565 nets in the commercial fishery. Rec. nets are 75 metres long (& commercial nets are 50 metres long) and are registered by PIRSA Fisheries, and that in 1995 the majority of the registered nets were used to target yellow-eye mullet.

Annual abundance indices for yellow-eye mullet are derived from commercial fishery statistics by calculating the catch per unit of effort (kg. fisher-day⁻¹ or kg. net-day⁻¹) for targeted catches of yellow-eye mullet (Higham *et al.* 2005). For the Lakes and Coorong Fishery, indices are calculated for both the small and large mesh gill nets (Higham *et al.* 2005). Higham *et al.* (2005) note that, although the number of fisher-days has declined between 1992/93 and 2002/03, the number of net-days stabilized between 1996/97 and 2001/02 but increased in 2002/03. Indices of abundance for the Marine Scalefish Fishery are calculated for both haul and gill nets as the cpue (kg. fisher-day⁻¹) for catches of yellow-eye mullet taken when this species was targeted by fishers.

As with mulloway, the potential for increasing efficiency of fishing effort when recorded as fisher-days has been recognised. Higham *et al.* (2005) note the uncertainty associated with small mesh gill net effort and the need to understand the implications of changes in fishing patterns related to net setting. There is a need to consider the adequacy of the measures of fishing effort and to assess the factors that might influence cpue.

Condition 6:

An improved index of abundance with finer temporal and spatial resolution should be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations or other factors, such as environmental variables. (See the note appended above to Condition 3 for mulloway)

Indicator 1.1.1.4 **There is adequate knowledge of environmental influences on stock dynamics to manage the fishery for the target stock.**

Scoring Guidepost 60

A conceptual understanding of the relationships between fish abundance and both habitat and environment has been developed.

Scoring Guidepost 80

Relationships between environmental variables and catches, indices of abundance, growth, etc. have been investigated at least qualitatively.

Scoring Guidepost 100

There is a sound understanding of the relationship between catches and/or indices of abundance and environmental variables.

Score

Mulloway	79
Golden perch	80
Goolwa cockles	70
Yellow-eye mullet	75

Comment

Mulloway

Data presented by Ferguson and Ward (2003) suggest a positive influence of freshwater flow on recruitment of young of the year to the Coorong lagoons. Several hypotheses consistent with the known biology of the species have been proposed to explain this relationship. For example, the freshwater flow may serve as an attractant of adult mulloway to the Murray Mouth, thereby improving the abundance of food for pre-spawning adults or improving the survival of larvae after spawning has occurred (Ferguson and Ward 2003). The flow might also act as an attractant and improve the recruitment of small juveniles into the Coorong lagoons (Ferguson and Ward 2003). The impact of freshwater flow on juvenile habitat has also been considered. Factors such as reduced salinity, increased turbidity or enhanced food supply may affect survival and growth of juvenile mulloway (Ferguson and Ward 2003). Results of a preliminary investigation of the proposed relationships are reported by Ferguson and Ward (2003), and are being investigated further in the current PhD study.

The potential importance of the influence of environmental factors to the recruitment of mulloway to the lagoons, their growth and distribution within the lagoons, their subsequent emigration from the lagoons to marine waters, and the distribution and spawning success of adult mulloway suggests that a sound understanding of the effect of these environmental factors should be developed. Such knowledge is likely to be of considerable value when environmental flows of the Murray River are discussed.

Condition 7:

The influence of freshwater outflows and other environmental variables on the abundance and distribution of mulloway should be ascertained, and their implications for management considered.

Golden perch

Ye (2004) investigated the relationship between monthly targeted cpue and average daily flow and found a strong positive correlation between drum net cpue and flow. Because drum nets become increasingly effective as river flow increases, drum net effort and catches increase as river flow increases to peak in September/October. The high flow rates between September and November also trigger upstream migration of adult fish, thereby increasing the catchability of the drum nets (Ye 2004).

High flows and floods stimulate spawning in golden perch and are considered likely to result in favourable conditions for the growth and survival of larvae and juveniles and the resultant recruitment to the fishery of strong year classes (Ye 2004). Age compositions of samples collected in 2002 from commercial catches from the River Fishery show the presence of strong year classes that are consistent with this hypothesis and with water flows in the years in which those year classes were spawned (Ye 2004). Thus, success of recruitment may be strongly linked to water flow in certain areas.

Goolwa cockles

It has been conjectured that freshwater flows may influence the abundance and biomass of Goolwa cockles by producing, through their nutrient load, an increase in food resources available to the cockles and/or by providing a cue for spawning. However, outflows from the Murray River have also been associated with mass mortalities of cockles, probably through reduced salinity (Murray-Jones and Johnson 2003). Murray-Jones and Johnson (2003) noted that an improved understanding of the relationship between freshwater outflow and recruitment, growth and survival of the Goolwa cockles is essential for the appropriate management of this resource. Environmental factors, such as the oceanic conditions at the time of early larval development, extended periods of calm conditions during the heat of summer and reduced oxygen levels, or beach erosion as a consequence of storm activity, may also affect the cockle population (Murray-Jones and Johnson 2003). Murray-Jones and Johnson (2003) reported no formal exploration of the relationship between freshwater outflow and cpues of cockles and thus it appears that such studies have not yet been conducted.

Condition 8:

The influence of freshwater outflows and other environmental variables on the abundance and distribution of Goolwa cockles should be explored (either qualitatively or quantitatively), and their implications for management considered.

Yellow-eye mullet

It is noted by Higham *et al.* (2005) that yellow-eye mullet are found in brackish and inshore coastal waters and within estuaries, particularly those that are shallow. They are considered to be estuarine-opportunists and are omnivorous. While they are broadly distributed throughout South Australian waters, the Coorong is the location from which most catch of this species is taken. Higham *et al.* (2005) note that the Murray Mouth closed in 1981, and that,

subsequently in 2001/02, it again experienced an almost complete closure. The impact of such a closure is that movement of fish between the lagoons and the estuary is restricted, and the waters within the lagoons experience lower dissolved oxygen content and elevated salinity. Higham *et al.* (2005) note that such changes have the potential to severely impact the yellow-eye mullet and its fishery. Similarly, changes in freshwater flow are known to affect the salinity in the lagoons and may thus affect the distribution, growth and survival of the species.

While the broad relationship between habitat and distribution of yellow-eye mullet appears to be well known, the influence of environmental variables on distribution, growth, survival and recruitment appears not yet to have been considered, as no description of either qualitative or quantitative studies appears in Higham *et al.* (2005). A qualitative understanding of the influence of environment variables on catches, catchability and biological processes is necessary if trends in cpue are to be assessed and inter-annual variability is to be interpreted.

Condition 9:

The influence of environmental variables and catch, cpue, growth, etc. of yellow-eye mullet should be explored (either qualitatively or quantitatively).

SC 1.1.2 There is adequate knowledge about the fishery for each target stock.

This sub-criterion is intended to assess whether data collected from the Lakes and Coorong fishery (and other fisheries exploiting the same target stock) regarding fishing operations and catches allow an accurate and precise assessment of the impacts of fishing on the various size and age classes of the target stock at appropriate spatial and temporal resolution. Sufficient data should be collected to enable the level of exploitation of the target stock to be accurately assessed and to allow factors affecting the indicator variables and indices of abundance of the stock to be taken into account when statistical analyses of these data are undertaken.

Indicator 1.1.2.1 All major sources of fishing mortality, including illegal fishing on the target stock, are measured or estimated.

Scoring Guidepost 60

Estimates on the catch from the target stock by all significant fishing sectors and fisheries, including those exploiting the stock outside the bounds of the Lakes and Coorong fishery, are available.

Scoring Guidepost 80

Data on retained and discarded catches of the target stock are collected from each significant fishing sector at an appropriate spatial and temporal resolution. A broad estimate is available of the mortality of discarded individuals of the target species. Broad estimates of illegal catches are available.

Scoring Guidepost 100

An accurate estimate is available of the mortality of discarded individuals of the target species. Catch data are collected from the fishery at a level of resolution determined by the fishing

gear (e.g., haul of a gill net) or fishing technique and at the spatial resolution appropriate to the fishing operation. Accuracy of catch data have been confirmed by fishery-independent data.

Score

Mulloway	65
Golden perch	65
Goolwa cockles	65
Yellow-eye mullet	65

Comment

Mulloway

Commercial catches are entered daily and reported monthly by fishers and are considered to be accurate records of the true catches, however methods to validate that these catches are accurate need to be developed.. The quantity and fate of undersized fish caught by commercial fishers is not recorded by Ferguson and Ward (2003).

The recreational fishery for mulloway in South Australia is significant, with a total catch between May 2000 and April 2001 that is estimated at 90.2 tonnes in the marine component alone. The commercial catch in 2000/01 was 145 tonnes, which was the highest recorded commercial catch for this species and which was substantially greater than that caught in the following year, i.e. 95 tonnes, a value much closer to the average commercial catch over the five years from 1997/98 to 2001/02. In addition to the quantity of mulloway harvested by recreational fishers, a considerable number of mulloway are caught and subsequently released, i.e. ~70% of the total catch in numbers (Jones and Doonan 2005). Ferguson and Ward (2003) note that the mortality of released mulloway is unknown but that the species is considered likely to experience relatively high catch and release mortality. Insufficient data exist to allow the calculation of a reliable estimate of the overall impact to the mulloway stock of the recreational fishery relative to that of the commercial fishery. However, the recreational harvest and the potential loss through catch and discard by the recreational sector are of approximately similar magnitude to the catches taken by the commercial sector and thus cannot be ignored when undertaking stock assessment.

Although the verbal advice that we received from Mr Francis Lovegrove, Ngarrindjeri Lands Progress Association, Meningie, suggests that the indigeneous catch was negligible relative to the catches of the commercial and recreational sectors, the catch is likely to be important for their community, and should therefore be reported for this and each of the other species being assessed. Removals through illegal fishing and through the mortality of fish that are released or discarded should also be reported on an annual basis such that it is possible to assess whether the stock assessment for the species is robust with respect to these losses.

Condition 10:

- (1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.
- (2) Research should be undertaken and an estimate of release mortality determined.
- (3) Estimates of annual indigenous and illegal catches, and removals through mortality of discarded fish, need to be developed.
- (4) For each fishing gear and fishing sector, the fishery data (catch and effort) should be collected at a spatial and temporal resolution that is appropriate for subsequent stock assessment.

Golden perch

Commercial fisheries data are available from the River Fishery and from the Lakes and Coorong Fishery, however methods to validate that these catches are accurate need to be developed. The quantity and fate of undersized fish caught by commercial fishers is not recorded by Ye (2004). As with other commercial fisheries in South Australia, these data are reported by fishers in mandatory monthly statistical returns. However, the assessment reported by Ye (2004) contains no information on catches that might have been taken by fishers in New South Wales from the central Murray stock of golden perch. Ye (2004) also comments on the illegal fishing of golden perch that is known to exist, but provides no estimates of the magnitude of the catch taken by this illegal fishery or of its impact on the status of the stock.

Using data collected by the National Recreational and Indigenous Fishing Survey, the recreational harvest of golden perch in South Australia was estimated to be 91 tonnes, however this figure excludes the 69% of the fish that were caught and released either in accordance with minimum size or bag limit regulations, or in “catch and release” fishing activities (Ye 2004). The mortality of released fish is unknown but likely to be substantial (Ye 2004).

Condition 11:

- (1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.
- (2) Research should be undertaken and an estimate of release mortality determined.
- (3) Estimates of annual indigenous and illegal catches, and removals through mortality of discarded fish, need to be developed.
- (4) For each fishing gear and fishing sector, the fishery data (catch and effort) should be collected at a spatial and temporal resolution that is appropriate for subsequent stock assessment.

Goolwa cockles

Commercial fishers are obliged to submit details of monthly catches and the resulting data are considered to be reliable, however methods to validate that these catches are accurate need to

be developed. Although collection of commercial fishing data commenced in 1976/77, Murray-Jones and Johnson (2003) caution that data sets for years prior to 1990 may be incomplete. A much greater spatial resolution of the data is required to allow assessment of changes in the distribution of the species or of fishing operations, and thus understand better any changes in abundance of the cockles. The only available catch estimate for the recreational fishery appears to be that derived from the recent National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003), which reported a catch for 200/01 of less than 30 tonnes.

Condition 12:

- (1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.
- (2) Research should be undertaken and an estimate of release mortality determined.
- (3) The spatial and temporal resolution of commercial catch statistics should be improved and changes in the distribution of fishing or of cockles assessed appropriately.
- (4) Estimates of annual indigenous and illegal catches, and removals through mortality of released/seived undersized cockles, need to be developed.

Yellow-eye mullet

Commercial catches are reported monthly by fishers and are considered to be accurate records of the true catches, however methods to validate that these catches are accurate need to be developed. The quantity and fate of undersized fish caught by commercial fishers is not recorded by Higham *et al.* (2005).

The National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) produced an estimate of annual recreational harvest of yellow-eye mullet of 47 tonnes in 2000/01 compared with a statewide commercial harvest of ~213 tonnes. The recreational harvest from the Lakes and Coorong region was estimated to be 9 tonnes compared with an estimated commercial harvest of 145 tonnes. However, concern has been expressed by Higham *et al.* (2005) that the National Survey may have failed to include sufficient representation of recreational gill net fishers and thus estimates of recreational harvest from the Lakes and Coorong Fishery may be underestimated. This is particularly relevant, noting that there are 1996 recreational nets that potentially can be deployed within the Lakes and Coorong Fishery. This represents considerable latent effort. It should also be noted that the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) indicated that approximately 34% of the statewide catch and 29% of the catch from the south-eastern region of the state (including the Lakes and Coorong Fishery) were released. No information is supplied by Higham *et al.* (2005) concerning the proportion of released fish that die as a result of catch and release.

Condition 13:

- (1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.

- (2) Research should be undertaken and an estimate of release mortality determined.
- (3) Estimates of annual indigenous and illegal catches, and removals through mortality of discarded fish, need to be developed.
- (4) For each fishing gear and fishing sector, the fishery data (catch and effort) should be collected at a spatial and temporal resolution that is appropriate for subsequent stock assessment.

Indicator 1.1.2.2 **The size and age structure of catches and sex ratio are measured.**

Scoring Guidepost 60

Estimates on the size and/or age composition of the stock fished are available.

Scoring Guidepost 80

Data on the size and/or age composition of representative samples of the commercial catch are collected at an appropriate spatial and temporal resolution and analyzed.

Scoring Guidepost 100

Selectivity of fishing gear is considered when assessing the size and composition of each stock.

Score

Mulloway	79
Golden perch	79
Goolwa cockles	65
Yellow-eye mullet	60

Comment

Mulloway

Details of the size compositions of the commercial gill net catches and from the catches taken by multi-panel research gill nets from within the lagoons, from the swinger net catches of commercial fishers, from a commercial haul net catch from the west coast of South Australia and from recreational line fishers are available (Ferguson and Ward 2003). The proportion of females in the swinger catch in 2002/03 was reported by Ferguson and Ward (2003) to be 0.55. These data, and the collection of otoliths for age reading and determination of the associated age compositions, were collected during the current PhD study on mulloway that commenced in 2001.

Preliminary estimates have been obtained of the selectivity of the large mesh gill nets employed to catch mulloway in the Coorong lagoons and the swinger nets employed on the oceanic beaches. Ferguson and Ward (2003) report that the modal length of the former was 525 mm TL (range 460-822 mm TL), while that of the latter was 975 mm TL for both males and females (range 757-1268 mm TL for males, 801-1245 mm TL for females).

Ferguson and Ward (2003) note that the methods of ageing developed in the current PhD study “could be used to establish an ongoing program for monitoring the age structure of catches”. Such a program is considered essential if the status of the mulloway fishery is to be adequately assessed. The variability in inter-annual recruitment that exists and that appears to be related to freshwater flow and upwellings needs to be understood if trends in abundance are to be reliably assessed. Ferguson and Ward (2003) note that, given the difference in growth rates and the selectivity of the nets, the sex ratio of catches in the swinger nets may prove a useful performance indicator. They point out that additional monitoring of the age/size structure is required for the fishery.

Condition 14:

An appropriate monitoring program should be established to collect reliable size composition data from the fishery and to monitor changes in annual age/size composition and sex ratio.

Golden perch

The method used to age golden perch has been validated and Ye (2004) has provided details of the age composition of commercial catches taken in 2002, predominantly using gill nets (84%) but with a small component from drum nets (14%). Fishery-independent research samples were also collected from the Murray River in 2002 and 2003, mainly using boat electro-fishing (Ye 2004). Ye (2004) notes that, with the aid of a commercial fisher from the Lakes and Coorong Fishery, samples of legal-sized fish from the gill net catch from the Lakes were collected in 2002 and 2003. Small fishery-independent samples were also collected from the Lakes in 2002 and 2003, primarily to collect data on undersize golden perch. It appears that there are no data on the size or age compositions of the catches taken by recreational or illegal fishers, as Ye (2004) reports no information on these. Although the above samples yielded size-composition data, variability in growth makes these less informative than the age compositions that were derived from the collected fish. Age composition data are important for assessing and managing the golden perch fishery, as these provide information on relative recruitment strengths of different year classes and allow this to be taken into account when assessing the status of the stock. There appear to be no data on the mesh selectivity of the gill nets used to capture golden perch.

Condition 15:

An appropriate monitoring program should be established to collect reliable size composition data from the fishery and to monitor changes in annual age/size composition and sex ratio.

Goolwa cockles

Length compositions recorded for Goolwa cockles between January 1973 and January 1974 by King (1995) are reported by Murray-Jones and Johnson (2003). They also present details of length samples collected from Goolwa Beach between 1992 and 1998. Similar data are not available for the cockles on the Younghusband Peninsula. The results of a study in 2000 on the Coorong Beach that compared the size composition from a cockle net with a smaller mesh with that obtained from the catches of commercial fishers are also reported by Murray-Jones and Johnson (2003). No selectivity curve is available for the cockle net, and would be

inappropriate to calculate as selectivity changes as the net is filled (Murray-Jones and Johnson 2003). Catches are sorted and sieved after capture by some fishers, to remove undersize individuals, however released individuals may suffer mortality as a consequence of their experience.

Condition 16:

An appropriate monitoring program should be established to collect reliable annual size composition data from the fishery and to monitor changes in these data.

Yellow-eye mullet

The length range of yellow-eye mullet caught commercially in South Australian waters during the early 1980s was recorded to be 21 to 28 cm CFL, with surprisingly, a mode of 28 cm CFL (Hall 1986, as reported by Higham *et al.* 2005). Higham *et al.* (2005) note that the selectivity for yellow-eye mullet of a range of mesh sizes from 31 to 82 mm was determined by Thomson (1957). Higham *et al.* (1985) report that current age and size composition data are not available for the yellow-eye mullet fishery. No information concerning the size and age composition of discarded fish is reported.

Condition 17:

An appropriate monitoring program should be established to collect reliable annual age/size composition data from the fishery and to monitor changes in age/size composition and sex ratio.

Indicator 1.1.2.3 Fishing methods and patterns are well understood.

Scoring Guidepost 60

Estimates on the fishing effort expended by each significant fishing sector (and fishery), by gear type, are available.

Scoring Guidepost 80

Effort data are collected from each commercial fishery at an appropriate spatial and temporal resolution.

Scoring Guidepost 100

Factors influencing the efficiency of different fishing gears and different sectors have been identified and data are collected to allow changes in efficiency to be assessed. Factors that influence the switching among species in the multi-species fishery have also been identified and taken into account.

Score

Mulloway	79
Golden perch	79
Goolwa cockles	79
Yellow-eye mullet	79

Comment

Effort by commercial fishers is logged daily and reported monthly. The data recorded include details of the days spent fishing, the locations fished, the gear used and the target species. As with recreational catches, there is a paucity of quantitative information on recreational fishing effort and the only definitive data that appear to exist are those derived from the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003).

Mulloway

In assessing indicator 1.1.1.3, there was concern that a fisher-day was a coarse measure of fishing effort. Due to a lack of any ongoing monitoring of effort, there is concern that any increases or decreases in efficiency might be masked, *e.g.* increasing duration of fishing time within each day of fishing. It is essential that the spatio/temporal resolution of the data is improved and that it is possible to determine the effort applied using each type of fishing gear if the data are to provide the information that will be required for future stock assessment.

Condition 18:

The spatio/temporal resolution of commercial effort statistics, by gear type, should be improved and changes in the distribution of fishing or of the fish assessed appropriately.

Golden perch

Increasing usage of nets in the River fishery caused an increase in the efficiency of effort when this was recorded as fisher-days. Although no such trend was apparent in the Lakes fishery, it is possible that this might also be susceptible to similar change in fishing operations (*e.g.* large catches of carp that are discarded may well effect CPUE). With the introduction of the prohibition on taking native fish in the River Murray, no commercial fishery data will be available to monitor the abundance of fish in this region of the fishery, despite the fact that this is the region from which recreational fishers appear to obtain virtually all their catch of golden perch. It is essential that the spatio/temporal resolution of the data is improved and that it is possible to determine the effort applied using each type of fishing gear if the data are to provide the information that will be required for future stock assessment.

Condition 19:

The spatio/temporal resolution of commercial effort statistics, by gear type, should be improved and changes in the distribution of fishing or of the fish assessed appropriately.

Goolwa cockles

Effort by commercial fishers is reported logged daily and monthly. The data recorded include details of the days spent (in hours) fishing, the locations fished, the gear used and the target species. Murray-Jones and Johnson (2003) have advised that more valuable effort data would result from greater resolution in reporting to allow determination of traveling time, and time spent locating, catching, sorting, and sieving. A much greater spatial resolution of the data is

required to allow assessment of changes in the distribution of the species or of fishing operations, and thus understand better any changes in abundance of the cockles.

Condition 20:

- (1) The spatial/temporal resolution of commercial effort statistics should be improved and changes in the distribution of fishing or of cockles assessed appropriately.
- (2) The effort reported by commercial fishers should be modified to be in sufficient detail to allow determination of traveling time, and time spent locating, catching, sorting, and sieving.

Yellow-eye mullet

Effort by commercial fishers is logged daily and reported monthly. The data recorded include details of the days spent fishing, the locations fished, the gear used and the target species. There is concern that the measure of effort used in the commercial fishery may fail to reflect changes in efficiency resulting from changes in fishing operations. As noted above, there is a paucity of quantitative information on recreational fishing effort. Moreover, as noted for previous indicators, the representation of recreational gill net fishers in the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) appears likely to have been inadequate. It is essential that the spatio/temporal resolution of the data is improved and that it is possible to determine the effort applied using each type of fishing gear if the data are to provide the information that will be required for future stock assessment.

Condition 21:

The spatio/temporal resolution of commercial effort statistics, by gear type, should be improved and changes in the distribution of fishing or of the fish assessed appropriately.

SC 1.1.3 **There is a well-defined and effective strategy for managing exploitation of each target stock.**

This sub-criterion is intended to assess whether an explicit strategy has been implemented to control the exploitation of the stock at a level that, considering the biology of the species and the availability of data, is highly likely to ensure that the stock is sustained at an appropriate level. Harvest controls should respond appropriately if the abundance of the stock declines, should be robust with respect to uncertainty of data and natural variability, implementation or the impact of fishing mortality imposed by other fishing sectors, and should be precautionary. Evidence that the harvest control rules are being applied to the fishery by fisheries managers should be available. The outcomes of application of the rules should be examined to determine whether the rules appear to be effective in controlling exploitation. In assessing effectiveness of the strategy, consideration should be given to the multi-species nature of the fishery and the effort switching among species that is a character of the Lakes and Coorong fishery. However, in such a fishery, the potential exists for economic or biological pressures (e.g. poor recruitment of a species) to drive the effort for other species to levels that are inappropriate. Strategies need to be available to ensure that such within-fishing season changes in the distribution of fishing effort are averted and that an appropriate balance of effort among species is maintained. A suite of harvest strategies is used in the fishery,

including both input and output controls, closed regions, etc., and it is the extent to which this combination of strategies is effective in managing exploitation that must be assessed.

Indicator 1.1.3.1 **The rules and procedures for limiting effort or catch are adequately defined and effective.**

Scoring Guidepost 60

Rules exist to constrain exploitation to an appropriate level, where this level has been broadly assessed on the basis of historical catches, indices of abundance, fishing practices and expert opinion.

Scoring Guidepost 80

Explicit harvest control rules and procedures have been defined and implemented. Reference points have been adopted such that when an indicator variable falls beyond the reference points, an appropriate management action is triggered that is designed to maintain the fishery within an acceptable range of catches and abundance indices.

Scoring Guidepost 100

The reference points are well selected and precautionary such that, despite inter-annual variability, abnormal levels of recruitment, spawning stock, exploitation or environmental conditions are likely to be detected.

Score

Mulloway	85
Golden perch	85
Goolwa cockles	79
Yellow-eye mullet	85

Comment

The Lakes and Coorong Fishery is exploited by both recreational and commercial fishers. The commercial fishery is a limited entry fishery comprising 37 fishers and exploitation is managed using a mix of gear restrictions, spatial and temporal closures, restrictions on the number of agents permitted to assist fishing operations and legal size limits (Sloan 2005). Recreational fishers are also constrained by gear restrictions, spatial and temporal closures and legal size limits, however no limit is imposed on the number of recreational fishers seeking to participate in the recreational fishery (Sloan 2005).

In addition to the formal management arrangements, the commercial fishers in the Lakes and Coorong Fishery have adopted fishing practices that reflect the changing abundances of the different species. Thus, harvesting switches to target different species at different times of the year and away from species that have experienced a decline in abundance. While it is likely that such behaviour reflects economic pressures, commercial fishers recognize, and fishery managers acknowledge, that the practice tends to reduce exploitation of species when such reduction is appropriate, thereby improving the sustainability of the different species that are exploited by the fishers.

The rules that have evolved for the fishery reflect the historical trends in catch and exploitation and the pattern of fishing that has been adopted by the fishers of the Lakes and Coorong Fishery. The release in 2005 of the Management Plan for the South Australian Lakes and Coorong Fishery (Sloan 2005) provides a detailed and explicit specification of the regulations and of the harvest control rules and actions that will be initiated should indicator variables fall beyond specified biological reference points. Other non-biological triggers relate to a change exceeding 50% in the total commercial fishing effort for any fishing method over a four year period, changes in species composition, surveys indicating that recreational effort levels exceed those identified in the National Recreational and Indigenous Fishing Survey, and failures of research and management processes such as the production of stock assessment and status reports in line with the strategic research and monitoring strategy (Sloan 2005).

The actions that are triggered are that (1) the Minister for Agriculture, Food and Fisheries and participants in the fishery are notified; (2) a detailed review is undertaken of the causes and implications of the indicator falling beyond its reference point; (3) key stakeholders are consulted regarding the need for alternative management actions for each fishing sector; and (4) a report is provided to the Minister, within three months of initial notification, advising of the conclusions of the review and providing recommendations on alternative management strategies (Sloan 2005). The consultative approach, in combination with the requirement for provision of appropriate management advice within a three month time frame, is considered appropriate for this fishery (Sloan 2005). The Minister bears ultimate responsibility for ensuring the sustainability of the stock and may take action to constrain fishing for a specified period if this should become necessary or if total catch limits are reached.

The use of upper and lower limits derived from historical values of catch and cpue ensures that inter-annual variability in these indicators is accommodated and that action is less likely to be triggered as a result of such variation. The down side of this is that adverse trends in exploitation or abundance may not be detected until they fall outside the range of natural variability. It would be more appropriate to trigger a review at an earlier stage than to delay triggering until the situation is critical. Clearly, if it was possible and if relationships are known from earlier research studies, it would be better to adjust the indicators for the influences of known factors and thereby remove some of the variability in the raw data. The concern is whether, given the variability that exists and the nature of this multi-species fishery, it would be possible to detect abnormal levels of recruitment, spawning stock, exploitation or environmental conditions in time to respond before the situation becomes serious. An appropriate management strategy evaluation to address this question might prove a rewarding post-graduate research study.

Rules have been introduced for each species to constrain exploitation to an appropriate level, where this level has been broadly assessed on the basis of historical catches, indices of abundance, fishing practices and expert opinion (Sloan, 2005). Thus, the requirement imposed by the first scoring guidepost has been satisfied. Indeed, these rules and the appropriate procedures have been both defined and implemented, and reference points have been set. A process has been implemented for each species to calculate and compare the indicators against

the reference points and a defined action is triggered that is intended to maintain the fishery within a specified range of catches and abundance indices (Sloan, 2005). Accordingly, the requirements of the second guidepost have been achieved, i.e. a score of at least 80 is warranted for all species except the cockles. The indicators and reference points include environmental and ecosystem aspects of the fishery, thus moving slightly towards the requirements of the third guidepost. However, as discussed in the preceding paragraph, there has been no demonstration that the reference points are well selected and precautionary. Accordingly, the species, except for cockle, have each been assigned a score of 85.

Mulloway

A mix of regulations is employed to control the activities of commercial fishers in the Lakes and Coorong fishery. To further control catches, commercial fishers in the Marine Scalefish Fishery and rock lobster fisheries are constrained to a maximum annual catch of 1,000 kg of mulloway (Sloan 2005). Fishers operating in the Commonwealth shark fishery are restricted to a 100 kg by-catch trip limit for mulloway (Sloan 2005).

The minimum legal size for mulloway is set at 460 mm TL within the Coorong estuary and at 750 mm outside the estuary (Sloan 2005). The primary intent of the size limit is “to maximise the opportunity for individual fish to reproduce at least once before capture”, however the management plan also acknowledges the objectives of maximizing the biological or economic yield per recruit (Sloan 2005). The declared policy of the South Australian Recreational Fishers Advisory Council (SARFAC) is that the minimum size limit should be set at the size at which the fish attain maturity and thus the Council opposes the current minimum legal size of 460 mm TL for fish caught within the lagoon as it poses a risk for the sustainability of the stock. It should be noted that the current estimate of the size at which mulloway mature in South Australia is 700 mm TL, however this may be revised as a result of the current PhD study (Ferguson and Ward 2003). As ~90% of the commercial catch from the Lakes and Coorong Fishery is derived from within the lagoon, and noting that the fishery has persisted for many years with the current regulation, there is strong economic argument by commercial fishers for retention of the current minimum size. The Southern Fishermen’s Association (2004) oppose raising the minimum legal size of mulloway caught within the lagoons. Without entering into a debate regarding minimum size, it should be noted that most fisheries are managed using a combination of input and output controls, including (but not restricted to) size limits, gear and effort controls, and closed areas and seasons. The Lakes and Coorong Fishery is no exception. It is not the effectiveness of a single control, such as minimum legal size, that is important, but how well the combination performs in achieving management objectives and sustaining the stocks.

It should be noted that, to maintain the fishery within its historical range, there is a need to also maintain the balance between the catches taken within and outside the Coorong (recognizing that recreational effort is not constrained).

The lack of information on the contribution of the mulloway within the Coorong lagoons to the adult fish in the oceanic waters outside the Coorong and on the fishing mortalities both within the lagoon and on the adult fish make it impossible to assess the appropriateness of the

current levels of exploitation and size limits. However, the issue is an important research question and should be the subject of further study. Nevertheless, whether or not the current levels of exploitation and size limits are optimal, the immediate question is whether the fishery for mulloway can be sustained given the current conditions. It is considered that, provided that the current levels of abundance within and outside the Coorong are maintained, catches and exploitation do not increase, and there is a rapid response to reduce exploitation to an appropriate level if any decline in abundance is detected, the fishery is likely to be sustained. Note that it is essential that the procedures that are used to monitor the fishery must be sufficiently reliable that there is a high probability that a decline in abundance is detected and a response triggered, and that the response has a high probability of ensuring that the stock will recover.

For the mulloway fishery, the biological reference points that will trigger action are as follows (Sloan 2005).

- (1) the total South Australian commercial catch taken using mesh nets falls above or below upper or lower reference values calculated as the means of the three highest and three lowest catches recorded in the reference period 1984/85 to 2001/02;
- (2) The cpue (kg/day) recorded for targeted commercial fishing using mesh nets in the Lakes and Coorong Fishery falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1984/85 to 2001/02;
- (3) The cpue (kg/day) recorded for targeted commercial fishing using swinger nets in the Lakes and Coorong Fishery falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1984/85 to 2001/02;
- (4) The rate of change in total South Australian commercial catch over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02;
- (5) The rate of change in cpue (kg/day) recorded for targeted commercial fishing using mesh nets in the Lakes and Coorong Fishery over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02;
- (6) The rate of change in cpue (kg/day) recorded for targeted commercial fishing using swinger nets in the Lakes and Coorong Fishery over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02.

Golden perch

For the golden perch fishery, the biological reference points that will trigger action are as follows (Sloan 2005).

- (1) the total commercial catch taken in the Lakes falls above or below upper or lower reference values calculated as the means of the three highest and three lowest catches recorded in the reference period 1984/85 to 2001/02;

- (2) The cpue (kg/day) recorded for targeted commercial fishing in the Lakes falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1984/85 to 2001/02;
- (3) The rate of change in commercial catch taken in the Lakes over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02;
- (4) The rate of change in cpue (kg/day) recorded for targeted commercial fishing in the Lakes over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02.

With the elimination of the commercial fishery from the River Fishery, the only consistent and reliable commercial fisheries data are those from the Lakes fishery. Consideration should be given to ways in which data on the status of the stock within the River might be obtained, such that appropriate reference points and triggers might be developed for this component of the stock.

It is pertinent to note that recruitment to the fishery appears variable and the fishery is highly dependent on strong flows to stimulate spawning and to improve the growth and survival of the young. Prolonged drought is likely to impact on recruitment success. There is a five to six year lag between spawning and subsequent recruitment to the fishery and, in years of prolonged drought, caution may need to be exercised to maintain the abundance of recruited year classes thereby ensuring that there are sufficient mature fish to ensure recovery of the stock when environmental conditions again become favorable.

Goolwa cockles

For the Goolwa cockle fishery, the biological reference points that will trigger action are as follows (Sloan 2005).

- (1) the total commercial catch taken by the Lakes and Coorong Fishery, the Marine Scalefish Fishery and the rock lobster fisheries falls above or below empirically defined upper or lower reference values derived from catches recorded in the reference period 1990/91 to 2000/01;
- (2) The cpue (kg/day) recorded by commercial fishers from the Lakes and Coorong Fishery falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1990/91 to 2000/01;
- (3) The rate of change in the commercial catch taken by the Lakes and Coorong Fishery, the Marine Scalefish Fishery and the rock lobster fisheries over the last three (or four, see below) years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1990/91 to 2000/01;
- (4) The rate of change in cpue (kg/day) recorded by commercial fishers from the Lakes and Coorong Fishery over the last three years exceeds the

greatest rate of change (\pm) experienced over three consecutive years during the reference period 1990/91 to 2000/01.

While the management plan specifies that trends in cpue are calculated over a three rather than four year period, clarification is required as to whether the same is true for total catch (as suggested by the column heading in the table of biological reference points) (Sloan 2005). Sloan (2005) provides no description of the method used to determine the empirically-defined upper and lower catch limits or explanation that demonstrates that these limits are precautionary.

The reference points selected for the fishery are based on the historical fishery data for the period from 1990/91 to 2000/01, a period during which catches increased markedly. It is appropriate that consideration is given as to whether reference points from these data are likely to be appropriately precautionary.

Condition 22:

Provide a considered evaluation as to whether the reference points derived from the 1990/91 to 2000/01 data are appropriately precautionary.

Yellow-eye mullet

For the yellow-eye mullet fishery, the biological reference points that will trigger action are as follows (Sloan 2005).

- (1) the total South Australian commercial catch falls above or below upper or lower reference values calculated as the means of the three highest and three lowest catches recorded in the reference period 1984/85 to 2001/02;
- (2) The cpue (kg/day) recorded for targeted commercial fishing falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1984/85 to 2001/02;
- (3) The rate of change in total South Australian commercial catch over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02;
- (4) The rate of change in cpue (kg/day) recorded for targeted commercial fishing over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02.

Some clarification of the measures used for yellow-eye mullet is required, however, as it appears from Sloan (2005) that it is the total South Australian catch that is used in points (1) and (3), above. This would be consistent with the decision reported in Higham *et al.* (2005) that the population of yellow-eye mullet in South Australian waters would be managed as a single stock. However, in their assessment of the performance of the Lakes and Coorong Fishery for yellow-eye mullet against the indicators defined in a draft of the Management Plan, the value of the catch that was used by Higham *et al.* (2005) was that recorded for the

Lakes and Coorong rather than for the entire state. The reference points reported by Sloan (2005) for the cpue of yellow-eye mullet, calculated using targeted fishing effort, fail to note that the values of the biological reference points are apparently calculated using the cpue derived for targeted effort using catches of small mesh gill nets within the Lakes and Coorong fishery, as shown in the evaluation by Higham *et al.* (2005).

Indicator 1.1.3.2 The harvest strategy is precautionary.

Scoring Guidepost 60

There is an implemented harvest strategy that includes at least one control point that triggers a required management response.

Scoring Guidepost 80

The harvest strategy includes multiple and diverse control points, all of which trigger specified management responses. If any control point is triggered, the management response requires that data are collected and analyzed to assess whether the fishery and the stock responds in accordance with expectation.

Scoring Guidepost 100

The harvest control rules have been tested to assess whether they are sufficiently precautionary and effective. The rules are periodically reviewed.

Score

Mulloway	80
Golden perch	80
Goolwa cockles	80
Yellow-eye mullet	80

Comment

The comments made for Indicator 1.1.3.1 are pertinent to this Indicator as well. The management plan described by Sloan (2005) has been implemented, stock status and stock assessments are being produced, and the plan has demonstrated that it triggers the required actions when indicators fall beyond specified reference points. Thus, the first guidepost is satisfied. The plan specifies multiple reference (control) points that reflect aspects of exploitation, abundance of different species, species composition, environment, economics, impact on by-catch species and aspects of the management process (research and stock assessment). One of the first actions that is undertaken when a trigger fires is a detailed evaluation of the data. This will determine the cause and whether management response is required or whether the fishery is progressing in accordance with expectations but has been affected by some known factor that has caused the trigger to fire. Although the requirements of the second guidepost have been satisfied, and thus a score of 80 is justified, there has been no assessment to determine whether the harvest control rules are sufficiently precautionary and effective.

It should be emphasized that the appropriateness of the indicators and reference points, and the effectiveness of the processes that are established to calculate and, if triggered, respond to change are crucial if a fishery is to be sustained. At the very least, the rules and procedures must ensure that exploitation is maintained within an appropriate range. In a multi-species fishery, the potential exists for increase in exploitation through change in target species or in response to change in species composition and associated abundance. If the rules and procedures fail to respond to constrain the activation of latent effort or trends in targeted effort or fishing efficiency, they are inadequate. It is strongly recommended that, given the trends that are evident in the catch and effort for cockles, the reference points for this and the other species should be reviewed to ensure that they are appropriate and sufficiently precautionary.

Criterion 1.2 (MSC Criterion 3): Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity.

Intent: The potential impact of fishing on the genetic structure of the stock or on the ability of the stock to reproduce should be recognized. Size, age and sex composition and abundance of mature individuals will inevitably be affected by fishing mortality. However, fishing may also impact on the genetic structure of the stock or affect growth or the relationship between fish length and the proportion of fish that are mature. Such impacts need to be monitored and an appropriate management response taken if evidence becomes available of any adverse change to the stock's reproductive capacity.

Indicator 1.2.1 To maintain the reproductive capacity of the target species, the level of spawning biomass of the stock is assessed to ensure that it remains above threshold levels.

Scoring Guidepost 60

A broad index of spawning biomass (or proxy) is available.

Scoring Guidepost 80

An index of spawning biomass is calculated periodically and is compared against a specified threshold.

Scoring Guidepost 100

There is an annual assessment of the spawning biomass index, which is compared to a set threshold. The index and threshold are periodically tested to ensure the reproductive capacity of the target species is maintained.

Score

Mulloway	85
Golden perch	85
Goolwa cockles	85
Yellow-eye mullet	85

Comment

General

Although no explicit assessment of trends in spawning biomass was available for any of the four species, it was recognised (see below) that an index of abundance that is currently calculated for each species could serve as a proxy for spawning biomass. These indices are calculated annually and compared against specified reference points, thereby more than satisfying the requirement of the 80 guidepost, which only requires these assessments periodically. A score of 85 is therefore assigned because these proxies are calculated annually. Further refinement of these indices of abundance is required (see 1.1.3.1) on an annual basis to score above 85. In other fisheries, changes in genetic composition that have resulted from exploitation have been reflected in changes in growth and in the length and age at which fish become mature. The potential for such changes and their implications for indices of spawning biomass should be recognised and an appropriate low-scale sampling regime initiated to monitor growth and maturation, such that such changes (e.g. size at sexual maturity or growth) may be detected.

Mulloway

The swinger fishery operating off the oceanic beaches outside the Coorong exploits adult mulloway. Although highly variable and influenced by freshwater flows, the cpue calculated for the swinger fishery provides a broad index of the abundance of mature mulloway. The index is calculated each year from commercial fisheries statistics and, in accordance with the management plan, is compared against reference values for this indicator (Sloan 2005). The reference values are derived from historical data over a specified reference period and reflect values that are consistent with the data during that period. That is, if the cpue is maintained within the range specified by the lower and upper limits then, provided that cpue is an accurate index of abundance, the mature biomass is likely to be sustained at a level consistent with previous experience.

Golden perch

The minimum legal size for golden perch is 330 mm TL, which, from the relationships between total length and age presented by Ye (2004), corresponds approximately to an average age of ~ 5 to 6 years. These are the age classes that appear to dominate the age compositions of catches taken within the Lakes (Ye 2004). Thus, the cpues recorded for the Lakes fishery may be considered an index of abundance of the mature biomass of golden perch. In accordance with the management plan, these indices of abundance are required to be calculated annually and compared with reference points such that, should the index fall below the levels recorded historically, action might be taken to respond to the decline.

Goolwa cockles

A minimum legal length of 35 mm across the longest axis of the shell has been set for Goolwa cockles (Murray-Jones and Johnson 2003). As noted earlier, the cockles in this region attain maturity at ~13 months of age and ~ 36 mm shell length (King 1976). Accordingly, the index of abundance derived from commercial catches taken by fishers in the Lakes and Coorong

fishery, *i.e.* the cpue, represents an index of mature biomass for the stock. The management plan for the fishery requires that this cpue is calculated each year and compared against the biological reference points that have been specified for this species.

Yellow-eye mullet

The minimum legal length of yellow-eye mullet is set at 21 cm TL, which corresponds to a length that is slightly smaller than the size of maturity of females determined by Harris (1968), *i.e.* 23 cm CFL (Higham *et al.* 2005). Thus, the landed commercial catch of yellow-eye mullet is dominated by mature individuals. Accordingly, the cpues that are used as indices of abundance for the stock essentially serve also as indices of abundance for the mature or spawning biomass. In accordance with the management plan, these indices of abundance are required to be calculated annually and compared with reference points such that, should the index of abundance fall below the levels recorded historically, action might be taken to respond to the decline.

MSC Principle 2

Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

The present environmental condition of the Lakes and Coorong Region (*adapted from DWLBC 2005*)

Studies over time indicate that the environmental health of the region has greatly declined. Geddes (2003) concluded that the biodiversity and productivity of the Coorong was at an historical low point. A comparison with the flora and fauna collected in the 1980s showed that the distribution and abundance of a variety of species was greatly reduced. Populations have decreased in numbers and retreated to small, more favourable areas, especially around the Murray Mouth. Geddes' survey showed that the poorest biodiversity and abundance was recorded in the South Lagoon of the Coorong. A dramatic decline in the number of water birds utilising the region has been observed over the last twenty years, and there is also evidence of declines in native fish populations (Wedderburn and Hammer 2003, MDBMC 2003). Even with the decline in the overall health of the region, the fishery has been maintained due to proactive management by the government and the fishing sector.

Loss of the natural flow regime in the Murray River because of human-induced changes throughout the catchment and in the estuary has had a huge impact on the ecosystems of the Region. The natural longitudinal salinity gradient of the Coorong lagoons is now absent, reflecting the long period of limited water exchange in the estuary and high evaporation in the South Lagoon. Geddes concludes that persistently high salinities probably represent a historically high salinity regime in the South Lagoon.

There is sufficient evidence to show that under the current management regime for water flow in the Murray, the estuarine habitats of the region are declining in area and quality (DWLBC 2005, Geddes 2003). Amongst many other issues, the impacts of the current water flow regime that leads to periodic closure of the mouth of river is considered to have a primary detrimental impact on Mulloway and on Yellow-eye Mullet, Flounder, black Bream and non-commercial species.

Waders/water birds

Reductions in the volumes and changes in the frequency, timing and duration of releases of water over the barrages have eroded the habitat quality and feeding efficiency for migratory waders and other shorebirds (DWLBC 2005). Water and wading birds are reliant on tidal variation for their foraging habits. If the mudflats are permanently inundated because there is little water movement from the Coorong out through the mouth due to sedimentation, the birds are prevented from foraging for the invertebrates that live there; if they are permanently exposed, the habitat becomes desiccated and the vertebrate and invertebrate prey species cannot survive.

The number of waders in the Coorong has shown a dramatic decline over the last 20 years; in 2001 the total number was 48,425 compared to a peak of 234,543 in 1982. In 2002 and 2003 an increase was observed with a total of 103,859 and 84,039 birds respectively. In 2005 a total of 81,777 waders were counted, which was an improvement on the 58,757 counted in 2004 (DWLBC 2005).

Of some concern are the lower numbers of Red-necked Stint utilising the Coorong, part of a trend of declining abundance documented since the late 1990s (DWLBC 2005). A doubling of Curlew Sandpiper numbers in 2005 compared to 2004 and a 60% increase in Sharp-tailed Sandpiper has also been recorded, although these numbers are still below 2002 levels (DWLBC 2005). Total numbers of birds counted by the Australasian Wader Studies Group in the Coorong in 2005 was 81,777; this is 40% greater than 2004 (58,757) and similar to the numbers in 2003 (84,039). However this is only one third of the peak numbers recorded in 1982.

Understanding the reasons for the overall decline in bird species is difficult because changes in the numbers of waders do not necessarily reflect changes in the condition of the Coorong. There are several potential reasons that can affect the estimated number of birds other than the quality of the Coorong environment. These factors include the quality and availability of alternative sites, the size of the flyway population, and the accuracy and precision of the monitoring methods. Nonetheless, declines in habitat quality of the Coorong region as a result of the present Murray River water management regime may be having a big impact on bird populations.

Fish

Constriction of the Murray mouth and low river flows are causing a decline in many fish species in the Coorong. Freshwater flows from the river have a direct influence on the spawning and recruitment of fish species. During periods of low flow and low rainfall, the Murray mouth is important in maintaining healthy fish populations in the Coorong because seawater becomes the major source of water to 'freshen' and maintain water quality in the Murray estuary and Coorong (Higham *et al* 2002). In addition, the passage for fish between the sea, the estuary, and the Lower Lakes is physically prevented by the presence of the barrages and constriction of the Murray mouth. Many species of fish depend on movement from the ocean into the estuary and freshwater Lower Lakes for reproduction and recruitment (Higham *et al* 2002).

The persistent critically high salinity levels (the salinities that are toxic to most species) have progressively moved closer to the northern end of the Coorong, reducing the area of estuary available to fish and other species. Reproduction in some species is unlikely to occur when salinities are higher than 78 000 – 110 000 EC. When salinities are around 125 000 EC in the South Lagoon, small-mouthed hardyheads may be the only species present (DWLBC 2005).

The freshwater fish community described by Wedderburn and Hammer (2003) in the Lower Lakes is diverse by South Australian and Murray-Darling Basin standards, with a mix of common diadromous species as well as common and threatened freshwater obligate species.

Eighteen native species have been recorded, including three, the Yarra and Southern Pygmy Perch and Murray hardyhead, of National and/or State conservation significance (i.e. EPBC Act 1999, Fisheries Act 1982). Five additional species of State conservation concern were also recorded.

Macroinvertebrates

The extended lack of River Murray flows through the mouth and into the Coorong has resulted in the incursion of coarse marine sands into the Coorong estuary, smothering the mudflats. Densities of benthic invertebrates are related to sediment type, and are richest in mud and poorest in sand. This is an important change in the estuarine habitats because mudflat invertebrates are crucial for the diets of many migratory and non-migratory wading birds in the Coorong, and may also be important for fish. Monitoring of estuarine-lagoonal macroinvertebrates in the Coorong by Geddes (2003, 2005) showed that high salinities in the North Lagoon during summer 2003 severely restricted the longitudinal distribution of most species to the very northern end of the North Lagoon (Geddes 2005). Results from various recent surveys and benthic studies are in agreement with records on environmental conditions and benthic distributions established in previous surveys, and substantiate concerns about deteriorating conditions and benthic communities in the Coorong and Lower Lakes (DWLBC 2005).

Aquatic plant communities

Prior to regulation of the river flow, a rich diversity of plants was distributed across the floodplain, temporary wetlands and main channel. However, with an increase in water turbidity due to lakeshore erosion, the aquatic flora is now restricted to the littoral zone. The lack of inundation of the floodplain, coupled with grazing and clearing, has also reduced plant biodiversity. As a consequence, there is weed invasion and loss of species and the flora is now severely depleted (DWLBC 2005).

Aquatic plants of the Lower Lakes are highly susceptible to changes in turbidity, flow regime, salinity and temperature, and water level, and so many are thus no longer able to colonise and survive in the deeper waters of the lakes. Construction of the barrages and reduced river flows have dramatically reduced plant biodiversity through the changes to water levels and quality in the lakes. Reed beds that have been able to establish in areas of reduced wave action are extensive and provide excellent shelter and habitat. However, they may be depauperate in species such as *Baumea* spp., *Eleocharis* spp., *Schoenoplectus pungens* and *Cyperaceae*. These plants relied on the natural timing, duration and frequency of flows to allow growth, flowering and seed development. These fluctuations have been replaced by a static system, with sudden and poorly timed barrage releases of insufficient duration to allow reproduction. Plant communities have therefore become depleted over time.

A 1995 biological survey of the Murray Mouth concluded that although estuaries are traditionally areas of low biodiversity, the mouth had a particularly low diversity due to poor water quality and flow manipulation (Edyvane et al 1996).

Changed water regimes due to barrage operations impact upon the life cycle of *Ruppia* species, another key food source for waders that feed upon its seeds and tubers. Growth in deeper water is restricted by light penetration, while plants growing in water shallower than 0.3m are prone to desiccation by the wind. If this plant fails in any one year due to inappropriate water levels, there are also consequences for subsequent years. Any consistent reduction in its abundance will have a detrimental affect on other components of the system, including migratory waders (DWLBC 2005). The production and extent of *Ruppia tuberosa* in the South Lagoon has deteriorated over the last ten years, and Geddes (2003) found that *Ruppia tuberosa* was the only representative plant in the survey of the Coorong. No *R. megacarpa* was collected at any of the surveyed sites, suggesting that the seed bank of this specoes was either limited or non-existent. Geddes relates this to salinity, which varied from seawater around the Murray mouth to hypermarine in the majority of the North Lagoon.

Water levels in the South Lagoon

During October and through late spring and summer, low seasonal water levels and tides promote the outflow of water through the Murray mouth, leading to South Lagoon inflows to the North Lagoon (Geddes 2005). The natural drop in water levels during late summer and autumn because of high levels of evaporation combined with tidal fluctuations expose extensive areas of mudflats that are prime wader bird habitat. However, if the mouth and associated channels are constricted, barrage releases are likely to lead to water levels rising within the estuary. When this occurs in conjunction with winds persisting from the north-west for extended periods, most of the mudflats become inundated to the point where shorebirds cannot access them (DWLBC 2005).

The drivers of the hydro-dynamics and ecology of the system include lake level, inflow, wind, turbidity and salinity. A range of other processes (such as seasonal sea level changes and tides) influence these drivers. The Coorong system overall is therefore highly modified, but is still highly complex, and has a high level of natural and human-induced variability.

Criterion 2.1 (MSC Criterion 1)

The fishery is conducted in a way that maintains natural functional relationships among species and should not lead to trophic cascades or ecosystem state changes.

SC 2.1.1 There is adequate knowledge of the ecosystem relevant to the distribution, life history strategy and fishery for the target species.

Indicator 2.1.1.1 The nature and distribution of habitats and communities relevant to the fishing operations are adequately understood.

Intent: This PI intends to assess the extent to which there is sufficient information about the ecosystems and habitats where the fishery operates to provide for properly informed assessments of the ecosystem impacts of the fishery.

Scoring Guidepost 60

Information exists in specific areas of the fishery, or in adjacent areas, but this may not be comprehensive or up to date.

Scoring Guidepost 80

The nature and distribution of the main habitats and communities where the fishery operates have been documented, such as mapping.

Scoring Guidepost 100

The nature and the distribution of all habitats and communities relevant to the fishing operations are known in detail from extensive research studies, and are documented (such as mapping) based on recent information.

Score 85

Findings

The fishery encompasses a number of distinct, but closely linked, freshwater, estuarine and marine ecosystem components, which collectively fall within the boundaries of a Ramsar listed National Park – an area recognised for its wetland habitats and importance for migratory waterbirds. The Murray mouth and Coorong is the largest estuarine habitat in southern Australia. The fishery includes area of the waters of three separate, but closely linked, ecosystems (PIRSA 2004) including:

- The freshwater ecosystems of the lower River Murray lakes of Lake Alexandria and Lake Albert;
- The northern and southern lagoons (of the Coorong); and
- The adjacent coastal marine waters along the Sir Richard and Youngusband Peninsulas,

The natural ecosystems supporting the fishery have been dramatically modified since European settlement of this area, and following the major changes to the catchment of the Murray River, which is Australia's largest river system. An extensive barrage network was constructed near the mouth of the Murray River in the early 1940s to stabilise water levels in the lower Murray Lakes and provide water for irrigation and human consumption. This action reduced the River Murray estuary (now restricted to below the barrages) to about 10% of its original size, and created a large freshwater lakes system above the barrages (the Lower Lakes) This resulted in major environmental changes including many changes to the dynamics of estuarine-dependent fish populations and the natural fish passage from marine to estuarine and freshwaters. The creation of the barrages had a generally negative impact on the overall natural ecosystems, and in particular on the amount and quality of habitat available for a range of estuarine dependant fish species, native plants and waterbirds. The Lakes and Coorong Fishery now operates in ecosystems that have been the subject of major human-induced changes (including loss of habitat extent and quality) and are subject to ongoing major influence from the management of water flows to maintain agricultural practices and irrigation water supplies across the length of the Murray River, and particular in the Lower Lakes system (DWLBC 2005).

The 4 species under MSC assessment are taken by the fishery in different habitats:
Mulloway – the ocean beaches of the peninsulas and the estuarine areas of the Coorong Lagoon system;
Yellow-eye mullet – the estuarine areas of the Coorong Lagoon system;
Callop – the freshwater Lower Lakes and river systems;
Cockles - the ocean beach of the Youngusband Peninsula.

The broad types of habitats are known (ocean beach, Coorong lagoons, freshwater), and for most there is an appropriate level of detail available to determine the impacts of the fishery. This information is derived mainly from earlier habitat studies (Edyvane et al. 1996) and although there is considerable detailed habitat mapping underway for the terrestrial and some wetland habitats, most of the estuarine and marine system remains mapped at a low level of taxonomic resolution.

The Coorong Lagoons experience a very wide range of water quality, productivity and a dynamic salinity regime, depending largely on the extent of water released from the lakes system through the barrages and the extent to which the mouth of the Murray is maintained in an open condition (permitting marine water influx to the lagoon systems). The characteristics and dynamics of the water parameters in the lagoons have been broadly assessed in a number of recent reports (such as Geddes 2003, Geddes 2005, DWLBC 2005)

This level of documentation of the habitats and communities, and knowledge of the water parameters is appropriate for the purposes of assessing the broad impacts of the fishery, and therefore is given a score of 85..

Indicator 2.1.1.2 Information on the trophic relationships and interactions of the target species within the foodweb is adequate to understand the impacts of the fishery.

Intent: This PI intends to assess the extent to which there is sufficient information about the trophic relationships of the target species to provide for properly informed assessments of the trophic impacts of the fishery.

Scoring Guidepost 60

Research projects are underway to study relevant foodwebs in the area.

Scoring Guidepost 80

The main prey and predators of the target species are known.

Scoring Guidepost 100

Quantitative information is available on the position and importance of the target species within the food web at key life stages, derived from extensive research projects on trophic interactions.

Score 75

Findings

A broadly adequate level of information is available about the diet and food preferences of the 4 species, and some of their interactions (Cockles – Murray-Jones and Johnson 2003, PIRSA 2004; Yellow-eye Mullet – Higham et al 2005; Callop – Ye 2004; Mulloway - PIRSA 2004). However, the main predators on the four species, and in particular, predators at the younger size/age classes, seems to be unclear. This is important to be able to assess the risk that fishing of the 4 species may pose for predators on the fished species.

Condition 23

- (a) Prepare a technical review and assessment of the likely interactions between the fishery for the 4 assessed species and the likely predators on each species, focusing on spatial and temporal analysis of risks that the fishery may pose to key predators, particularly piscivorous birds, considering the age/size availability of the assessed species.
- (b) Show evidence of support for enhanced levels of high-quality research on predator-prey relationships in the Coorong, and specifically on linkages with the commercially fished species so that main predators can be better understood.

SC 2.1.2 There is knowledge of the fishery and its characteristics that is adequate for assessing ecosystem impacts.

Indicator 2.1.2.1 The fishery characteristics, including gear types, areas and times fished, and level of effort are adequately understood for the purposes of assessing ecosystem impacts of the fishery.

Intent: This PI intends to assess the extent to which there is sufficient knowledge of the characteristics of the fishery to provide for an informed assessment of the ecosystem impacts of the fishery.

Scoring Guidepost 60

Only permitted gear types are used in the fishery, and the main fishing patterns in the fishery are well enough understood to relate them generally to important ecosystem issues (such as sensitive habitats or important biological communities or sites).

Scoring Guidepost 80

The use of each gear type, in space and time, is well known and periodically reported to fishery managers.

Scoring Guidepost 100

The patterns of gear use are monitored at a fine enough scale and on a daily basis to understand the wide variety of biological interactions associated with fishing and related activities. All data is properly reported to fishery managers.

Score 85

Findings

The fishery only uses permitted gear types, which are well known and are fully specified as part of the PIRSA licence conditions (PIRSA 2004; PIRSA 2005). There is daily logging of gear use, reported to managers monthly (PIRSA 2004). Use of gear types is occasionally assessed for compliance by fisheries inspectors (correspondence from PIRSA to SFA). The logging and reporting of effort is conducted within spatial blocks in the fishery that relate well to habitat types, except for the cockle fishery, which is reported only by a single main fishery area. In addition the fishery conducts a voluntary daily monitoring program that records the details of fishing location, gear type and environmental conditions (including area visitation, illegal fishing, and abundance of birds in the vicinity of the fishing operation (unpublished data reports provided to SCS).

A score of 85 is assigned to this indicator at this time, as the only issue of concern is getting better knowledge of the distribution of effort in the cockle fishery, which is handled under Indicator 1.1.2.1. However, if the added information on the distribution of effort indicates concerns about other ecosystem functions, then the score for this indicator may need to be re-assessed

Indicator 2.1.2.2 There is adequate knowledge of the impacts on the habitat of fishing gear and operations associated with fishing.

Intent: This PI intends to assess the extent to which there is sufficient knowledge about the physical impacts of the gear types on habitats to provide for an informed assessment of the impacts of the fishery.

Scoring Guidepost 60

The effects of the main gear types and operations associated with fishing in the fishery are generally understood and considered to have minor impacts based on studies in other fisheries.

Scoring Guidepost 80

For fishing gear and operations associated with fishing that have been identified as having the potential to have direct habitat impacts in the area of the fishery, the impacts are being investigated.

Scoring Guidepost 100

Continuing reviews or research projects are conducted to assess the potential for ongoing habitat impacts in the area of the fishery, with special attention to any sensitive habitats or biological communities.

Score 85

Findings

The gear types and patterns of use are well understood in this fishery, and, for most, the gear types used and the patterns of fishing are very unlikely to lead to any major impacts on habitats. The mesh nets, swinger nets and handrakes are not likely to be a major issue in terms of habitat damage. While handrakes for cockles is highly disturbing to the sand habitat, the fishing is conducted within the intensely dynamic shallow surf/swash zone of the beach, and is unlikely to contribute any significant additional measure of disturbance to the beach ecosystem. The deployment of mesh nets in the Coorong and lakes is not likely to have any significant physical impact on benthic ecosystems since they are usually not in contact with the sediment (to minimise scavenging of fish by crabs).

A score of 85 has been assigned to this based on the level of understanding about gear types and use in the fishery. A higher score may appear to be warranted, however, the fact that there appear to have been no direct studies or assessments of the impacts of gear on habitats suggests that a higher score is not warranted. In addition, there have been some concerns expressed about fishing operations include boating and shore based-infrastructure, and beach transport for cockle fishing and mulloway fishing. The impact of these operations has also not been assessed. Although stakeholders hold some concerns about these impacts, generally they seem to be within acceptable levels. The potential for impacts on the nesting success of hooded plovers on the beaches is assessed in 2.2.2.3 below.

SC 2.1.3 **There is adequate knowledge about the risks to the ecosystems, habitats and species that are posed by the fishery.**

Indicator 2.1.3.1 **Information on the nature and extent of the by-catch and incidental mortality of non-target species is adequate to determine the ecosystem risks posed by the fishery.**

Intent: This PI intends to assess the extent to which there is adequate information about the bycatch and any associated mortality of on-target species to provide for an informed assessment of the impacts of the fishery.

Scoring Guidepost 60

The main by-catch species in the fishery have been identified, and there is some knowledge of incidental mortality posed by the fishery.

Scoring Guidepost 80

The risks to bycatch species have been assessed (by relevant authorities) to determine the potential impacts by the fishery or related operations. Where appropriate, formal bycatch monitoring programs are in place to support risk assessments.

Scoring Guidepost 100

Bycatch monitoring is conducted in sufficient detail to assess ongoing mortalities to all bycatch species. For species identified at high risk from fishing operations, reviews are conducted to determine the impact on the conservation status of the affected population(s).

Score 75

Findings

There is no consistent information that is routinely available and assessed on the bycatch in the fishery (PIRSA 2004). This means that there has not been a formal assessment of the risks posed by bycatch in the fishery. The fishery probably has only minor bycatch, and associated issues may be minor, as can be judged from the lack of public or agency comments or concern about the fishery and its operations in relation to bycatch. However, while there is some objective evidence that has been provided for the assessment (confidential data records provided to SCS), PIRSA has identified a concern over bycatch issues in the fishery (FRDC project application SA05-29) and there remains the possibility that some elements of the fishery may have bycatch of concern. Apparently minor bycatch of birds, crabs, and non-commercial fish do occur in the fishery, however this needs to be confirmed through objective data capture and analysis of field data taken from samples of the fishery.

Condition 24

The assessment team was not provided with any data or evidence about the type, level or potential impacts of bycatch in the fishery. However, the FRDC project on bycatch (FRDC SA05-29) now underway is noted as an important mechanism for securing a more objective set of data and knowledge on the bycatch. The client is required to provide evidence of the composition and magnitude of the bycatch in the fishery, completion of an assessment of the risks posed by such bycatch, the level of risks assigned, and establishment of monitoring programs for the catch of any key bycatch species determined as a result of the FRDC project.

SC 2.1.4 Strategies have been developed within the fisheries management system to address and restrain any significant negative impacts of the fishery on the ecosystem.

Indicator 2.1.4.1 Management objectives and strategies are set in terms of impact identification and avoidance/reduction.

Intent: This PI intends to assess the extent to which there are appropriate strategies designed and implemented in the fishery that will effectively restrain any identified impacts of the fishery.

Scoring Guidepost 60

Management systems in the fishery recognise impact identification and avoidance/reduction but there are only limited objectives and strategies that have been adopted.

Scoring Guidepost 80

A range of management objectives and strategies designed to detect and reduce ecosystem impacts have been implemented, and are determined in conjunction with an appropriate range of ecological expertise and stakeholders.

Scoring Guidepost 100

Management objectives and strategies for restraining ecosystem impacts are monitored for effective compliance across the fishery, and any unavoidable impacts are mitigated on a precautionary basis (such as using fishing closures in space or time).

Score 90

Findings

The fishery is limited entry (37 licences), and has a limited range of gear types (PIRSA 2004; PIRSA 2005) which are permitted because they are considered to not have a major impact on habitats or species that are not permitted to be caught. The fishing strategies are limited to those that are considered to have minimal impact (such as limited length of mesh nets, hand raking of cockles). The fishery has a code of practice about catch of non-target species (SFA 2002, 2006) which is intended to act to reduce any impacts of fishing, although there is not as yet any independent verification of the effectiveness of this code of practice because there is no formal process for monitoring and assessing bycatch in the fishery (discussed above). In addition, the fishery is developing a form of environmental management system to underpin its operations (SFA undated). No specific issues about negative interactions of the fishery with habitats and ecosystems were raised by stakeholders. While bycatch has yet to be determined in detail, there appears to be limited impacts resulting from the current mix of strategies and fishing practices that would need to be further developed into different or more enhanced strategies. This will be further assessed as the results of research projects covered in Conditions 23 and 24 become available, but the present mix of strategies and practices seem to be the appropriate mechanism for maintaining a low level of impact on habitats and non-target species.

SC 2.1.5 Assessments of impacts of the fishery show no unacceptable impacts on the ecosystem structure and/or function, on habitats or on the populations of associated and dependent species.

Indicator 2.1.5.1 Effects of the fishery on the ecosystem, through the removal of target and non-target species and impacts on habitats, are not unacceptable.

Intent: This PI intends to assess the extent to which any impacts of the fishery on ecosystems are not unacceptable in the sense that they do not exceed acceptable limits.

Scoring Guidepost 60

Impacts of the fishery on the ecosystem are thought to be acceptable, based on information on impacts from other comparable fisheries situations.

Scoring Guidepost 80

Impacts of the fishery are acceptable based on data derived from this fishery and on advice from a range of ecological experts and stakeholders.

Scoring Guidepost 100

Impacts of the fishery are assessed in ongoing research projects, and quantified by appropriate comparative and manipulative studies using fished and unfished areas, and found to be within acceptable limits.

Score 75

Findings

The impacts of the fishery appear to be acceptable, based on agency and stakeholder comments. However, PIRSA has recently highlighted that bycatch may be an issue for the fishery (FRDC project application SA05-29), and no objective evidence was presented to the assessment to establish that impacts of the fishery are acceptable. It is not precautionary to assume a lack of impacts because of a lack of evidence. Nonetheless, given the nature and scale of the fishery, the habitat types being fished, the apparent lack of stakeholder concern about issues, including from environmental managers that are local to the region, it appears that the impacts are small and may be at a level that is acceptable. The main issues that need to be resolved with factual assessments of the actual impacts of the fishery appear to be the risks posed by bycatch, the possible impact on one species of nesting bird, and the possible trophic level impacts on predators posed by removals of the targeted species.

Given the general understanding of the area, the care managers give to understanding the general ecological setting, and the limited potentials for impact based on gear types and fishing operations, we have scored this indicator at 75. A higher score is precluded based on the lack of direct information as noted above.

Condition 25

In this Condition, the client needs to provide evidence of a cooperative process that involves the RAMSAR and National Park managers and other stakeholders to assess, and as necessary mitigate, the level of trophic-foodweb risks of the fishery (from bycatch or the removal of target species) to the ecosystem, habitats and non-target species of the three main fishery areas (freshwater, Coorong lagoons, ocean beach). This might be best achieved through a qualitative risk assessment process conducted cooperatively with the park and fishery management agencies after the FRDC bycatch project has been completed, in a manner consistent with that of the AFMA/CSIRO risk assessment methodology – Level 1 (4 years). Condition 24 will resolve concerns about the impacts of bycatch from the fishery.

Criterion 2.2 (MSC Criterion 2)

The fishery is conducted in a manner that does not threaten biological diversity (at the genetic, species or population levels) and avoids or minimises mortality of, or injuries to endangered, threatened or protected species.

SC 2.2.1 There is adequate knowledge about protected, endangered, threatened or icon species that may be potentially affected by the fishery.

Indicator 2.2.1.1 **The identity and distribution of protected, endangered, threatened or icon species in the vicinity of the fishery are adequately understood.**

Intent: This PI intends to assess the extent to which there is sufficient information about the protected, endangered, threatened or icon species where the fishery operates to provide for properly informed assessments of the impacts of the fishery.

Scoring Guidepost 60

A list of the key species is available, together some notes on their distribution in the vicinity of the fishery.

Scoring Guidepost 80

The distribution of protected, endangered, threatened or icon species that regularly occur in the vicinity of the fishery is known.

Scoring Guidepost 100

Maps of the distribution of each of the protected, endangered, threatened or icon species are readily available, together with details of any seasonal or periodic aggregations.

Score 90

Findings

There is a detailed knowledge of the protected, endangered, threatened or icon species of bird fauna and the fish fauna and their broad distribution in the region (DWLBC 2005; Wedderburn and Hammer 2003; MDBNC 2003). These details are not highly specific to the fishery, but are adequate to be able to determine the identity and broad distribution of the protected, endangered, threatened or icon species that may occur in the vicinity of the fishery and its operations. Specific details of possible interactions with the fishery have been assessed (SFA correspondence to SCS). A score of 90 is assigned as a result of this information. A higher score would require more specific knowledge on direct interactions.

Indicator 2.2.1.2 **Information on the trophic dependency, habitat use, or other interactions of protected, endangered, threatened or icon species with the target species are adequately understood.**

Intent: This PI intends to assess the extent to which there is sufficient information about the trophic relationships between the protected, endangered, threatened or icon species and the target species to provide for properly informed assessments of the impacts of the fishery.

Scoring Guidepost 60

The natural history, habitat use and trophic preferences of protected, endangered, threatened or icon species that may occur in the main fishing grounds are broadly understood from studies in other fisheries.

Scoring Guidepost 80

The trophic interactions and habitat use of protected, endangered, threatened or icon species in relation to the target and non-target species are broadly understood in relation to the main fishing grounds.

Scoring Guidepost 100

The trophic preferences and habitat use of protected, endangered, threatened or icon species, has been determined in quantitative research projects in the fishing grounds and the vicinity of the fishery, and is derived from studies comparing fished and unfished areas.

Score 85

Findings

The information is adequate to determine that it is unlikely that the main protected, endangered, threatened or icon species (fish and birds) have any direct interactions with the target species. Most of the protected, endangered, threatened or icon species either generally utilise areas that are not fished, or they eat species not also taken by the fishery and (Wedderburn and Hammer 2003; DWLBC 2005; SFA correspondence/assessment provided to SCS). However, the fishery may compete with some piscivorous birds for food, and there is a possible negative trophic interaction. This will need to be considered as part of the risk assessment required in Conditions 24 and 25. A score of 85 is assigned here based on the available information and broad understanding of trophic relationships between the target species and other parts of the ecosystem. A higher score would require a more specific and quantitative assessment of trophic interactions.

SC 2.2.2 There is adequate knowledge about the risks to protected, endangered, threatened or icon species that may be posed by the fishery.

Indicator 2.2.2.1 Risks associated with the nature and extent of the by-catch of, or habitat interactions with, protected, endangered, threatened or icon species have been determined.

Intent: This PI intends to assess if the risks of the potential bycatch of protected, endangered, threatened or icon species have been determined.

Scoring Guidepost 60

The main by-catch of protected, endangered, threatened or icon species in the fishery have been identified.

Scoring Guidepost 80

The catch of, and incidental impacts on, protected, endangered, threatened or icon species is monitored and reported, and the data are routinely synthesised and assessed with assistance of an appropriate range of fishery management, ecological expertise and stakeholders

Scoring Guidepost 100

The bycatch of any protected, endangered, threatened or icon species is monitored and reported in detail, and population status of each such species is regularly assessed.

Score 75

Findings

The fishery probably has only minor bycatch of protected, endangered, threatened or icon species, and associated issues may be minor, as can be determined from the lack of public or agency comments or concern about the fishery and its operations in relation to bycatch. However, there is little objective evidence that has been provided for the assessment, and there remains the reasonable possibility that some elements of the fishery may have bycatch of concern, and risks have not been determined. Apparently minor bycatch of some species of birds, crabs, and non-commercial fish is acknowledged to occur in the fishery (SFA correspondence to SCS), however this needs to be confirmed through an objective analysis of field data taken from samples of the fishery. The new reporting forms associated with the LCF Management Plan are expected to make provision for both voluntary and mandatory data collection on a range of bycatch species, including protected, endangered, threatened or icon species (PIRSA 2004) and this will inform an assessment of the risks.

Condition 26

Conditions 23, 24, and 25 all apply.

The FRDC project on bycatch now underway is noted as an important mechanism for securing a more objective set of data and knowledge on the bycatch.

Indicator 2.2.2.2 **Risks associated with the trophic dependency of the protected, endangered, threatened or icon species on the target species within the food web have been determined.**

Intent: This PI intends to assess if the risks of the fishery through trophic relationships of the protected, endangered, threatened or icon species with either the target or bycatch species have been determined.

Scoring Guidepost 60

The main trophic dependencies of the protected, endangered, threatened or icon species that occur in the vicinity of the fishery have been identified.

Scoring Guidepost 80

The potential trophic impacts of removal of the target and bycatch species on protected, endangered, threatened or icon species have been assessed using knowledge from other fisheries/areas, and involving the relevant range of ecological expertise and stakeholders.

Scoring Guidepost 100

The potential trophic impact of removal of the target species and bycatch species on protected, endangered, threatened or icon species has been determined using quantitative research projects in this fishery involving studies comparing fished and unfished areas, or equally effective techniques.

Score 79

Findings

The main protected, endangered, threatened or icon species do not appear to have any direct trophic interactions with the target species, and so there is not likely to be a major trophic impacts (DWLBC 2005, SFA correspondence/assessment to SCS). However, the possible trophic competition of the fishery with piscivorous birds will be assessed as part of conditions 23 and 25.

Condition 27

Conditions 23, 24, and 25 apply here.

Indicator 2.2.2.3 Risks associated with the use of fishing gear and associated fishing operations in habitats of importance to protected, endangered, threatened or icon species have been determined.

Intent: This PI intends to assess if the risks of the uses of each gear type used in the fishery and any fishery operations or practices on the habitats where the fishery operates have been determined.

Scoring Guidepost 60

The main usage of gear types, fishing operations and deployment practices have been identified.

Scoring Guidepost 80

The main patterns in deployment of gear types and fishing operations in the main habitats have been identified, including extent, location and frequency of use, and studies are underway to determine risks to protected, endangered, threatened or icon species.

Scoring Guidepost 100

The characteristics of each gear type and their deployment details have been quantified, including details of usage near any habitats sensitive for protected, endangered, threatened or icon species, and deployment patterns are routinely monitored and reported for assessment purposes.

Score 75

Findings

The risk of gear use and associated operations on habitat of importance to protected, endangered, threatened or icon species has not been formally determined, but anecdotal and limited data indicate that the gear impacts are minimal. The exception to this may be the cockle operation on the ocean beach where vehicles may potentially pose a risk to sites of importance to hooded plover nesting. The EP&BC Act submission (PIRSA 2004) provides for mitigation of this impact, but the effectiveness of this has not been formally assessed. While the formal risks have not been determined, stakeholders did not indicate any other habitat disruption issues, consistent with the judgement of the assessment team.

Condition 28

The assessment has not been provided with evidence that the physical impacts of the gear and operations of the fishery have been studied in habitats of importance to protected, endangered, threatened or icon species. The client is required to develop a process (such as risk assessment), in collaboration with the relevant agencies and ecological experts, to identify specific habitats that may be at risk of physical impacts (disturbance) from the fishery or its operations, then, if any moderate or higher level risks are identified, establish any relevant further investigations or mitigation procedures, practices etc that may be agreed between relevant agencies, experts and the fishery. The client should then provide appropriate evidence that the level of the impact has been suitably identified, and that investigations or mitigations of this impact are underway.

SC 2.2.3 Strategies have been developed to avoid or minimise impacts on protected, endangered, threatened or icon species.

Indicator 2.2.3.1 Management objectives and strategies are established to restrain potential impacts on protected, endangered, threatened of icon species.

Intent: This PI intends to assess if strategies have been developed and implemented in the fishery that are sufficient to restrain the fishery from having unacceptable impacts on the protected, endangered, threatened or icon species.

Scoring Guidepost 60

Management systems in the fishery recognise impact identification and avoidance/reduction but there are only limited objectives and strategies that have been adopted to restrain impacts on protected, endangered, threatened or icon species.

Scoring Guidepost 80

A range of management objectives and strategies designed to detect and reduce impacts on protected, endangered, threatened or icon species have been implemented, and are determined in conjunction with an appropriate range of ecological expertise and stakeholders.

Scoring Guidepost 100

Management objectives and strategies for restraining impacts on protected, endangered, threatened of icon species are monitored for effective compliance across the fishery, and any

unavoidable impacts are mitigated on a precautionary basis through the use of closed areas/times or other equivalently highly effective measures.

Score 90

Findings

The fishery is limited entry and has a limited range of gear types (PIRSA 2004; PIRSA 2005) which are permitted because they are considered to not have a major impact on habitats or species that are not permitted to be caught. The fishing strategies are also limited to those that are considered to have minimal impact (such as limited length of mesh nets, hand raking of cockles). The fishery has a code of practice about catch of non-target species (SFA 2002, 2006) which is intended to act to reduce any impacts of fishing, although there is not as yet any independent verification of the effectiveness of this code of practice because there is no formal process for monitoring and assessing bycatch in the fishery (discussed above).

Only few specific issues about negative interactions of the fishery with protected, endangered, threatened or icon species were raised by stakeholders, and none of these were expressed as major issues. While bycatch has yet to be determined in detail, there appears to be limited impacts resulting from the current mix of strategies and fishing practices that would need to be further developed into different or more enhanced strategies. This will be further assessed as the results of research projects covered in Conditions 23 and 24 become available, but the present mix of strategies and practices seem to be the appropriate mechanism for maintaining a low level of impact on protected, endangered, threatened or icon species.

SC 2.2.4 Fishing is conducted in a manner that does not have unacceptable impacts on protected, endangered, threatened or icon species.

Indicator 2.2.4.1 The interaction of the fishery with protected, endangered, threatened or icon species does not result in unacceptable impacts.

Intent: This PI intends to assess the extent to which any impacts of the fishery on protected, endangered, threatened or icon species are not unacceptable in the sense that they do not exceed acceptable limits.

Scoring Guidepost 60

There is no evidence that the fishery has detrimental impacts on any population of a protected, endangered, threatened or icon species in the vicinity of the fishery.

Scoring Guidepost 80

An assessment of the impacts of the fishery on each protected, endangered, threatened or icon species has demonstrated that impacts are within agreed acceptable limits, determined in consultation with a range of ecological experts and stakeholders.

Scoring Guidepost 100

There is a regular assessment of the impacts of the fishery on each protected, endangered, threatened or icon species, and impacts are always within the prescribed acceptable limits.

Score 80

No objective evidence was presented to the assessment to establish that impacts of the fishery on protected, endangered, threatened or icon species are acceptable. However, given the rotational nature and small scale of the fishery, the habitat types being fished, the apparent lack of stakeholder concern about issues including bycatch, including from those of environmental managers that are local to the region, it appears that the impacts on protected, endangered, threatened or icon species are small and likely to be acceptable. These are largely a set of assumptions, but they will be progressively verified through the implementation of Conditions 23 and 25 outlined above.

At this time, while there is little tangible and objective evidence of unacceptable impacts of the fishery on protected, endangered, threatened or icon species, if there were such impacts, given the small scale of the fishery activities, the intense use of the region by recreationists, the day-to-day management by national parks staff, and the range of other activities related to the conservation and management of the Coorong and the Murray mouth area for internationally recognised conservation values, it is likely that if there were any major detrimental impacts of this fishery on protected, endangered, threatened or icon species they would not pass unnoticed by the stakeholders or by fishers.

Therefore, the impacts of the fishery are judged to be broadly within acceptable limits at this time, determined mainly by the rotational nature and small scale of the fishery, the lack of significant issues raised by stakeholders, and the direct observations of the fishery by the assessment team.

Principle 3

The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Intent: This principle is to ensure that there is an institutional and operational framework for implementing Principles 1 and 2 appropriate to the community based Lakes and Coorong fishery. Principle 3 is the governance principle that integrates the principles and objectives of the Lakes and Coorong fishery management system.

Criterion 3.1

The management system has a clearly defined scope, capable of achieving MSC Principles and Criteria and includes short and long-term objectives, including ecosystem objectives, consistent with a well managed fishery.

Intent: This criterion is to assess the match between the management systems of the multi-species Lakes and Coorong fishery and the terms and intentions of the MSC Principles and Criteria.

Comment

The assessment of this governance principle is essentially based on the Lakes and Coorong Fishery Management Plan (Sloan 2005) which was reviewed and accepted. Comments related to the Principle 3 criteria depend on the efficacy of that Plan and the potential changes that need to be made depending on the responses made by the various stakeholders to that Plan. At the time of assessment it is assumed that the PIRSA responses, where appropriate, would constitute a reasoned attempt at rectifying any of the governance shortcomings highlighted by stakeholders and are thus part of the assessment.

Indicator 3.1.1 The management system incorporates and applies an adaptive and precautionary exploited stock strategy for a multi-species fishery. [Relates to MSC Criteria 3.2, 3.7, 3.9, 3.10]

Intent: To assess whether a plan of management exists for the Lakes and Coorong fishery that has a stock assessment strategy for the four key commercial species, including assessments of these stocks, appropriate data collection and research, and fishing effort controls that can be adapted to account for changes in the fishery.

Scoring Guidepost 60

The management system has the means to collect basic data on the fishery, recognizes the need for sustainability indicators and has basic controls on fishing effort.

Scoring Guidepost 80

The management system has a process to develop sustainability indicators, including catch rates, and sets objectives related to these data, has measures to control effort, assessments of the key species have been undertaken and a plan of management exists.

Scoring Guidepost 100

- The management system includes scientific assessment of stocks and sets precautionary long-term stock management objectives and stock assessments and harvest strategy evaluations are undertaken in an open process and the methods and results made available in published reports and periodically externally reviewed.
- The harvest strategy includes effective effort and/or output controls, maintains stocks at productive levels (specified by appropriate target and limit reference points), provides for the recovery of depleted stocks to specified levels within specified time frames, and is evaluated using robust assessment methods that consider the use of a range of management tools.

Score 85

Findings

The management system for the Lakes and Coorong fishery has established a process to develop sustainability indicators, including catch rates, and has set objectives related to these data and other fisheries related data, has clearly defined legislated measures to control effort in all components of the fishery, has undertaken a series of assessments of the key species and has a plan of management for the fishery. The following comments are a brief summation of these matters.

The Lakes and Coorong fishery is a limited entry fishery of 35 licensed fishers operating under the *Fisheries (Scheme of Management – Lakes and Coorong) Regulations 1991*.

A Management Plan for the South Australian Lakes and Coorong fishery (the Plan) (Sloan 2005) was introduced in April 2005 after several years of extensive consultation with all key stakeholder groups. The powers contained in section 14 of the *Fisheries (Management Committees) Regulations 1995* provide the legal basis for the preparation of the Plan. The Plan provides a general harvest strategy for the fishery that specifies a strategic framework that links fishery stock assessment processes and management decision making for the four key species mulloway, golden perch, Goolwa cockles and yellow-eye mullet and other minor species.

The fishery management decision making harvest strategy considers both the environmental performance (freshwater flows, river mouth openings and capacity for fish passage) and fish stock performance (total catch, CPUE, recruitment and other stock indicators) of the fishery. Under this integrated approach, critical environmental drivers such as river flow, will be explicitly taken into account when assessing the overall health of the fishery and in decision making processes (adaptive and precautionary strategy). And, the management strategy covers the recreational, indigenous and commercial components of the fishery.

The harvest strategy (Sloan 2005:48) describes how fishery related data should be collected, how the data should be analysed and how the results of data analyses should be interpreted and used to determine management actions. The application of the harvest strategy is evident:

the Inland Fishery Management Committee (IFMC), established under the *Fisheries (Management Committees) Regulations 1995*, meets about six times per year and has supporting species and research sub-Committees to deal with changes to the status of the four stocks and other species when appropriate.

The fishery is managed under the overall goal of '*sustainable harvesting of fisheries resources*' which has the specific objectives of:

- Fishing is conducted at a level that maintains ecological viable stock levels and protects fish stocks from over-fishing;
- Sufficient biological and environmental information is collected and analysed to make informed management decisions; and
- For fish stocks that are determined to be operating outside of established reference levels, the fishery will be managed to promote recovery to ecologically viable stock levels, within agreed timeframes.

The management system has a process to develop sustainability indicators. For example, under the Plan (Sloan 2005) each of the above objectives has an agreed set of performance indicators, reference points and triggers. For the performance indicator '*total annual commercial catch per unit effort (CPUE) for each key species*' an *annual average commercial CPUE for each key species is above or below the upper or lower reference values*' – e.g. the reference value range for yellow-eye mullet is between 47kg/day and 93kg/day.

Biological Reference Points and triggers have been developed for the main species fishery as part of the Plan (Sloan 2005:117) but these are based on the best available fishery dependent catch and effort data, and as explained in the Plan (Sloan 2005:106), these limitations will be overcome over time. Reliance on fishery independent based reference points and triggers is an improvement on previous management processes and a good beginning in putting rigor into the decision making process. But fishery independent measures such as pre-season surveys would improve the acceptance of this important aspect of management for at least portions of the fishery. The fishery and PIRSA are not in a position to fund fishery-dependent data and a reason why the Plan (Sloan 2005) intends to keep catch within the 20 years historical range of cpue data.

However, the Plan acknowledges that the Lakes and Coorong fishery can be currently classified as a data poor fishery (Sloan 2005:93) with limited quantitative knowledge available to decision makers. As a result, a strategic research and development plan has been developed to guide research and stock assessment undertaken addresses established strategic priorities and information gaps. Due to the multi-species nature of the fishery, no one set of performance indicators would be suitable for all species or all impacts.

The need for future stock assessment is supported by conditions suggested within indicator 1.1.1.3 above. However, the Plan (Sloan 2005:106) incorporates a stock assessment and species status report cycle that will build the necessary and sufficient information needed for adaptive management (see fishery-wide research priorities of the Plan (Sloan 2005:107)).

The Plan (Sloan 2005:103) contains an in depth statement on limitations to species (Schedule 1 – Permitted Species) and gear restrictions imposed on recreational, commercial and traditional fishers. The Plan (Sloan 2005:32) has divided the fishery into four management areas to relate the fishery to difference in the ecology of the Lakes and Coorong area and 16 reporting areas for commercial data collection (i.e. compulsory logbooks). Specific management arrangements relate to these areas to account for the different ecological process and fish movements.

The management system is based on the following policy divers that ensure that as the fishery builds on the current data available, the current adaptive and precautionary exploited stock strategy for this multi-species and multi-gear fishery will be enhanced:

- Section 42 protected fish of Fisheries (General) Regulations 2000 – Regulation 6;
- National strategy for ecological sustainable development;
- The precautionary principle under the Intergovernmental Agreement on the Environment;
- The Australian *Environment Protection and Biodiversity Conservation Act 1999*;
- The Native Fish Strategy for the Murray Darling Basin 2003-2013;
- The National Policy on Fisheries By-catch;
- The Coorong and Lakes Alexandrina and Albert Ramsar Management Plan;
- Coorong National Park Management Plan;
- Asset Watering Plan for the Lower Lakes and Murray Mouth; and
- Environmental flows strategy for the river Murray

The connectivity and inter-relationships between the above and the Plan (Sloan 2005) need to be clearly demonstrated within the decision making process of the IFMC.

The management system also incorporates and supports the Southern Fishermen’s Association (SFA), the South Australian Fishing Industry Council (SAFIC) and the South Australian Recreational Fisheries Advisory Council (SARFAC) as part of the building of stakeholder participation in the adaptive and precautionary exploited stock strategy.

Indicator 3.1.2 **The management system incorporates and applies an effective strategy to manage the ecological impacts of fishing [Relates to MSC Criteria 3.2, 3.7, 3.9, 3.10]**

Intent: To assess whether the plan of management has a strategy that identifies, mitigates and monitors the ecological impacts of the lakes and Coorong fishing operations through the application of appropriate input controls, recognises and includes appropriate community and conservation/environment management approaches.

Scoring Guidepost 60

Management system ensures awareness of ecological impacts of fishing and the collection of some basic fishery data.

Scoring Guidepost 80

The management system considers ecological impacts from fishing, has processes for dealing with the impacts, and has expert advice and consultation processes as required. .

Scoring Guidepost 100

The management system has a formal strategy that takes into account all significant ecological impacts of the fishery, including non-target species and habitats and monitoring processes are in place.

Score 80

Findings

Management system has a process for the collection of basic ecological data through studies by SARDI and other sources. The development of the 'voluntary environmental monitoring form', as part of the SFA Environmental Management Plan, that collects observations of fishers on a range of ecological and fishing interactions within the Lakes and Coorong environs will provide an important database that can be used to build awareness of ecological impacts of fishing within the stakeholder groups and the management system.

All commercial fishers have the legal obligation of submitting monthly logbooks, the data of which resides within the SARDI cpue comprehensive database including regional and fishing grid data that can be used in conjunction with any spatial ecological data collected.

The management system therefore considers ecological impacts from fishing at various spatial scales and has processes for dealing with the impacts through the research program and has expert advice available to be included in the functioning of the IFMC and appropriate consultation processes that include SAFIC, SFA and SARFAC as required. Of concern is how the management system will deliver on the expert advice and the consultation needed for an effective strategy.

The SFA has on numerous occasions provided comprehensive reports on the need for changes to fishing practices and have sort and gained regulation changes. For example, the 'Best practices to minimise interaction of juvenile mulloway, crabs and birds with fishing gear' (SFA 2002) that provided practical solutions to bycatch reduction and the basis for legislation changes

The management system is based on the premise that effectiveness of management improves with industry participation and Codes of Practice rather than just dependence on a regulatory response to managing the ecological impacts of fishing. To support the management system, the SFA has for example, developed the 'voluntary environmental monitoring form'.

Indicator 3.1.3 the management system incorporates and applies an effective strategy to manage the socio-economic impacts of the fishery, and the fishery is free from significant subsidies, which promote over-fishing or ecosystem degradation. [Relates to MSC Criteria 3.2, 3.4, 3.6, 3.7]

Intent: To assess whether the plan of management incorporates the socio-economic context within which the Lakes and Coorong fishing operations take place through understanding the social and economic connectivity of fishing, fishing rights (whatever the degree of exclusivity) and the recreational and traditional stakeholders participating in the fishery.

Scoring Guidepost 60

The fishery management system seeks to understand social and economic consequences of decision-making so they can identify subsidies to the fishery that promote over-fishing or ecosystem degradation.

Scoring Guidepost 80

The management system formally considers the long-term interests of people dependent on fishing for food and livelihood, and there are no significant direct subsidies to the fishery that promote over-fishing or ecosystem degradation.

Scoring Guidepost 100

The management system considers the long-term interests of people dependent on fishing for food and livelihood, in a manner consistent with ecological sustainability and ensures that all aspects of fishery are free from significant direct subsidies that promote over fishing or ecosystem degradation.

Score 85

Comment

The fishery management system has in place a formal requirement under the *Fisheries Act 1982* 'achieving the optimum utilization and equitable distribution of those resources' and the *Fisheries (Scheme of Management - Lakes and Coorong) Regulation 1991* that seeks to understand social and economic consequences of decision-making and the *Fisheries (Management Committees) Regulations 1995* which provides the IFMC with the requirement to support the gathering and analyses of social and economic information through the cost recovery process. Although the IFMC does not have an indigenous member of the IFMC, PIRSA has indicated that IFMC will be seeking to make an appointment to allow for input from the Ngarrindjeri peoples. The mooted establishment of a Ngarrindjeri Nation Natural Resources Management Committee will help facilitate input into the IFMC,

For example, EconSearch (2005) in a financial and economic analyses of the Lakes and Coorong fishery in 2003/04 indicate that the average gross income from a Lakes and Coorong licence is \$160,244, earnings before taxation and interest is \$36,474 with a rate of return to capital of 15.9% and a mean economic rent of \$24,756: results comparable to any fishery of this nature. The majority of the GVP of the fishery stems from Adelaide sales and the production of Goolwa cockles (43%). The fishery also generates some \$5.2M in household income. The fishery generates some 98 direct jobs with indirect another 52: a ratio of 4 which is substantial for such a community based fishery and a good reason why such fisheries have a place and need to be recognised. The community contribution from the fishers is high with members involved in supporting local schools, caring for the elderly, assisting sporting clubs

and leading environmental awareness activities and clean-up of the local waterways and environs.

The best available information cannot identify any subsidies to the fishery that promote over-fishing or ecosystem degradation. Letters from the following agencies support this claim:

- Senator the Hon Ian Macdonald, Minister for Fisheries, Forestry and Conservation (30.12.2004);
- Hon Rory McEwan MP Minister for Agriculture, Food and Fisheries (7.2.2005);
- Mr W. R. Paterson, CEO Coorong District Council (29.11.2004); and
- Mr John Coombe, Chief Executive, Alexandrina Council (8.12.2004).

The South Australian government does provide funding for drought relief and specific research for management purposes but believes that these payments (subsidies) do not lead to over-fishing impacts (Minister for Agriculture, Food and Fisheries Rory McEwan, 7.2.2005).

The management system formally considers the long-term interests of people dependent on fishing for food and livelihood. The Plan has a specific goal '*optimum utilization and equitable distribution, within constraints of sustainability imperatives*' with the specific economic objective of '*maintain a flow of economic benefits from the fishery to the broader community through the wise use of Lakes and Coorong resources*' with a performance indicator of '*trend in the annual total economic impact of the commercial fishery*'. Other objectives relate to recreational and indigenous communities with performance indicators such as '*trends in recreational ... and indigenous participation in the fishery*'.

The South Australian government's State Food Plan 2004-2007 expects the value adding from the fishery to contribute to the food needs of the south Australian people: a contribution by the Lakes and Coorong fishery has been a real increase of 1.1% annually over the past decade despite unfavourable climate conditions (drought and low river flows). A Quality Assurance Program has been introduced in the Lakes and Coorong Goolwa cockle fishery which ensures the water quality within defined areas does not present a risk to human safety – only cockles taken from a classified area can be sold for human consumption.

Indicator 3.1.4 **The management system has a plan for research needed to support the harvest strategy [Relates to MSC Criterion 3. 8]**

Intent: To assess the linkage between the plan of management objectives with the research plan and strategies, including harvest strategies and biological processes.

Scoring Guidepost 60

A basic research plan exists. Reasonable minimum research to support management is undertaken and considered in the management of the fishery.

Scoring Guidepost 80

There is a research plan to support the management system, resources are available for critical studies in support of management, and the data collected is used for species reports and stock assessments.

Scoring Guidepost 100

There is a research plan, designed jointly by scientists, managers and stakeholders to support the management system, resources are available to support research for the needs of management, research results are published and considered under the management system, and harvest strategies for the fishery are based on stock assessments.

Score 85

Comment

There is a research plan, designed jointly by scientists, managers and stakeholders to support the management system. This research plan is a key component of the Lakes and Coorong Management Plan (Sloan, 2005:106). The research strategy is made up of five broad areas (top priorities are indicated):

- fisheries assessment and biology (e.g. stock assessment data, cost effective methods to estimate non target species);
- habitat and ecology (fishery dependent and independent data collection and quantitative assessment of by-catch by-product, threatened, endangered and protected species);
- governance and management (resource allocation methodologies);
- socio-economics (importance of fishery to the local community and economy and recreational and traditional participation); and
- industry development (market and product development and MCS accreditation).

The research plan has been developed based on the strategic research priorities of the Fisheries Research and Development Corporation (FRDC), the South Australian Fisheries Research Advisory Board (SAFRAB), SARDI and the IFMC, industry and the Lakes and Coorong fishers' Wild fisheries for the future initiative. The plan has three key processes: strategic inputs (strategic fishery-wide research priorities, species specific strategic research priorities, undated information on stock status and the four key species; annual research planning process (IFMC) and outputs from the annual research planning process (stock assessments, species status reports, generic studies)

Reasonable minimum research to support management is undertaken as illustrated in the comments within Principle 1 and considered in the management of the fishery through the IFMC. Key cpue data is collected through compulsory logbooks and held in the SARDI database and used for species reports and stock assessments. Results of research are published in journals, SARDI and FRDC reports and are routinely considered by the management system.

A key area that needs to be understood are the limited resources available for critical studies in support of management, but some resources are available through the cost recovery process from licence fees of commercial fishery participants. This funding provides for a cycle of research that will lead to better information for decision making. The SFA is also creative in obtaining funds for research to support the harvest strategy.

Indicator 3.1.5 **The management system has a plan for research needed to support the understanding of the ecological impacts of fishing [Relates to MSC Criterion 3.8.]**

Intent: To assess the linkage between the plan of management objectives with the research plan and strategies, including the interactions between ecological processes and fishing operations.

Scoring Guidepost 60

A basic research plan exists. Reasonable minimum research to support ecosystem management is undertaken and considered in the management of the fishery.

Scoring Guidepost 80

The management system has processes for establishing a research plan to support the understanding of the impacts of the fishery on the ecosystem, and resources are available for critical studies in support of ecosystem management.

Scoring Guidepost 100

There is a research plan, designed jointly by experts, managers and stakeholders to support the ecosystem and to address significant environmental impacts of fishing, resources are available to support research for the needs of ecosystem management, the effectiveness of the research plan has been assessed and the research results are published and considered under the management system

Score 85

Comment

The management system has processes for establishing a research plan to support the understanding of the impacts of the fishery on the ecosystem. This plan is achieved through the IFMC designed jointly by experts, managers and stakeholders to support the ecosystem and to address significant environmental impacts of fishing. However, there are limited resources available to support research for the needs of ecosystem management: a key aspect of the effectiveness of the Plan (Sloan 2005:93).

The Plan has a research strategy that includes habitat and ecology with top priorities for fishery dependent and independent data collection and quantitative assessment of by-catch by-product, threatened, endangered and protected species.

Basic to this priority, is an FRDC project, an industry initiative, with \$205,000 funding to achieve the following objectives:

1. Assess the (i) composition and magnitude of retained and discarded catches and (ii) rates of capture of retained and discarded species in the main types of gear used by commercial and recreational fishers in the Coorong lagoons in order to establish a risk assessment framework for by-catch management.

2. Assess the survival of key species (e.g. mulloway, yellow-eye mullet) discarded for each of the main gear types employed by the commercial (large mesh gill net, haul net) and recreational sectors (line, small mesh gill net).
3. Identify mechanisms for reducing by-catch in the main fishing gear used in the Coorong lagoons and provide extension of these ideas to industry.
4. Develop potential performance indicators and reference points related to by-catch of the main fishing gear used in the Coorong lagoons.

This project also addresses key strategies identified in Goal 3 of the Plan (Sloan 2005:55). This goal concerns minimising fishery impacts on by-catch species by (i) quantification of the impact of fishing operations on by-catch species, (ii) improved recording of data on by-catch interactions and by-catch species composition and (iii) risk analysis to assess the vulnerability of by-catch species. Additionally, there is a need for baseline data on by-catch to set the levels for reference points and triggers outlined in the Plan.

The effectiveness of the research plan has not been assessed yet and limited research results are published and considered under the management system. The Plan however has long term strategies to build research proposals and seek appropriate funding. Research is supported by the SFA. For example, the development of the ‘voluntary environmental monitoring form’, as part of the SFA Environmental Management Plan, that collects observations of fishers on a range of ecological and fishing interactions within the Lakes and Coorong environs.

Criterion 3.2

The management system recognizes applicable legislative and institutional responsibilities and coordinates implementation on a regular, integral, explicit basis.

Intent: This criterion is to assess the compliance of the multi-species Lakes and Coorong fishery management system with the applicable conventions, laws and rules.

Indicator 3.2.1 **The fishery is managed and conducted in a manner that respects international conventions and agreements and not under any controversial unilateral exemption to an international agreement [Relates to MSC Criterion 3.1]**

Intent: To assess whether the Lakes and Coorong fishery adheres to international conventions and laws such as UNCLOS and the Convention on Biodiversity.

Scoring Guidepost 60

The management system appears to operate within applicable international conventions and agreements, although no detailed examination of this has been made.

Scoring Guidepost 80

The management system does not employ or in any manner seek to operate within any exemption to otherwise applicable international conventions and agreements, and all appropriate laws have been identified.

Scoring Guidepost 100

All measures taken within the management system are in compliance with relevant international treaty and agreement obligations and no unilateral exemptions from any treaty obligation pertaining to the fishery are undertaken.

Score 95

Comment

Evidence suggests that all measures taken within the management system have the intention of being in compliance with relevant international treaty and agreement obligations and no unilateral exemptions from any treaty obligation pertaining to the fishery are undertaken. This is evident within the Plan (Sloan, 2005:13) and the operations of the IFMC and PIRSA in managing the fishery.

The management system appears to operate within applicable international conventions and agreements, although no detailed examination of this has been made except that the Plan (Sloan, 2005:13) highlights the major drivers for the management of the Lakes and Coorong fishery as being acceptance of international obligations. No controversial unilateral exemptions to an international agreement are listed within the Plan.

For example, the management system through the objectives and strategies of the Plan (Sloan, 2005:42) is based on the following key policy drivers that ensure that as the fishery builds on the current data available, the current adaptive and precautionary exploited stock strategy for this multi-species and multi-gear fishery will be enhanced:

- Sustainable management of fisheries resources - National strategy for ecological sustainable development stemming from UNCLOS and the FAO Code of Responsible Fishing;
- Precautionary approach to fisheries management - The precautionary principle under the Intergovernmental Agreement on the Environment stemming from Agenda 21 and subsequent international agreements and conventions;
- Minimising impacts on bycatch species and the broader environment - The International Biodiversity Convention as the basis for the Australian *Environment Protection and Biodiversity Conservation Act 1999*;
- Wise use of fisheries resources - Albert Ramsar Management Plan;

The most important driver for the Lakes and Coorong area is the RAMSA agreement that sits above all other legislation for that ecosystem. The connectivity of the Ramsar Plan to the management of the fishery has yet to be fully developed.

No evidence is available to suggest that the management system, based on the Plan (Sloan 2005) and the associated administrative procedures of PIRSA or the IFMC, employs or in any manner seeks to operate within any exemption to otherwise applicable international conventions and agreements, and all appropriate laws have been identified and included in the Plan. As new management plans for the region are developed, laws related to other

stakeholder responsibilities will be accounted for in the reviews of the Plan and the operational procedures of the IFMC.

Indicator 3.2.2 **The fishery is managed and conducted in a manner that complies with domestic law [Relates to MSC Criterion 3.16].**

Intent: To assess whether the Lakes and Coorong fishery adheres to Australian and South Australian laws.

Scoring Guidepost 60

The management system appears from preliminary observations to operate within applicable domestic law and no noted violations have been identified that would jeopardize the management of fisheries resources.

Scoring Guidepost 80

The management system is known to be in compliance with all substantive and procedural aspects of applicable domestic law; there are no known repeat offences and no consistent judgments against the fishery that would jeopardize the resource.

Scoring Guidepost 100

The management system is consistently in compliance with all substantive and procedural aspects of applicable domestic law and no officer or agent of the management system, including its component entities, has been found to be in contempt of any domestic court of jurisdiction on any matter related to performance of official duties on behalf of the management system

Score 95

Comment

The management system is consistently in compliance with all substantive and procedural aspects of applicable domestic law. For example, the management system is in compliance with, or is in the process of implementing, the following;

- The *Fisheries Act 1982*;
- *Fisheries (Scheme of Management – Lakes and Coorong) Regulations 1991*;
- *Fisheries (Management Committees) Regulations 1995*;
- Section 42 protected fish of Fisheries(General) Regulations 2000 – Reg 6;
- National Strategy for Ecological Sustainable Development;
- The precautionary principle under the Intergovernmental Agreement on the Environment;
- The Australian *Environment Protection and Biodiversity Conservation Act 1999*;
- The Native Fish Strategy for the Murray Darling Basin 2003-2013;
- The National Policy on Fisheries By-catch;
- The Coorong and Lakes Alexandrina and Albert Ramsar Management Plan;
- Coorong National Park Management Plan;

- Native Fish Strategy;
- Environmental flows strategy for the river Murray; and
- Asset watering plan for the Lakes and Coorong, Lower Lakes and Murray Mouth being developed by DWLBC.

As new management plans for the region are developed, laws related to other stakeholder responsibilities will be accounted for in the reviews of the Plan and the operational procedures of the IFMC.

No evidence is available that any officer or agent of the management system, including its component entities, has been found to be in contempt of any domestic court of jurisdiction on any matter related to performance of official duties on behalf of the management system.

The management system has an advisory committee, the IFMC that has a statutory obligation to forward fishery management recommendations to the Minister for Agriculture, Food and Fisheries, has members with direct participation within the fishery who may have breached fisheries legislation in carrying out their fishing operations. However, such breaches are not related to the operation of the management system. No such breaches were found. There is some evidence however (Fishwatch correspondence dated 7 /3/2005) that there have been some minor breaches of the Fisheries Act/Regulations by some fishers in recent past years.

Criterion 3.3

Stakeholders are directly involved in management of the fishery, disputes can be settled within the system and the managers have useful advice on which to base decisions.

Intent: This criterion is that the system of management is based on principles of participation that ensures these stakeholders are an integral part of the decision making processes that includes appropriate conflict resolution procedures and adequate information for decision making.

Indicator 3.3.1 **The management system involves all categories of stakeholders appropriately on a regular, integral, explicit basis [Relates to MSC Criterion 3.2].**

Intent: To assess whether all categories of stakeholders are part of a formal, transparent decision making processes of the management system.

Scoring Guidepost 60

The management system has informal processes that allow for stakeholder groups to be consulted.

Scoring Guidepost 80

The management system makes decisions after formally consulting stakeholder groups.

Scoring Guidepost 100

The management system makes transparent decisions that fully account and serve all stakeholder groups and ensures that stakeholders are involved in the management advisory processes.

Score 95

Comment

The management system is based on a co-management decision making process that formally includes stakeholders through the IFMC. The Plan (Sloan, 2005:60) has a strategy of *'promote stakeholder involvement in the management of the fishery through established co-management processes'* with the performance indicator *'IFMC membership reflects the stakeholder interests in the fishery'*. The IFMC provides recommendations to the Minister for Agriculture, Food and Fisheries and PIRSA so the management system makes decisions after formally consulting stakeholder groups.

The management system makes transparent decisions that fully account and serve all stakeholder groups as recommendations and decisions are known to stakeholders through members of the IFMC and become a public record through PIRSA and industry information processes. The mooted establishment of a Ngarrindjeri Nation Natural Resources Management Committee will help facilitate traditional fisheries input into the IFMC provided the IFMC will seek indigenous membership.

However, no documentary evidence has been provided that all decisions are transparent but the IFMC has a formal process that includes all stakeholders in providing information through agenda items and minutes of meetings and action items are all known to members. For example, a change in the use and type of nets when targeting mullet to avoid the by-catch of juvenile mulloway involved fisher participation in fishing trials, documentation of impacts, meetings with various stakeholder groups, presentation and discussion within the IFMC, recommendations to the Minister for Agriculture, Food and Fisheries, acceptance by PIRSA and finally appropriate legislation. The process is formal and used within the management system.

Indicator 3.3.2 **The management system provides for timely and fair resolution of disagreements [Relates to MSC Criteria 3.2, 3.5].**

Intent: To assess whether appropriate conflict resolution processes are incorporated and enforced within the system of management

Scoring Guidepost 60

Mechanisms for informal dispute resolution exist, and are used by some stakeholders.

Scoring Guidepost 80

The management system has effective mechanisms for both formal and informal transparent processes for the resolution of disputes at all levels of, and for, most issues arising within the system.

Scoring Guidepost 100

The management system has established objective mechanisms for resolution of disputes at all levels of, and for all issues arising within the system and that these dispute resolution procedures show evidence of being open to and used by a variety of participants and stakeholders where appropriate.

Score 80

Comment

The management system has effective mechanisms for both formal and informal transparent processes for the resolution of disputes at all levels of, and for, most issues arising within the system. For example, at the formal level, PIRSA, Minister for Agriculture, Food and Fisheries and the Parliament can resolve disputes based on IFMC and/or stakeholder inputs. At an informal level, the connectivity and inter-relationships that exist within the fishery and other stakeholders allows for differing views to be resolved.

However, no formal set of dispute resolution guidelines exist for the IFMC. Thus an improvement in the management system would be to have a formal policy that enunciates a set of dispute resolution guidelines for all co-management committees.

The management system has shown evidence of being open to and used by a variety of participants and stakeholders through the IFMC process and the subsequent management recommendations that are reviewed by PIRSA and the Minister for Agriculture, Food and Fisheries as part of their decision making process.

Indicator 3.3.3 **The management system presents managers with clear, relevant information, which is considered in decision-making [Relates to MSC Criterion 3.2].**

Intent: To assess whether the system of management provides for the formal collection, analysis of information so that managers and the decision making processes are based on the 'best available information'.

Scoring Guidepost 60

The management system's decision makers are provided with clear and relevant information under the management system and there is evidence that it is considered in the decision making process.

Scoring Guidepost 80

The decision-makers show evidence of considering the information provided to them under the management system and some evidence that alternative proposals of stakeholders have been considered.

Scoring Guidepost 100

The management system regularly provides decision makers with analysed alternatives for action and shows evidence of a pattern of behaviour by decision makers that reveals that they have found the information provided to them to be useful.

Score 90

Comment

Management system has a process for the collection of basic ecological and fishery data through studies by SARDI and other sources. For example, a) the SFA monitoring of the interactions of the fishery with the lakes and Coorong ecosystem will provide an important database that can be used to build awareness of ecological impacts of fishing within the stakeholder groups and the management system and b) all commercial fishers have the legal obligation of submitting monthly logbooks, the data of which resides within the SARDI cpue comprehensive database including regional and fishing grid data and c) the paucity of recreational cpue data that will need to be enhanced through new surveys to complement the National Recreational and Indigenous Fishing Survey. All of this information can be used in conjunction with any spatial ecological data collected.

The management system's decision makers – the Minister for Agriculture, Food and Fisheries and PIRSA, are provided with clear and relevant information. Under the co-management system established for South Australian fisheries, all of the stakeholders within the Lakes and Coorong fishery have access to the various research and related information available through the IFMC process, including formal agenda papers and minutes, that regularly provides alternative proposals and related recommendations to the decision makers.

The decision-makers show evidence of considering the information provided to them under the management system as changes to legislation include regulatory impact statements and Ministerial and Cabinet briefing papers that need to provide evidence of the clear and relevant information used and that alternative proposals of stakeholders have been considered by the decision makers.

Criterion 3.4

The management system applies information through implementation of measures and strategies (by rule or by voluntary action of fishery) that demonstrably control the degree of exploitation of the resource in the light of the natural variation in ecosystems.

Intent: This criterion is to ensure that the best available information of the ecological aspects of the fishery is used in the development and application of effective exploitation control mechanisms.

Indicator 3.4.1 **The management system has measures and strategies that restrict gear and practices to avoid by-catch, minimize mortality of by-catch, and reduce discards [Relates to MSC Criterion 3.12, 3.17].**

Intent: To assess whether the system of management has effective controls on the Lakes and Coorong fishing gear and operations to reduce the levels of by-catch and discards.

Scoring Guidepost 60

By-catch reduction has been considered by the management system and fishers cooperate in the implementation.

Scoring Guidepost 80

Specific by-catch reduction methods/strategies are included in the management of the fishery.

Scoring Guidepost 100

There are specific requirements in place to significantly reduce by-catch and discards in the management system and results are measured against a series of agreed goals.

Score 75

Comment

The management system has recognised the importance of by-catch reduction through the Plan (Sloan 2005:56). For example, Goal 3, Objective b, '*Minimise fishery impacts on by-catch species and the ecosystem*' with a range of supporting strategies including '*quantify the impact of fishing operations on by-catch species through targeted research projects*' and a specific reference point/trigger of '*the amount of by-catch (discards) in commercial mesh net fishing operations, relative to the total catch of retained species is greater than 20% (in weight) in any given year*' and PIRSA intends to review this and other strategic components on the completion of the FRDC by-catch study and risk assessment.

The Plan (Sloan 2005:37) specifies permitted species, recreational fishing methods, bag and boat limits and spatial and temporal closures and gear specifications as required under the *Fisheries (General) Regulations 2000*. For example, the use of a spear guns or hand held spears are not permitted within Lake Alexandrina; numbers of hooks and hoop nets are limited. Of significance, is the number of registered recreational mesh nets (1996 in 2006) and users must be within 50m of these nets at all times – not a satisfactory unit of fishing effort or catch. SARFAC supports the 'Management strategy for the sustainable use of recreational fishing in SA' and the 'National Code of Practice for Recreational and Sport Fishing' both of which, along with their other policies encourage recreational restraint in the use of inappropriate gear and practices to avoid by-catch, minimize mortality of by-catch, and reduce discards.

The Plan (Sloan 2005:104) reflects the multi-species nature of the fishery and specifies commercial sector gear restrictions, permitted species (Sloan 2005:103), and spatial and temporal closures (Sloan 2005:36) and size limits as required under the *Fisheries (General) Regulations 2000*. For example, mulloway has a minimum legal length of 46mm within the Coorong estuary and 75 outside the Coorong estuary; various time closures for use of nets within the various areas of the fishery to protect fish stocks during specific stages of their life cycle.

The SFA fishers cooperate in the implementation of these restrictions and have been actively involved in their development as indicated through the 2003 strategic plan. For example, the development of the 'voluntary environmental monitoring form', as part of the SFA Environmental Management Plan, that collects observations of fishers on a range of ecological and fishing interactions within the Lakes and Coorong environs. This information supports the PIRSA logbook system and will complement the FRDC by-catch research.

A score of 75 is assigned as there are still no specific management measures in place to manage possible bycatch issues. SCS received further comment from PIRSA Fisheries about concerns over the lack of quantitative information on bycatch levels in the fishery, and as a result of this knowledge gap, a limited capacity to manage ecosystem impacts associated with bycatch.

Condition 29

Improve the understanding of by-catch and any impacts on non-target species (Conditions 23, 24, and 25 apply), and once this understanding is improved, introduce specific management measures to address any issues.

Indicator 3.4.2 **The management system has measures and strategies that minimize adverse impacts on the habitat [Relates to MSC Criteria 3.10, 3.13].**

Intent: To assess whether the system of management has effective controls on the Lakes and Coorong fishers to minimize the impacts of fishing gear and operations on habitat.

Scoring Guidepost 60

The management system has processes to identify and document fishery impacts on all **major** habitats.

Scoring Guidepost 80

The management system has processes for gathering of knowledge on sensitive habitats in the area of the fishery, and there are mechanisms in place to assess whether the impacts are significant and to respond accordingly.

Scoring Guidepost 100

The management system requires efforts to identify and document fishery impacts on all habitats and mechanisms have been established to assist fishers in changing fishing operations to reduce habitat damage.

Score 79

Comment

Through the Plan (Sloan 2005:56), the management system has a required process that should be used to identify and document fishery impacts on all major habitats. In other words, the management system requires efforts to identify and document fishery impacts on all habitats and mechanisms. For example, Goal 3b strategies 1-7 identify the operational directions of the IFMC for meeting the outcomes of this indicator. The application of this component of the harvest strategy is evident: the Inland Fishery Management Committee (IFMC), established under the *Fisheries (Management Committees) Regulations 1995*, meets about six times per year and has supporting species and research sub-Committees to deal with changes to the status of the four stocks and other species when appropriate.

Although, the IFMC has membership from stakeholder groups (and is working to get better indigenous representation) it lacks substantial input on sensitive habitats as little funding is available for this knowledge to be collected. However, even though there are mechanisms in place to assess whether the impacts are significant through an expanded IFMC, with little information currently available the IFMC will be hampered in its ability to respond according to changes in the Lakes and Coorong habitat.

The SFA has lead the way in assisting fishers in changing fishing operations to reduce habitat damage through their 2003 Strategic Plan and instigated regulatory changes to support the goals of their environmental management plan.

Condition 30:

Conditions 25 and 28 apply.

Indicator 3.4.3 **The management system does not allow use of destructive fishing practices [Relates to MSC Criterion 3.14].**

Intent: To assess whether the system of management has effective controls on the Lakes and Coorong fishers to stop the use of destructive fishing practices.

Scoring Guidepost 60

The management system prohibits the use explosives or toxic chemicals to kill or stun aquatic species and defines specific penalties.

Scoring Guidepost 80

There is evidence that the fishery does not use destructive fishing practices to kill or stun aquatic species.

Scoring Guidepost 100

There is a formal monitoring system in place to determine if such destructive fishing practices occur and evidence of prosecutions (if any) of these breaches.

Score 95

Comment

Under the *Fisheries (Scheme of Management – Lakes and Coorong) Regulations 1991* and the *Fisheries (General) Regulations 2000*, fishers cannot use destructive fishing practices including explosives and chemicals. PIRSA Fishwatch is the compliance and enforcement arm of PIRSA which has staff situated along the South Australian coastline. Their mandate is to ensure compliance with regulations such as the use of destructive fishing practices. No violations were recorded against the use of destructive fishing practice in the last five years - correspondence from PIRSA Fishwatch (7/3/2005).

Indicator 3.4.4 **The management system provides for rebuilding and recovery [Relates to MSC Criterion 3.10].**

Intent: To assess whether the system of management has effective information of the status of fish stocks including reference and trigger points and strategies to rebuild the four stocks as determined.

Scoring Guidepost 60

There are regular discussions by key stakeholders on the state of the stocks to consider if these were over exploited, in need of rebuilding including possible recovery strategies.

Scoring Guidepost 80

Assessments are made of the population, and or stocks, to determine if they are falling below acceptable levels (a predetermined trigger point - threshold/limit point), and where stocks are identified as depleted there is a timely process in place to allow for developing plans for rebuilding appropriate to the stock (i.e. taking note of a multi-species fishery with potential effort transfer).

Scoring Guidepost 100

Where population or stocks impacted by the fishery have declined below acceptable levels, the management system is structured so that pre-developed plans will be implemented.

Score 80

Comment

Information for this indicator is based on comments from Indicator 1.1.3.1 above. Where important the comments are repeated. The basis of best practice is to not only know the status of key species but also to have processes that can consider if these are over exploited, in need of rebuilding including possible recovery strategies.

The management system for the Lakes and Coorong fishery can accommodate these processes. For example, the IFMC meets regularly and a review of each species takes place annually based on either a stock assessment or a species report based on cpue and related data. The approach for rebuilding and recovery is as follows.

The Lakes and Coorong Fishery is exploited by both recreational, commercial fishers and there is relatively little traditional fishing. The Plan (Sloan 2005) indicates that commercial fishery is a limited entry fishery comprising 37 fishers and exploitation is managed using a mix of gear restrictions, spatial and temporal closures, restrictions on the number of agents permitted to assist fishing operations and legal size limits. According to the Plan (Sloan 2005), recreational fishers are also constrained by gear restrictions, spatial and temporal closures and legal size limits, however no limit is imposed on the number of recreational fishers seeking to participate in the recreational fishery.

The Plan (Sloan 2005) provides a detailed and explicit specification of the regulations and of the harvest control rules and actions that will be initiated should indicator variables fall beyond specified biological reference points. Other non-biological triggers relate to a change exceeding 50% in the total commercial fishing effort for any fishing method over a four year period, changes in species composition, surveys indicating that recreational effort levels exceed those identified in the National Recreational and Indigenous Fishing Survey, and failures of research and management processes such as the production of stock assessment and status reports in line with the strategic research and monitoring strategy (Sloan 2005).

The use of upper and lower limits derived from historical values of catch and cpue ensures that inter-annual variability in these indicators is accommodated and that action is less likely to be triggered as a result of such variation. However, adverse trends in exploitation or abundance may not be detected until they fall outside the range of natural variability. An improved response timeframe would be to trigger a review at an earlier stage than to delay triggering until the situation is critical. An example of how the management system assesses the need for rebuilding and recovery is the mulloway fishery.

The biological reference points of the mulloway fishery that will trigger action are as follows (Sloan 2005:117).

- (7) the total South Australian commercial catch taken using mesh nets falls above or below upper or lower reference values calculated as the means of the three highest and three lowest catches recorded in the reference period 1984/85 to 2001/02;
- (8) The cpue (kg/day) recorded for targeted commercial fishing using mesh nets in the Lakes and Coorong Fishery falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1984/85 to 2001/02;
- (9) The cpue (kg/day) recorded for targeted commercial fishing using swinger nets in the Lakes and Coorong Fishery falls above or below upper or lower reference values calculated as the means of the three highest and three lowest cpues recorded in the reference period 1984/85 to 2001/02;
- (10) The rate of change in total South Australian commercial catch over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02;
- (11) The rate of change in cpue (kg/day) recorded for targeted commercial fishing using mesh nets in the Lakes and Coorong Fishery over the last

- (12) four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02;
- (12) The rate of change in cpue (kg/day) recorded for targeted commercial fishing using swinger nets in the Lakes and Coorong Fishery over the last four years exceeds the greatest rate of change (\pm) experienced over four consecutive years during the reference period 1984/85 to 2001/02.

The actions that are triggered are that (1) the Minister for Agriculture, Food and Fisheries and participants in the fishery are notified; (2) a detailed review is undertaken of the causes and implications of the indicator falling beyond its reference point; (3) key stakeholders are consulted regarding the need for alternative management actions for each fishing sector; and (4) a report is provided to the Minister for Agriculture, Food and Fisheries, within three months of initial notification, advising of the conclusions of the review and providing recommendations on alternative management strategies (Sloan 2005).

The consultative approach, in combination with the requirement for provision of appropriate management advice within a three month time frame, is considered appropriate for this fishery (Sloan 2005). However, the Minister for Agriculture, Food and Fisheries bears ultimate responsibility for ensuring the sustainability of the stock and may take action to constrain fishing for a specified period if this should become necessary or if total catch limits are reached.

An improvement in the management system would be the development of action plans for all key species that are likely to be triggered under the current reference points and trigger that will need to be improved as more fishery independent data becomes available.

It is noted that stock enhancement should not occur within the Lakes and Coorong fishery. The Native Fish Strategy has identified inappropriate translocation and stock enhancement as one of the key threats to native fish populations in the Murray Darling Basin.

Indicator 3.4.5 **Incorporates no-take zones where appropriate [Relates to MSC Criterion 3.10].**

Intent: To assess whether the system of management has options for establishing and enforcing no-take MPAs for both fisheries management and conservation/biodiversity objectives.

Scoring Guidepost 60

Management system has the ability to incorporate closures where appropriate to manage effort and impacts of fishing.

Scoring Guidepost 80

The management system has processes for including the use of no-take zones as a means of achieving the fishing, conservation/biodiversity objectives/strategies of the fishery, and conservation agencies are consulted on the need for, and implementation of, these zones.

Scoring Guidepost 100

The management system has processes for review, modification and implementation of established no-take zones and the purpose and effectiveness of these no-take zones is described and assessed.

Score 80

Comment

Management system has the ability to incorporate closures where appropriate to manage effort and impacts of fishing. For example, under the Plan (Sloan 2005:36) there are a series of commercial spatial and temporal closures for the key species such as Goolwa cockles on the ocean beaches between 1 June and 31 October and for the use of nets but only during specified periods: all nets in Area 1 of the Coorong between 25 December and 7 January. In effect, these are not no-take-zones. And for recreational fishers, the Plan (Sloan 2005:38) does have no-take-zones for mesh nets only. However, the objectives for establishing spatial and temporal closures for fisheries are not always the same as objectives for conservation and biodiversity purposes. For example, the above fisheries closures are for protection of spawning populations and for separation of different user group fishing gears or methods, whereas, protection of habitat or non-target species may have a higher priority with the need for no-take-areas set aside for conservation and biodiversity purposes – none are evident.

The management system has processes in place for including the use of no-take zones as a means of achieving the fishing objectives/strategies of the fishery, but for the achievement of the conservation/biodiversity objectives/strategies there is a need for an integrated approach with the IFMC and conservation agencies. Therefore, there are no formal processes for review, modification and implementation of established no-take zones for conservation/biodiversity purposes. The purpose and effectiveness of these no-take zones for achieving conservation/biodiversity objectives is thus neither described nor formally assessed under the Plan.

Indicator 3.4.6 **The management system minimizes operational waste [Relates to MSC Criterion 3.15].**

Intent: To assess whether the system of management has effective controls on the Lakes and Coorong fishers to reduce waste of fishing operations such as plastic, oils and ghost fishing gear.

Scoring Guidepost 60

The management system has processes that encourage fishers to consider the impacts of their fishing operations waste and develop strategies to minimize waste.

Scoring Guidepost 80

The fishery encourages minimization of operational wastes and there is evidence of its effectiveness.

Scoring Guidepost 100

There are effective monitoring and enforcement programs for reducing operational waste from the fishery, through an agreed Environmental Management System.

Score 85Comment

The management system has fisheries regulations that encourage fishers to consider the impacts of their fishing operations waste under *Fisheries (General) Regulations 2000* and *Fisheries (Scheme of Management – Lakes and Coorong) Regulations 1991*. Through the IFMC and the initiatives of SFA, the management system has encouraged the fishers to develop strategies to minimize waste through the development of an industry agreed Code of Practice developed by SFA. This was the first fishery in Australia to implement an Environmental Management Strategy (EMS) that included ensuring fishery waste was minimised. The fishers regularly clean up the Lakes and Coorong environs as part of their adhering to their voluntary Code and EMS.

The SFA has developed a monitoring program for reducing operational waste from the fishery. For example, the development of the ‘voluntary environmental monitoring form’, as part of the SFA Environmental Management Plan, that collects observations of fishers on a range of ecological and fishing interactions within the Lakes and Coorong environs. Data from these forms will be made available to the IFMC for analysis, interpretation and form the basis of on-going assessment of wastes and their impacts on the fishery.

The PIRSA Fishwatch risk assessment in the Plan (Sloan 2005:123) does not rate the issue of enforcing waste as of any significance nor has any mitigating strategies that targets this matter.

Criterion 3.5**The management system provides for enforcement and compliance**

Intent: The intention of this criterion is to ensure that the multi-species Lakes and Coorong fishery management system has components for monitoring, control, surveillance and enforcement and adhered to by stakeholders.

Indicator 3.5.1 **The management system enforces compliance in the fishery and has knowledge of the level of illegal fishing on the target species. [Relates to MSC Criteria 3.11, 3.16]**

Intent: To assess whether the system of management has effective compliance controls on the Lakes and Coorong fishers to stop illegal fishing practices.

Scoring Guidepost 60

The management system has a compliance and enforcement system with capacity to constrain illegal fishing to meet the objectives of the management plan.

Scoring Guidepost 80

The management system has established a compliance and enforcement system and has demonstrated a consistent ability to enforce applicable rules designed to ensure the level of illegal fishing meets stated objectives.

Scoring Guidepost 100

The management system has established a comprehensive compliance and enforcement system, contains procedures for effective compliance; monitoring, control, surveillance and enforcement, which ensure that management system controls are not violated and appropriate corrective actions are taken to meet required outcomes. There is evidence of minimal violations or illegal fishing.

Score 95

Comment

The management system has established a comprehensive compliance and enforcement system (PIRSA Fishwatch) and has demonstrated a consistent ability to enforce applicable rules designed to ensure the level of illegal fishing meets stated objectives. Fishwatch contains procedures for effective compliance; monitoring, control, surveillance and enforcement which is supported by a legal section within PIRSA to ensure that the management system controls are not violated as agreed through *Fisheries (General) Regulations 2000* and *Fisheries (Scheme of Management – Lakes and Coorong) Regulations 1991* and the Plan (Sloan 2005).

Appropriate corrective actions are taken to meet required outcomes through the mitigating strategies agreed under the compliance risk assessment for the Lakes and Coorong fishery (Sloan 2005:123). The cost of compliance is negotiated annually based on the risk assessment and PIRSA compliance policies, with the fishery through the IFMC under the PIRSA cost recovery process and paid by fishers under a licence fee (EconSearch 2005;11).

Fishwatch has developed a risk management strategy for the fishery that has been developed with the full involvement of all key stakeholders through the IFMC.

For the commercial fishery, mitigating actions include: to ensure the management system enforces compliance with respect to illegal fishing practices, the use of illegal or excess fishing gear the agreed mitigating strategies include: alternative methods to detect and remove illegal gear, conduct awareness programs, conduct vessel controls, issue expiation notices, conduct intelligence driven operations, etc. For example, the use of different size limits for mulloway has compliance implications but is not regarded as a significant issue in the fishery. PIRSA intends to review compliance needs after the by-catch study.

Although there is evidence of minimal violations of illegal fishing – Fishwatch correspondence dated 7 /3/2005 indicating that of the 30 violations that occurred over the last five years, for both recreational and commercial fishing operations: the main offence was undersize fish.

Criterion 3.6

The performance of the management system is regularly and candidly evaluated and adapted as needed to improve

Intent: This criterion is to ensure that the management system of the multi-species lakes and Coorong fishery is regularly assessed and improved.

Indicator 3.6.1 The management system provides for internal assessment and review [Relates to MSC Criterion 3.3].

Intent: To assess whether the Lakes and Coorong system of management has an effective internal assessment and review mechanism that has been implemented.

Scoring Guidepost 60

The management system has an informal internal system for evaluation of management performance as it relates to the sustainability of the fishery.

Scoring Guidepost 80

The management system has a systematic system for evaluation of management performance as it relates to the sustainability of the fishery.

Scoring Guidepost 100

The management system has a formal and transparent internal, continuing, system for evaluation of management performance as it relates to the sustainability of the fishery.

Score 80

Comment

The management system has both a formal and informal internal system for evaluation of management performance as it relates to the sustainability of the fishery. This is evident through the operation and review of the Plan (Sloan 2005:13). The Plan will operate for a five year period from 2005 to 2010 subject to annual review and amendments as per the recommendations of the IFMC which has the mandate to develop, implement, review and amend the Plan under the *Fisheries (Management Committees) Regulations 1995*.

The performance of the management system relates to the sustainability performance indicators and appropriate actions that are triggered are that (1) the Minister for Agriculture, Food and Fisheries and participants in the fishery are notified; (2) a detailed review is undertaken of the causes and implications of the indicator falling beyond its reference point; (3) key stakeholders are consulted regarding the need for alternative management actions for each fishing sector, such as input and output controls, closures, environmentally friendly fishing gear and methods; and (4) a report is provided to the Minister, within three months of initial notification, advising of the conclusions of the review and providing recommendations on alternative management strategies (Sloan 2005:45).

This consultative approach, in combination with the requirement for provision of appropriate management advice within a three month time frame, is considered appropriate for this fishery (Sloan 2005:46). Sloan (2005:46) also suggests that a more structured approach should be used when the appropriate management and review tools are available to the IFMC. However, the Minister bears ultimate responsibility for ensuring the sustainability of the stock and may take action to constrain fishing for a specified period if this should become necessary or if total catch limits are reached.

The performance of the management system in achieving the sustainability of the fishery depends on the IFMC having the resources and willingness to evaluate the harvest strategy for the fishery. The agreed performance indicators of the harvest strategy of the Plan (Sloan 2005) are new and untested and the process for the assessment of these indicators is not fully developed within the Plan. But the intention of the strategic approach to the management of the fishery is evident. However, for such a relatively small fishery, the resources for a comprehensive internal assessment may not be available or evaluation may need to be prioritized.

Indicator 3.6.2 **The management system provides for external assessment and review [Relates to MSC Criterion 3.2, 3.3].**

Intent: To assess whether the Lakes and Coorong system of management has an effective external assessment and review mechanism that has been implemented.

Scoring Guidepost 60

Aspects of the management system and assessments have an occasional external review as it relates to the sustainability of the fishery.

Scoring Guidepost 80

The management system has a system for a regular external evaluation of management performance as it relates to the sustainability of the fishery.

Scoring Guidepost 100

The management system provides for an independent, expert review of management performance as it relates to the sustainability of the fishery.

Score 80

Comment

Under the Commonwealth of Australia *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and a range of other legislation and policy drivers, the management system includes a regular external evaluation of management performance as it relates to the sustainability of the fishery. For example, the fishery needs to meet the assessment criteria of the EPBC Act for the fishery to be able to export product. The

requirements of this assessment are very complex and thus provide an ongoing assessment of the performance of the fishery management system in achieving sustainability.

Other external assessment requirements relate to the policy, legislation and Codes of practice of other non-fishery stakeholder groups such as

- National strategy for ecological sustainable development;
- The precautionary principle under the Intergovernmental Agreement on the Environment;
- The Australian *Environment Protection and Biodiversity Conservation Act 1999*;
- The Native Fish Strategy for the Murray Darling Basin 2003-2013;
- The National Policy on Fisheries By-catch;
- The Coorong and Lakes Alexandrina and Albert Ramsar Management Plan;
- Coorong National Park Management Plan;
- Asset Watering Plan for the Coorong, Lower Lakes and the Murray Mouth;
- Draft Environmental Flows Strategy for the River Murray; and
- Upper South East Dryland Salinity and Flood management Scheme.

7 TRACKING, TRACING FISH AND FISH PRODUCTS

Under Section 4, a brief description is given of the monitoring of catch in the fishery. MSC Chain of Custody requirements were only checked as far as the landing of fish on board legally licensed fishing vessels and found to be compliant with MSC requirements. Further chain of custody assessments were not conducted for any of the fish moving from boat deck into the processing segment of the fishery either onboard or at shoreside processors. It is highly recommended that any Chain of Custody certificates issued for product originating from this fishery also examine and verify the captain's logbook data, the required reporting data on catch from the fishery, and observer reports as part of ensuring that the fish products carrying the MSC logo are properly verified.

8 PEER REVIEW, PUBLIC COMMENT, AND OBJECTIONS

A peer review has been conducted by two peer reviewers. The peer reviews can be found in Appendix 2. A public comment period will also be held, as well as a posting period for objections as required by the MSC.

9 CERTIFICATION RECOMMENDATION AND PERFORMANCE SCORES

It is the assessment team's consensus judgment that the management of the Lakes and Coorong fishery complies overall with the MSC Principles and Criteria. Therefore, SCS as the certification body of record recommends that the fishery be issued a joint fishery/chain of

custody certificate pending (1) the submission of an Action Plan to show how the applicant intends (content and timelines) to meet the proposed conditions, (2) approval by the certification body (SCS) of the action plan, and (3) proof of a contractual agreement between the applicant and an accredited certification body that assures the applicant will continue to comply with all specified conditions, all required surveillance audits, and all other responsibilities under the MSC program.

The fishery achieved a normalized score of 80 or above on each of the three MSC Principles independently for each of the four species:

- **Principle 1** (Mulloway-82.29) (Golden Perch-82.89) (Goolwa Cockle-81.76) (Yellow-eyed Mullet-81.84)
- **Principle 2** 81.09
- **Principle 3** 86.66

Although the evaluation team found the fishery in overall compliance (a normalized score of 80 on each MSC Principle), it also found the fishery's performance on a few specific indicators to be below the established compliance mark (an unweighted score of 80 for a single indicator). In these specific cases, the MSC requires that the Certification Body set 'Conditions for Continued Certification' that when met bring the level of compliance for the select indicator up to the 80-level score. Table 6 below shows the overall results of the evaluation in terms of Principle 1, 2, and 3.

Table 6. Scoring assigned to fishery using AHP.

Principles, Criteria, Subcriteria, and Indicators	AHP Assigned Weight	AHP Assigned Score Mulloway	AHP Assigned Score Golden Perch	AHP Assigned Score Goolwa Cockle	AHP Assigned Score Yellow eyed Mullet
MSC Principle 1	.333	80	83	80	82
MSC Criterion 1	.500				
SC 1.1.1	.250				
Indicator 1.1.1.1	.181	80	90	85	85
Indicator 1.1.1.2	.181	75	90	75	85
Indicator 1.1.1.3	.373	75	75	70	75
Indicator 1.1.1.4	.264	79	80	70	79
SC 1.1.2	.250				
Indicator 1.1.2.1	.333	65	65	65	65

		Indicator					
		1.1.2.2	.333	79	79	65	60
		Indicator					
		1.1.2.3	.333	79	79	79	79
	SC						
	1.1.3		.500				
		Indicator					
		1.1.3.1	.667	85	85	79	85
		Indicator					
		1.1.3.2	.333	80	80	80	80
MSC							
Criterion							
3			.500				
		Indicator					
		1.2.1	1.000	85	85	85	85
MSC							
Principle							
2			.333	81.09			
MSC							
Criterion							
1			.455				
	SC						
	2.1.1		.125				
		Indicator					
		2.1.1.1	.400	85			
		Indicator					
		2.1.1.2	.600	75			
	SC						
	2.1.2		.125				
		Indicator					
		2.1.2.1	.500	85			
		Indicator					
		2.1.2.2	.500	85			
	SC						
	2.1.3		.188				
		Indicator					
		2.1.3.1	1.00	75			
	SC						
	2.1.4		.188				
		Indicator					
		2.1.4.1	1.00	90			
	SC						
	2.1.5		.375				
		Indicator					
		2.1.5.1	1.00	75			
MSC							
Criterion							
2			.545				
	SC						
	2.2.1		.139				
		Indicator					
		2.2.1.1	.400	90			
		Indicator					
		2.2.1.2	.600	85			

SC			
2.2.2		.189	
	Indicator		
	2.2.2.1	.333	75
	Indicator		
	2.2.2.2	.333	79
	Indicator		
	2.2.2.3	.333	75
SC			
2.2.3		.208	
	Indicator		
	2.2.3.1	1.00	90
SC			
2.2.4		.464	
	Indicator		
	2.2.4.1	1.00	80
MSC			
Principle			
3		.333	86.66
SCS			
Criterion			
1		.203	
	Indicator		
	3.1.1	.214	85
	Indicator		
	3.1.2	2.14	80
	Indicator		
	3.1.3	.143	85
	Indicator		
	3.1.4	.214	85
	Indicator		
	3.1.5	.214	85
SCS			
Criterion			
2		.108	
	Indicator		
	3.2.1	.500	95
	Indicator		
	3.2.2	.500	95
SCS			
Criterion			
3		.203	
	Indicator		
	3.3.1	.333	95
	Indicator		
	3.3.2	.333	80
	Indicator		
	3.3.3	.333	90
SCS			
Criterion			
4		.203	
	Indicator		
	3.4.1	.176	75
	Indicator		
		.176	79

	3.4.2		
	Indicator		
	3.4.3	.176	95
	Indicator		
	3.4.4	.176	80
	Indicator		
	3.4.5	.176	80
	Indicator		
	3.4.6	.176	85
SCS			
Criterion			
5		.141	
	Indicator		
	3.5.1	1.00	95
SCS			
Criterion			
6		.143	
	Indicator		
	3.6.1	.500	80
	Indicator		
	3.6.2	.500	80

10 MEETING CONDITIONS FOR CONTINUED CERTIFICATION

To be awarded an MSC certificate for the fishery, the applicants must agree in written contract to develop an action plan for meeting the required 'Conditions'; a plan that must provide specific information on what actions will be taken, who will take the actions, and when the actions will be completed. The Action Plan must be approved by SCS as the certification body of record. The applicant must also agree in a written contract to be financially and technically responsible for surveillance visits by an MSC accredited certification body, which would occur at a minimum of once a year, or more often at the discretion of the certification body (based on the applicant's action plan or by previous findings by the certification body from annual surveillance audits or other sources of information). The contract must be in place prior to certification being awarded. Surveillance audits will be comprised in general of (1) checking on compliance with the agreed action plan for meeting pre-specified 'Conditions', and (2) sets of selected questions that allow the certifier to determine whether the fishery is being maintained at a level of performance similar to or better than the performance recognized during the initial assessment.

We are mindful that even though the applicant (SFA) takes the necessary steps to meet conditions, it's capacity to affect the management system may be limited. In the case where the managers or other sectors of the fishery are not able to cooperate, it will be the applicant's responsibility to find other ways to effectively meet the conditions. The certification body will be mindful of the difficulties that may accrue as a result of different interests in the fishery when measuring performance against the required conditions.

10.1 GENERAL CONDITIONS FOR CONTINUED CERTIFICATION

The general 'Conditions' set for the Lakes and Coorong fishery are:

- SFA must recognize that MSC standards require regular monitoring inspections at least once a year, focusing on compliance with the 'Conditions' set forth in this report (as outlined below) and continued conformity with the standards of certification.
- SFA must agree by contract to be responsible financially and technically for compliance with required surveillance audits by an accredited MSC certification body, and a contract must be signed and verified by SCS prior to certification being awarded.
- SFA must recognize that MSC standards require a full re-evaluation for certification (as opposed to yearly monitoring for update purposes) every five years.
- Prior to receiving final certification, SFA shall develop an 'Action Plan for Meeting the Condition for Continued Certification' and have it approved by SCS.

10.2 SPECIFIC CONDITIONS FOR CONTINUED CERTIFICATION

In addition to the general requirements outlined above, SFA must also agree in a written contract with an accredited MSC certification body to meet the specific conditions as described in Section 6 and summarized below (within the agreed timelines that will be agreed in the 'Action Plan for Meeting the Condition for Continued Certification' to be approved by SCS).

MSC Principle 1

Indicator 1.1.1.2 There is knowledge of the life history and biology of the species.

Score

Mulloway	75
Goolwa Cockles	75

Mulloway

Condition 1:

A reliable assessment should be made of the extent to which the juvenile mulloway within the Coorong lagoons and the adult assemblage found off the beaches and in the waters adjacent to the mouth of the Murray River outside the Coorong are interdependent. Data should be collected and analysed to provide reliable estimates of growth and size and age at maturity.

Goolwa Cockles

Condition 2

Reliable estimates of growth and of the size and age at which maturity are attained should be determined, together with a more detailed understanding of spatial distribution and recruitment processes.

Indicator 1.1.1.3 There is information to measure trends in abundance of stocks.
Scoring.

Score

Mulloway	75
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Golden perch	75
Goolwa cockles	70
Yellow-eye mullet	75

Mulloway

Condition 3:

An improved index of abundance, with finer temporal and spatial resolution, should be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations or other factors, such as environmental variables. Note that (1) existing indices of abundance should be maintained as these have been established as the indicator variables that are calculated and compared against reference points to trigger an appropriate management response; and (2) the refinement of existing fishery-dependent indices of abundance may require the collection of additional and more detailed spatial and environmental data by each type of fishing gear to enhance the catch and effort data currently supplied by fishers and will require appropriate statistical analyses of those data.

Golden perch

Condition 4:

An improved index of abundance with finer temporal and spatial resolution should be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations or other factors, such as environmental variables. (See the note appended above to Condition 3 for mulloway)

Goolwa cockles

Condition 5:

An improved index of abundance should, with finer temporal and spatial resolution, be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations, distribution of cockles, or other factors, such as environmental variables. (See the note appended above to Condition 3 for mulloway) The potential that catch per unit of effort may be sustained (i.e. that cpue is hyperstable) through movement of fishers to new sections of beach needs to be accounted for by appropriate collection and analysis of data.

Yellow-eye mullet

Condition 6:

An improved index of abundance with finer temporal and spatial resolution should be developed (to supplement existing indices) that is less likely to be influenced by temporal/spatial changes in fishing operations or other factors, such as environmental variables. (See the note appended above to Condition 3 for mulloway)

Indicator 1.1.1.4 **There is adequate knowledge of environmental influences on stock dynamics to manage the fishery for the target stock.**

Score

Mulloway	79
Goolwa cockles	70

Yellow-eye mullet 75MullowayCondition 7:

The influence of freshwater outflows and other environmental variables on the abundance and distribution of mulloway should be ascertained, and their implications for management considered.

Goolwa cocklesCondition 8:

The influence of freshwater outflows and other environmental variables on the abundance and distribution of Goolwa cockles should be explored (either qualitatively or quantitatively), and their implications for management considered.

Yellow-eye mulletCondition 9:

The influence of environmental variables and catch, cpue, growth, etc. of yellow-eye mullet should be explored (either qualitatively or quantitatively).

Indicator 1.1.2.1 All major sources of fishing mortality, including illegal fishing on the target stock, are measured or estimated.

Score

Mulloway	65
Golden perch	65
Goolwa cockles	65
Yellow-eye mullet	65

MullowayCondition 10:

- (1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.
- (2) Research should be undertaken and an estimate of release mortality determined.
- (3) Estimates of annual indigenous and illegal catches, and removals through mortality of discarded fish, need to be developed.
- (4) For each fishing gear and fishing sector, the fishery data (catch and effort) should be collected at a spatial and temporal resolution that is appropriate for subsequent stock assessment.

Golden perchCondition 11:

- (1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.
- (2) Research should be undertaken and an estimate of release mortality determined.

(3) Estimates of annual indigenous and illegal catches, and removals through mortality of discarded fish, need to be developed.

(4) For each fishing gear and fishing sector, the fishery data (catch and effort) should be collected at a spatial and temporal resolution that is appropriate for subsequent stock assessment.

Goolwa cockles

Condition 12:

(1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.

(2) Research should be undertaken and an estimate of release mortality determined.

(3) The spatial and temporal resolution of commercial catch statistics should be improved and changes in the distribution of fishing or of cockles assessed appropriately.

(4) Estimates of annual indigenous and illegal catches, and removals through mortality of released/seived undersized cockles, need to be developed.

Yellow-eye mullet

Condition 13:

(1) Processes should be implemented and data obtained to develop indices or measures of both annual recreational and indigenous fishing activity (catch, effort) that could supplement any future National Recreational Fishing Surveys.

(2) Research should be undertaken and an estimate of release mortality determined.

(3) Estimates of annual indigenous and illegal catches, and removals through mortality of discarded fish, need to be developed.

(4) For each fishing gear and fishing sector, the fishery data (catch and effort) should be collected at a spatial and temporal resolution that is appropriate for subsequent stock assessment.

Indicator 1.1.2.2 **The size and age structure of catches and sex ratio are measured.**

Score

Mulloway **79**

Golden perch **79**

Goolwa cockles **65**

Yellow-eye mullet **60**

Mulloway

Condition 14:

An appropriate monitoring program should be established to collect reliable size composition data from the fishery and to monitor changes in annual age/size composition and sex ratio.

Golden perch

Condition 15:

An appropriate monitoring program should be established to collect reliable size composition data from the fishery and to monitor changes in annual age/size composition and sex ratio.

Goolwa cocklesCondition 16:

An appropriate monitoring program should be established to collect reliable annual size composition data from the fishery and to monitor changes in these data.

Yellow-eye mulletCondition 17:

An appropriate monitoring program should be established to collect reliable annual age/size composition data from the fishery and to monitor changes in age/size composition and sex ratio.

Indicator 1.1.2.3 **Fishing methods and patterns are well understood.**

Score

Mulloway	79
Golden perch	79
Goolwa cockles	79
Yellow-eye mullet	79

MullowayCondition 18:

The spatio/temporal resolution of commercial effort statistics, by gear type, should be improved and changes in the distribution of fishing or of the fish assessed appropriately.

Golden PerchCondition 19:

The spatio/temporal resolution of commercial effort statistics, by gear type, should be improved and changes in the distribution of fishing or of the fish assessed appropriately.

Goolwa cocklesCondition 20:

- (1) The spatial/temporal resolution of commercial effort statistics should be improved and changes in the distribution of fishing or of cockles assessed appropriately.
- (2) The effort reported by commercial fishers should be modified to be in sufficient detail to allow determination of traveling time, and time spent locating, catching, sorting, and sieving.

Yellow-eye MulletCondition 21:

The spatio/temporal resolution of commercial effort statistics, by gear type, should be improved and changes in the distribution of fishing or of the fish assessed appropriately.

Indicator 1.1.3.1 **The rules and procedures for limiting effort or catch are adequately defined and effective.**

Score

Goolwa cockles 79Goolwa CocklesCondition 22:

Provide a considered evaluation as to whether the reference points derived from the 1990/91 to 2000/01 data are appropriately precautionary.

MSC Principle 2

Indicator 2.1.1.2 Information on the trophic relationships and interactions of the target species within the foodweb is adequate to understand the impacts of the fishery.

Score 75Condition 23

- (a) Prepare a technical review and assessment of the likely interactions between the fishery for the 4 assessed species and the likely predators on each species, focusing on spatial and temporal analysis of risks that the fishery may pose to key predators, particularly piscivorous birds, considering the age/size availability of the assessed species.
- (b) Show evidence of support for enhanced levels of high-quality research on predator-prey relationships in the Coorong, and specifically on linkages with the commercially fished species so that main predators can be better understood.

Indicator 2.1.3.1 Information on the nature and extent of the by-catch and incidental mortality of non-target species is adequate to determine the ecosystem risks posed by the fishery.

Score 75Condition 24

The assessment team was not provided with any data or evidence about the type, level or potential impacts of bycatch in the fishery. However, the FRDC project on bycatch (FRDC SA05-29) now underway is noted as an important mechanism for securing a more objective set of data and knowledge on the bycatch. The client is required to provide evidence of the composition and magnitude of the bycatch in the fishery, completion of an assessment of the risks posed by such bycatch, the level of risks assigned, and establishment of monitoring programs for the catch of any key bycatch species determined as a result of the FRDC project.

Indicator 2.1.5.1 Effects of the fishery on the ecosystem, through the removal of target and non-target species and impacts on habitats, are not unacceptable.

Score 75Condition 25

In this Condition, the client needs to provide evidence of a cooperative process that involves the RAMSAR and National Park managers and other stakeholders to assess, and as necessary mitigate, the level of trophic-foodweb risks of the fishery (from bycatch or the removal of

target species) to the ecosystem, habitats and non-target species of the three main fishery areas (freshwater, Coorong lagoons, ocean beach). This might be best achieved through a qualitative risk assessment process conducted cooperatively with the park and fishery management agencies after the FRDC bycatch project has been completed, in a manner consistent with that of the AFMA/CSIRO risk assessment methodology – Level 1 (4 years). Condition 24 will resolve concerns about the impacts of bycatch from the fishery.

Indicator 2.2.2.1 Risks associated with the nature and extent of the by-catch of, or habitat interactions with, protected, endangered, threatened or icon species have been determined.

Score 75

Condition 26

Conditions 23, 24, and 25 all apply.

The FRDC project on bycatch now underway is noted as an important mechanism for securing a more objective set of data and knowledge on the bycatch.

Indicator 2.2.2.2 Risks associated with the trophic dependency of the protected, endangered, threatened or icon species on the target species within the food web have been determined.

Score 79

Condition 27

Conditions 23, 24, and 25 apply here.

Indicator 2.2.2.3 Risks associated with the use of fishing gear and associated fishing operations in habitats of importance to protected, endangered, threatened or icon species have been determined.

Score 75

Condition 28

The assessment has not been provided with evidence that the physical impacts of the gear and operations of the fishery have been studied in habitats of importance to protected, endangered, threatened or icon species. The client is required to develop a process (such as risk assessment), in collaboration with the relevant agencies and ecological experts, to identify specific habitats that may be at risk of physical impacts (disturbance) from the fishery or its operations, then, if any moderate or higher level risks are identified, establish any relevant further investigations or mitigation procedures, practices etc that may be agreed between relevant agencies, experts and the fishery. The client should then provide appropriate evidence that the level of the impact has been suitably identified, and that investigations or mitigations of this impact are underway.

Principle 3

Indicator 3.4.1 The management system has measures and strategies that restrict gear and practices to avoid by-catch, minimize mortality of by-catch, and reduce discards [Relates to MSC Criterion 3.12, 3.17].

Score 75

Condition 29

Improve the understanding of by-catch and any impacts on non-target species (Conditions 23, 24, and 25 apply), and once this understanding is improved, introduce specific management measures to address any issues.

Indicator 3.4.2 The management system has measures and strategies that minimize adverse impacts on the habitat [Relates to MSC Criteria 3.10, 3.13].

Score 79

Condition 30:

Condition 25 and 28 apply..

11 MSC LOGO LICENSING RESPONSIBILITIES

As the “applicant” for certification of the Lakes and Coorong fishery , SFA is the only entity that has the right to apply for a license to use the MSC logo. It is also the case that SFA has the right to approve the use of the logo for other fishers in the fishery at its discretion, as long as it abides by MSC directives.

12 CONCLUSION

The SCS Assessment team concluded after all aspects of the MSC procedures were followed, that the Lakes and Coorong fishery for the 4 species specified meets the standards of the MSC. The lead assessor for the assessment team presented all evidence to the SCS Certification Panel, which agreed with the assessment team’s decision and authorized certification of the fishery.

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APPENDIX 1 – COMMERCIAL GEAR RESTRICTIONS

Device	Restriction	Dimensions	
<i>Mesh nets (Coorong Area 1)</i>		<i>Small mesh monofilament</i>	<i>Large mesh monofilament</i>
	Max length	50m, with a combined total length of 500m	50m, with a combined total length of 500m.
	Min mesh size	50mm	115mm
	Max mesh size	64mm	150mm
	Maximum drop	33 meshes	2m
	Min break strain	5.5kg	7kg
	Max number	The number endorsed on a licence, subject to: - A maximum of 11 mesh nets (50m) may be joined together and used a single net; and - If a net with a mesh size greater than 150mm is used, only 5 may be used at any one time.	
Mesh nets (Coorong Area 2)		<i>Small mesh monofilament</i>	<i>Large mesh monofilament</i>
	Max length	50m, with a combined total length of 550m	50m, with a combined total length of 550m.
	Min mesh size	50mm	115mm
	Max mesh size	64mm	None
	Maximum drop	50 meshes	2m
	Min break strain	5.5kg	7kg
	Max number	The number endorsed on a licence, subject to: - A maximum of 11 mesh nets (50m) may be joined together and used a single net; and - If a net with a mesh size greater than 150mm is used, only 5 may be used at any one time.	
Mesh nets (Coorong coastal waters)		<i>Small mesh monofilament</i>	<i>Large mesh monofilament</i>
	Max length	50m, with a combined total length of 600m	
	Min mesh size	50mm	115mm
	Max mesh size	64mm	None
	Maximum drop	Max depth of 1m below water surface	2m
	Min break strain	5.5kg	7kg
	Max number	The number endorsed on a licence, subject to: - One mesh net may be used at any one time.	
Mesh nets (Lakes Alexandrina, Albert)	Max length	50m, with a combined total length of 550m	
	Min mesh size	50mm	
	Max mesh size	None	
	Maximum drop	5m	
	Min break strain	None	
	Max number	The number endorsed on a licence (max of 100)	
Swinger nets (Coorong coastal waters)	Max length	100m	
	Min mesh size	120mm	
	Max mesh size	None	
	Min break strain	9kg	
	Max rope length	600m	
	Max number	1	

Size Limits for Commercial Species and Spatial and Temporal Closures

Species	Minimum Legal Length
Mulloway	Within Coorong estuary: 46cm Outside Coorong estuary: 75cm
Goolwa cockle	3.5cm
Yellow eye mullet	21cm
Greenback flounder	25cm (currently for commercial sector only)
Black bream	28cm
Murray cod	50cm (minimum) – 100cm (maximum)
Golden perch	33cm
Australian salmon	21cm
Yabbies	No size limit
Bony bream	No size limit
Congolli	No size limit
Carp	No size limit

Species or Gear	Area	Time Closure Period
Goolwa cockles	Ocean beaches (Area 4)	1 June to 31 October
Murray cod	Lake Alexandrina and Lake Albert (Area 3)	1 September to 31 December
All nets	Area 1 of the Coorong	25 December to 7 January
Small mesh nets (set and haul)	Area 1 of the Coorong	1 November to 31 March
All nets	Within 500m of the Murray Mouth	All year round
All nets	Goolwa channel	Between midnight on Friday and sunset on the following Sunday

APPENDIX 2 – PEER REVIEWS

Peer Review 1

Peer Review of MSC Draft Assessment Report on the Lakes and Coorong Fishery – South Australia

BACKGROUND

The Marine Stewardship Council (MSC) is an independent, global, non-profit organisation whose role is to recognise, via a certification program, well-managed fisheries and to harness consumer preference for seafood products bearing the MSC label of approval.

The Southern Fishermen’s Association (SFA) is currently seeking independent third party accreditation of the Lakes and Coorong Fishery (LCF) under the MSC. They consider that successful accreditation of the fishery combined with independent science, environmental partnerships and active communication of their role as environmental watchdogs will guarantee their future and provide improved opportunities to increase domestic and overseas market demand for species harvested from the fishery.

Scientific Certification Systems, Inc. (SCS) is the MSC Accredited Certification Body that has been employed to prepare the MSC Assessment Report of the Lakes and Coorong Fishery. The assessment process requires two peer reviews of the Draft Assessment Report prepared by SCS. Fishwell Consulting was approached by SCS to conduct a written peer review of the MSC Assessment Report as outlined below.

SCOPE OF REVIEW

The scope of the peer review is to provide comment on:

- a. The overall clarity of the report
- b. Under Sections 1 through 5 and Sections 7 through 12 of the report, only comment if necessary on the adequacy of the background information provided in terms of informing the reader about the fishery, the MSC assessment process, and the evaluation team’s conclusions and recommendations.
- c. Under Section 6 (Assessment Results) of the report, provide technical comments on whether the written text under each performance indicator adequately describes the information reviewed, the assessment team’s conclusions as drawn from the information provided, and whether the score assigned to each ‘performance indicator’ appears logically consistent with the written explanation and the scoring guidelines for each performance indicator.

- d. Under Section 6 (Assessment Results), provide comments as necessary and appropriate on any technical inaccuracies or inadequacies based on the peer reviewer's own knowledge of the fishery.

The report has been assessed in 3 parts sections. Part 1 relates to comments on the report and fishery, Part 2 assesses sections 1 to 5 and 7 to 12, and Part 3 assesses Section 6 of the report. Finally, there are some suggested corrections, typos and minor general issues identified at Appendix 1.

1: GENERAL COMMENTS ON ASSESSMENT REPORT AND FISHERY

The assessment generally appears to address the criteria as identified by the MSC and provides a reasonably sound and understandable assessment of the status of the fishery. There are, however, a number of areas in which the reviewer believes that the assessment could be improved. This is likely to require that a number of additional conditions be included in the assessment and some level of reassessment of the fishery against to the MSC standards.

There are a number of common themes identifiable in the assessment that if addressed through specific conditions would improve the fishery's performance so that it can better address the MSC principles and criteria and thereby strengthen the environmental performance of the fishery. These general areas are identified below and specific comments are provided in Parts 2 and 3.

Data collection and assessments.

The fishery is relatively data poor with little local baseline biological information on a number of the key species (eg growth, size at maturity, distribution, movement especially in respect to gender differentiation). The scope of the management units and stock structure is also generally unknown or limited. It is important to improve the quality of this information if the fishery is to be properly managed and assessed as to its sustainability. How this will be addressed should be clearly outlined in the assessment.

In data poor situations, it is often difficult to determine the effectiveness and appropriateness of the reference or trigger points with respect to sustainability and demonstrably precautionary controls need to be applied. As an example, the current size limit controls in the fishery appear inconsistent with some biological characteristics of the species and should be re-evaluated as to their precautionary nature.

A range of biological and improved spatial and temporal data and impacts from other fisheries and sectors are required to assess the effects of fishing on the ecosystem and resource.

An important assumption made throughout the assessment is that by considering that the fishery is self-recruiting, it is being managed in a precautionary manner. Whilst this may be the case, the potential impacts from other fisheries and sectors should be more explicitly

factored into the assessment despite the lack of data. Also, given that the fishery operates in one of the only major estuarine systems in the region, the hypothesis that fishery encompasses the only spawning population in the region should be considered. The lack of sound data and assessments to support this fundamental management assumption, and issues that flow from this, need to be looked at as a priority.

Effective controls on catch and effort in the fishery.

The reviewer agrees that the capacity for fishers to diversify between gears and species in this fishery can be considered as an advantage for sustainability, allowing the fishery to be flexible with natural seasonal and long-term variations in stock abundance. The flip-side of this flexibility is that, at any one time, there may be considerable levels of latent effort in the fishery for any one gear type. The assessment does not adequately consider the potential impact on stocks should this latent effort be realised by all fishers moving towards particular gear type or targeting a particular species or area. While this may not be considered likely, prices and potential markets have a strong influence on fisher behaviour and controls need to be in place to ensure any wholesale change in the fishery is sustainable. A truly precautionary approach in a data-poor fishery would need to consider the consequences, if due to strong economic incentives (eg export driven market for cockles doubles the price) or poor environmental conditions (eg ongoing low flow rates lead to failed recruitment of a species), additional effort was targeted at one species or area of the fishery.

What immediate measures are there to stop or control activity should, say, 37 licensees target the cockle or mulloway fisheries? The fishery needs to clearly identify some fundamental triggers and management actions to ensure sustainability and prevent wholesale changes in the fishery that could severely impact any one particular species or area.

Improvements in the efficiency or design of fishing gear also need to be considered in a largely input-controlled fishery. The assessment needs to better explain how gear is used by the industry, how it is controlled, and the potential for effort creep, and examine how these should be managed.

Effort can also increase as fishers are allowed to have other people use their licence if they have another LCF licence or a licence in another fishery, thereby increasing potential effort. The impacts of the 371 Marine Scale licensees, 68 Northern and 181 Southern Rock Lobster licensees, who are also entitled to take species that are part of the fishery, are not implicitly addressed in the report, although it is noted that their impacts are factored into any assessments. .

Other issues

The significant impacts of river flow (natural and man made) appear to be the factor that will have the greatest impact on the fishery, the fish, other species and the habitat that this fishery operates in. It is not really clear what strategies are in place to collect adequate data to deal with this ongoing issue as the triggers are generally based on responses to fishing activity, not pre-emptively based on water management issues.

It is difficult to assess the fishery impacts on bycatch until the FRDC bycatch report is completed and it is unclear when that will occur.

There is a lack of indigenous involvement in the fishery processes, such as the IFMC. This should be addressed.

The Department of Environment and Heritage (DEH) undertook an assessment of the fishery under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2005 and identified a number of risks to the fishery's sustainability. The reviewer considers that a number of these risks still remain outstanding and should be addressed in the MSC assessment:

- Unvalidated fishery dependent data is not reported at a fine enough temporal and spatial scale.
- Lack of assessment of recreational, indigenous and illegal catch
- Size limit controls inconsistent with many biological characteristics
- Limited stock assessment processes
- Limited direct control on effort across sectors
- Absence of evaluation of ecological impacts.

2: REVIEW OF SECTIONS 1 TO 5 AND 7 TO 12.

If the section is silent in the following table, the reviewer considered that the section has adequately met the information required to understand the fishery, the MSC process and that the evaluation team's conclusions and recommendations were satisfactory.

Section	Page	Para*	Comments
1.1	4	1	<ul style="list-style-type: none"> • Acronyms should be expanded.
2.1	5 6	2 Fig 1	<ul style="list-style-type: none"> • The description of the area on page 5 should be clearly identified on Figure 1. • The map on page 6 and text on page 5 do not clearly identify the area under consideration.
2.2	9	5	<ul style="list-style-type: none"> • Requires clarification on which Act is being reviewed.
2.3	10	4 Fig 2	<ul style="list-style-type: none"> • Reference to harvest data for mulloway 'below' is not provided. Figure 2 provides value but not harvest.
2.3	10	5	<ul style="list-style-type: none"> • The demise of the yabbie fishery requires additional discussion to at least hypothesise as to the reasons for the complete disappearance of a fishery from the region.
2.3	10	6	<ul style="list-style-type: none"> • This paragraph implies that the major environmental driver is natural environmental conditions; whereas the impacts of man controlled water management would appear to be significantly greater.

2.3	11		<ul style="list-style-type: none"> • Figure 2 has ‘callop’ identified in the legend but not in the previous text. • A table would assist as this figure is cluttered
2.3.1.1	13	1 Fig 3	<ul style="list-style-type: none"> • Although the size of the harvest at 88/89 and 01/02 are comparable, there has been significant variations in total harvest and by species within the period shown in Figure 3. • This would benefit from some discussion.
2.3.1.2	14	2	<ul style="list-style-type: none"> • There needs to be some explanation of the correlation between increased cockle and decreased carp harvest. • This is identified as a major issue by the reviewer due to the potential to switch species.
2.4.1	17	1	<ul style="list-style-type: none"> • Need to clarify Director of what organisation (Fisheries)
2.4.1	16 17	Fig 6 2	<ul style="list-style-type: none"> • The text on page 17 states that SFA is the body recognised to liaise with in regards to the fishery, but Fig 6 does not show any direct link
2.4.2	18	Table 2	<ul style="list-style-type: none"> • Some gear type numbers have ‘1 per license’ and others ‘1’, this needs to be clarified. The reader needs to be able to understand the fishing gear to have an informed understanding of its potential impacts. • See reference below to Appendix C and D.
2.4.2	18	1	<ul style="list-style-type: none"> • There are references to Appendix C and D but no Appendices at all with the document. See comments above.
2.4.3	19	1	<ul style="list-style-type: none"> • The document would benefit by having a description of the recreational gear and bag limits similar to Table 2.
2.5	19	Table 3	<ul style="list-style-type: none"> • Information is missing identifying further information relating to Total direct, Total flow on and Total. • This section could further explain and expand on the basis for these estimates.
3.0	21	4	<ul style="list-style-type: none"> • Further information on monitoring the identification of fishery origin would enhance this section.
5.2	27	Table 4	<ul style="list-style-type: none"> • This table would benefit from reformatting as it is unclear who was interviewed from some organisations (people or groups). • SFA, the key industry group for this fishery was not identified as having been interviewed (although SAFIC, their parent body was). This needs clarifying.
9	105	4	<ul style="list-style-type: none"> • The recommendation may need to be reassessed on resolution of any issues identified in this review.

* para refers to the number of paragraphs from the top of the page.

3: SPECIFIC COMMENTS IN RELATION TO A REVIEW OF SECTION 6

If the section is silent in the following table, the reviewer believes that the report requires no technical comment as it adequately describes the information reviewed, the assessments and score appear logical with regard to the written explanation and scoring guidelines.

Page	Indicator	Para*	Comments
32	1.1.1.1	4	<ul style="list-style-type: none"> • The report states that it is unclear whether the management unit for mullocky is appropriate. As such the score of 80 must be questioned. • No program has been identified to rectify this question in this section, and the identity of the target stock is unknown. • A condition to address this would be beneficial.
33	1.1.1.1	4	<ul style="list-style-type: none"> • The assessment of 90 for golden perch seems high when the appropriateness of the management unit has been identified as requiring further assessment. • A condition to address this would be beneficial.
33	1.1.1.1	5	<ul style="list-style-type: none"> • The score of 85 for Goolwa cockles appears high as there has been no genetic information collected on the cockles in the fishery, so the identity of the target stock is unknown. • A condition to address this would be beneficial.
34	1.1.1.1	4	<ul style="list-style-type: none"> • The score of 85 for yellow eye mullet appears high as there is uncertainty regarding the population substructure, which would mean that the current arrangements of managing as a single stock are not precautionary. • A condition to address this would be beneficial.
36	1.1.1.2	2	<ul style="list-style-type: none"> • Due to the paucity of local information on Mulloway provided in this section, the condition should include the collection and analysis of growth and size at maturity, especially in respect to gender differentiation.

37	1.1.12	2	<ul style="list-style-type: none"> • The high level of uncertainty in the growth of golden perch in a spatial and temporal context may provide difficulties in determining sizes at sexual maturity. • How this will be addressed in assessments should be discussed.
37	1.1.1.2	4	<ul style="list-style-type: none"> • The patchy spatial and temporal distribution of cockles (in respect to fishing activity), in conjunction with the significant catch increase, means that additional information on the life history of this species is extremely important and may not currently be adequate.
38	1.1.1.2	4	<ul style="list-style-type: none"> • There is little information available to undertake a reliable assessment of yellow eye mullet.
40	1.1.1.3	5	<ul style="list-style-type: none"> • Condition 2 for Mulloway would be enhanced if temporal and spatial fishery information was finer.
41	1.1.1.3	3	<ul style="list-style-type: none"> • Condition 3 for golden perch would be enhanced if temporal and spatial fishery information was finer.
41	1.1.1.3	4	<ul style="list-style-type: none"> • The impacts of hyperstability of CPUE and significant environmental influences on recruitment of cockles should be recognised and discussed. • Condition 4 for cockles would be enhanced if temporal and spatial information was finer.
42	1.1.1.3	5	<ul style="list-style-type: none"> • Condition 5 for yellow eye mullet would be enhanced if temporal and spatial fishery information was finer.
46	1.1.1.4	2	<ul style="list-style-type: none"> • There is no reference to the indigenous take, other commercial fisheries that take mullocky, or illegal activity with respect to dealing with this indicator.

			<ul style="list-style-type: none"> • This section would benefit from some discussion and condition 9 with some action on these matters.
47	1.1.1.4	1, 2	<ul style="list-style-type: none"> • There is no reference to the indigenous take or other commercial fisheries that take golden perch in dealing with this indicator. Illegal activity is identified but not quantified. • This section would benefit from some discussion and condition 10 with some action on these matters.
47	1.1.1.4	4	<ul style="list-style-type: none"> • There is no reference to the indigenous take, other commercial fisheries that take Goolwa cockles, or illegal activity with respect to dealing with this indicator. • This section would benefit from some discussion and condition 11 with some action on these matters.
48	1.1.1.4	1	<ul style="list-style-type: none"> • There is no reference to the indigenous take, other commercial fisheries that take yellow eye mullet, or illegal activity with respect to dealing with this indicator. • This section would benefit from some discussion and condition 12 with some action on these matters.
50	1.1.2.2	3	<ul style="list-style-type: none"> • Clarify for yellow eye mullet how the length range was 21 – 28 cm but the modal length was 28 cm. • What are the implications for population structure?
50-52	1.1.2.3	2, 3, 6	<ul style="list-style-type: none"> • Mulloway, golden perch and yellow eye mullet would benefit from having conditions relating to temporal and spatial reporting similar to those for Goolwa cockles (ie condition 17).
52	SC 1.1.3	2	<ul style="list-style-type: none"> • There needs to be cognisance of the potential issues related with the impacts (catch and effort) of switching between species by

			<p>fishers based on abundance or economic parameters.</p> <ul style="list-style-type: none"> • What considerations have been made for the provisions that permit licensees to allow other fishers to use parts of their licence if the licensee has other licences.
53	1.1.3.1	2	<ul style="list-style-type: none"> • The assumption that allowing operators to switch between species, gear etc is a positive in regards to sustainable use needs to be considered in light that it can also be a negative if the economic return of fishing one species outweighs the return of another species that may be more abundant. For example if the price of cockles make it more economically efficient to catch a lower volume than catching a larger volume of a low value species like carp, fishers may fish down a stock to very low levels and cause severe depletions.
		3	<ul style="list-style-type: none"> • The catch limits in the non Lakes and Cooroy Fisheries (LCF) allow relatively large volumes of Mulloway to be caught without the same level of scrutiny as the LCF. How will this be addressed?
		4	<ul style="list-style-type: none"> • The effectiveness or the appropriateness of the reference points to restrict effort are unclear.
55	1.1.3.1	2	<ul style="list-style-type: none"> • Although this does comply with the guidelines for a score of at least 80, the fact that it is impossible to assess the appropriateness of the current level of exploitation of mulloway makes it impossible to tell if the regime is effective.
56	1.1.3.1	2	<ul style="list-style-type: none"> • With the limitation of fishing of golden perch from the ‘Rivers’ the reference points may become invalid and perhaps other options should be considered. • The impact of river flow appears to be a key for this species and perhaps a reference point reflecting that would be appropriate.
57	1.1.3.1	2	<ul style="list-style-type: none"> • As the report indicates, there is a lack of certainty as to the precautionary nature of the catch limits for cockles. • This species may be better rated at a lower level with a condition to provide information as to how and why these limits have been used and why they are precautionary.
60	1.2.1	1	<ul style="list-style-type: none"> • The use of the existing CPUE data for mulloway is a very coarse

			measure, and improved spatial and temporal data as identified previously would improve the index.
60	1.2.1	3	<ul style="list-style-type: none"> • The use of fishery dependant data to calculate CPUE for cockles may be misleading for this species as distribution is patchy and fishers harvest aggregations. • A fishery independent method may provide a better index.
60	2.1.2.1	4	<ul style="list-style-type: none"> • As previously mentioned there is a need for greater spatial and temporal recording of catch and effort data targeted on yellow eye mullet.
68	2.1.2.2	6	<ul style="list-style-type: none"> • It would be beneficial if a study was undertaken as to the potential impacts on the habitat of the various gear types. • This could be addressed by a specific condition.
70	2.1.4.1	6	<ul style="list-style-type: none"> • Although there have been no identified negative impacts, until the FRDC bycatch research project is completed it is difficult to asses the impacts and actions. • I believe that it should be condition 22 not 2.2.
73	2.2.1.2	6	<ul style="list-style-type: none"> • I believe that it should be condition 23 not 2.3.
75	2.2.2.2	4	<ul style="list-style-type: none"> • The reference should be to all PET species not just the main ones. • I believe that it should be condition 22 and 23 not 2.2 and 2.3.
77	2.2.3.1	4	<ul style="list-style-type: none"> • Although impacts are probably minimal the score seems high considering that the impacts on PET species have not been assessed yet under condition 23. • I believe that it should be condition 22 not 2.2
78	2.2.4.1	3	<ul style="list-style-type: none"> • Although impacts are probably minimal the score seems high considering that the impacts on PET species have not been assessed yet under condition 23.
		5	<ul style="list-style-type: none"> • It is unclear what 'acceptable levels' are.
80	3.3.1	3	<ul style="list-style-type: none"> • Clarification as to whether it is 35 or 37 licensed fishers.
81	3.1.1	3	<ul style="list-style-type: none"> • I believe the references to 'fishery dependant' should be 'fishery independent' at lines 6 and 8.
81	3.1.1	4	<ul style="list-style-type: none"> • Reference should be made to multi gear as well as multi species.
82	3.1.1	2	<ul style="list-style-type: none"> • It is unclear how there are connectivity and inter relationships between the policy drivers and the Plan.
83	3.1.2	5	<ul style="list-style-type: none"> • This section could be improved by describing what system is in place to deal with the 'voluntary environmental monitoring form' and how this data or reports of interaction are incorporated into the management system.
84	3.1.3	4	<ul style="list-style-type: none"> • It should be noted that the direct and indirect employment relates to the commercial sector only. • It is unclear how a ratio of 4 was determined from the data. • The data on jobs differs slightly from the figures in Table 3
86	3.1.4	4	<ul style="list-style-type: none"> • The score appears high when it is considered that there are acknowledged shortfalls in resources to undertake critical

			research to support the management strategies in place.
87	3.1.5		<ul style="list-style-type: none"> The score appears high when it is considered that there are acknowledged shortfalls in resources to undertake the critical research to support the understanding of ecological impacts.
90	3.2.2	5	<ul style="list-style-type: none"> DEH identified the illegal take of cockles as a high risk. To achieve such a high score this section should clearly articulate whether there are repeat offenders or not in the fishery.
91	3.3.1	7	<ul style="list-style-type: none"> As the IFMC does not have indigenous representatives it is unclear how formal consultation takes place with this stakeholder group. This needs to be addressed or the score should be reduced.
93	3.3.3	4	<ul style="list-style-type: none"> There is a reference to a 2006 recreational survey. This needs to be discussed in the report, or removed if the survey has not been undertaken.
96	3.4.2	2	<ul style="list-style-type: none"> The IFMC does not have indigenous representatives so this paragraph needs to be amended.
99	3.4.4	3	<ul style="list-style-type: none"> As identified in the assessment, an improvement to the management system would be the development of action plans for all key species that are likely to be triggered under the current reference points and triggers. These would need to be improved as more fishery independent data becomes available.
100	3.4.5	2	<ul style="list-style-type: none"> There needs to be clarity as to how conservation organisations are consulted on the need for and implementation of no-take zones.

* para refers to the number of paragraphs from the top of the page

Peer Review 2

General

The Marine Stewardship Council (MSC) presents a comprehensive framework against which sustainability of fisheries (including their component stocks) can be assessed under principals of Ecological Sustainable Development (ESD). Thus the assessment process recognises that community resources can be utilised for social and economic benefit whilst maintaining ecological processes on which life depends. Yardsticks of performance (guideposts) against the various ESD indicators are presented in the draft assessment report. The following is a peer review of the MSC Assessment Report: The Lakes and Coorong Fisheries Southern Australia (6th December 2006).

I found the draft report to be clearly presented with a detailed description of the assessment process, a comprehensive synopsis of the fishery, its history, management, and information on the main component fish stocks. The performance indicators (and guideposts) are well described and cover elements of the fishery, the habitat and ecosystem on which the fishery depends, and management effectiveness (including social and economic performance). The performance indicators are scored on the basis of available information and on the considered opinion of the assessment team. Justifications for the scoring of performance indicators are presented. My assessment of the draft report is directed at the assessment results of the report (Section 6).

The Lakes and Coorong Fishery is a multi-species, multi-gear fishery embracing a diversity of habitats (including coastal, estuarine, lacustrine, and riverine). The habitat and ecosystems (particularly the estuary and lagoons of the Coorong) have been profoundly altered through anthropogenic changes most notably to river flows. Similarly, the introduction of at least one exotic species, the European Carp, has presumably had a substantial impact on the ecology of the freshwater ecosystems embracing the fishery.

The draft assessment report relates mainly to four species (among many others) taken in the fishery. It was not clear why other species, particularly flounder and black bream were not included in the assessment. A justification for the choice of the four “main” species should be presented in the final assessment report.

An additional complexity (in assessing fishery impacts) is the participation of several extractive users: commercial, recreational, and indigenous. Unlike many other commercial fisheries, the recreational component is significant with at least one species (mulloway) yielding more to recreational fishers than to commercial fishers (as measured by estimated annual catches). This is problematic as estimates of recreational fisheries catches are typically infrequent, rarely precise and seldom accurate.

The commercial fishers and the managers of the Lakes and Coorong fishery should be commended on taking a proactive approach to ecosystem-based management of their fishery. I note that there is a voluntary code of conduct aimed at conducting their fishery in an ecological sustainable manner. I note also the pioneering efforts undertaken by the commercial fishers in developing an environmental management system (EMS) for the Lakes and Coorong. These efforts, however, are compromised by a general lack of relevant biological information meaning that robust assessments of the component stocks have not been undertaken. Furthermore, there is a general lack of information on ecological impacts of the fishery such as by-catch, discard mortality, and trophic interactions caused by extractions of the various fish species.

Despite a requirement of the management plan, there appears to have been no coordinated approach in getting even basic information on the fishery and its component stocks (the four “main” species). Simple non-costly catch sampling, whereby samples of the catch could be taken for size composition data yielding a time series for evaluation against catch and effort statistics, has evidently not been undertaken. Fundamental life history information on the four main species (and presumably the other species taken in the fishery) is lacking. Growth, mortality, recruitment, reproduction (e.g. fecundity at age, size at maturity) are all lacking, based on scant data, or derived from unrepresentative or dated studies. This lack of basic information erodes the credibility of the assessment and presents as an obvious need given the profound changes occurring in the component ecosystems (in particular salinity). This is acknowledged by the managers: *The Lakes and Coorong fishery can be currently classified as a data poor fishery (Sloan 2005:93)* with limited quantitative knowledge available to decision makers.

More specifically, the following present as fundamental flaws in the assessment process:

- no formal stock assessments have been conducted on the four main species other than a superficial examination of catch rates;
- There are virtually no fishery-independent assessments with most of the available information unpublished (e.g. an ongoing PhD study) or in internal reports. The lack of peer-reviewed information on the fishery weakens the defensible basis for presenting it as ecological sustainable;
- Un-validated fishery-dependent data (catch rates) are demonstrably inadequate (e.g. for cockles because catch rates (CPUE) can be maintained for declining stocks by serial depletion). Effort data are fisher days and effort can therefore vary considerably according to daily fishing intensity. Harvesting switches to target different species at different times of the year and away from species that have experienced a decline in abundance. Thus CPUE data may be unreliable for species that are caught incidentally i.e. not targeted;
- There are admittedly poor data on by-catch. Birds (e.g. cormorants), reptiles (e.g. freshwater turtles), crustaceans (e.g. Murray crayfish) and native fin fish (e.g. Murray Cod) can all be caught in the fishery;
- Recreational harvests are significant but unquantified (at least reliably). There are nearly 2000 mesh nets authorised for use by recreational fishers. Why? Mesh nets will increase the by-catch problem and potentially threaten the ecological viability of the fishery.

Note that in most cases, I found that the scored performance indicators demonstrably do not align to (i.e. scored less than) the scoring guidepost guidelines.

Specific comments on the performance indicators

Suggested scores are provided against each performance indicator (against the score provided in the draft assessment) (draft assessment score/my score).

1.1. Knowledge of target stock

1.1.1.1 There is adequate knowledge of the identity of each target stock

Mulloway

Score 80/60

Catches by each fishing sector, particularly recreational cannot be reliably attributed to the specific management unit. It is unclear from the data presented where Mulloway are taken. The commercial fishery operates both within the lagoon and off the ocean beach. The mixing elements applicable to the stock would be different in each case. There is some evidence to suggest aggregations (not spawning) near the Murray mouth spring/summer time. Mulloway are vulnerable to recreational and commercial fishers. How much traditional fishing occurs? Much of the information applicable to the stock status comes from non-peer reviewed reports e.g. Ferguson and Ward (2003).

Golden Perch (callop)

Score 90/80

What is the impact of barrages on the distribution of this species. No recreational catch recorded from the Lakes and Coorong. What about traditional harvests?

Goolwa cockles

Score 85/70

Widely distributed shellfish. Harvested off ocean beaches by commercial and recreational fishers. Catch data from recreational sector are unreliable.

Yellow-eye mullet

Score 85/60

Grey literature cited for information of stock status (Higham et al. 2005). Caught by both recreational and commercial fishers. Recreation catches cannot be specifically attributed given that records accord to the "south eastern region".

1.1.1.2. There is knowledge of the life history and biology of the species.

Mulloway

Score 75/60.

There are serious gaps in information in the life history. Life history information based largely on South African studies. Life histories are likely to be influenced by particular habitat-related factors e.g. freshwater and food availability from Murray River. Temperature and salinity variation within Lakes and Coorong occurs seasonally and interannually. There is competition with other fish particularly exotic species within Lakes and Coorong. Qualified comment such as "The life history *appears* similar to that described for South Africa". Not good enough to sustain a score of 75.

Ferguson and Ward (2003) report that juveniles remain in the Coorong for 2–5 years but SFA suggest that this might not be the case. This erodes confidence in this unpublished report. Periodic closures of the river mouth will profoundly influence life history of Mulloway.

There are limited data on growth and size at maturity. *It is noted that the current PhD study will resolve a number of deficiencies currently present in the biological data.* The current PhD study commenced in 2001. Peer-reviewed publications arising from this study would provide more confidence in the use of the results in the assessment of Mulloway stocks.

Note that this also addresses the stock structure issue above.

Golden perch

Score 90/80

There is uncertainty in the data re reproductive biology e.g. size at maturity. This uncertainty will impact on the efficacy of size limits for the species. Limited (but validated growth data are available. What about mortality?

Goolwa cockles

Score 80/60

Information derived from internal reports (one from 1976 King). Admittedly, “*The biology and ecology of Donax deltoides in South Australia has been little studied*”. Even so, the environmental conditions along an exposed sandy beach are likely to be less variable than those within the lakes. Aggregations are variable and can influence spatial depletion. I cannot see how this lack of information can support a “clear understanding of the life history of the species” (see also below).

Yellow-eye mullet

Score 85/60

Length at age and size at maturity information comes from an old (1968) unvalidated study cited in a non-peer reviewed report. *Higham et al (2005) highlight the need for basic biological information on patterns of age, growth, and reproduction to allow reliable assessments of the adequacy of the current minimum legal size and other management arrangements and to allow an assessment of the sustainability of current levels of exploitation.*

1.1.1.3. There is information to measure trends in abundance of stocks.

Mulloway

Score 75/60

There are limited data on recreational extractions available other than the National survey which provide estimates of mulloway caught in South Australia.

Abundance indices are derived from commercial fishery statistics. Effort is recorded as the number of fisher days (differences between nets and frequency of netting per day?).

“*The impact of freshwater flows on the relationship between abundance and the cpue recorded within the lagoons through, for example, changes in salinity, turbidity, food availability and distribution of mulloway is poorly understood*”. Note that these factors are also likely to influence life history characteristics (see above).

Golden Perch

Score 75/60

Fisher days and net days used as measure of effort but cpue influenced by number of sets, month of year among other factors. Use of unvalidated fishery dependent data erodes confidence in the use of CPUE as an index of abundance.

Goolwa cockles

Score 75/60

Index of abundance is harvest per fisher day. Measure of abundance excludes catches of undersized animals that are returned to the ocean. How can estimates of recruitment be made? There is also a problem of serial depletion i.e. catch rates are maintained by accessing different aggregations. Monthly catch and effort data are reported daily by commercial fishers (but on what spatial scale?).

Yellow eye mullet

Score 75/60

Net fishers are underrepresented in the National rec fishing survey but there are spatially imprecise data for Coorong.

Indices of abundance are catch per fisher day or catch per net day. The potential for increased efficiency (in effort) has not been quantified. There is uncertainty with small mesh gill net effort and changes in fishing patterns.

1.1.1.4 There is adequate knowledge of environmental influences on stock dynamics to manage the fishery for the target stock.

Mulloway

Score 79/55

Admittedly: *The impact of freshwater flows on the relationship between abundance and the cpue recorded within the lagoons through, for example, changes in salinity, turbidity, food availability and distribution of mulloway is poorly understood.*

This does not inspire confidence that “ a conceptual understanding of the relationships between the fish abundance and both habitat and environment has been developed.

Golden Perch

Score 80/60

Most relevant information is applicable to the river fishery not the Coorong. Flow rates will influence catchability. *Flow rates may influence recruitment* but this correlation is only presented in an unpublished report. Ye (2004) only looked at drum nets not gill nets which are the main method used in the Coorong. What about gill nets? Barely a score of 60 warranted given the guidelines.

Goolwa cockles

Score 75/55

Freshwater impacts on cockles may be both positive (nutrients/food) and negative (mortalities) but no empirical studies have been published. Not much empirical information on the relationship between river output and cockle abundance. Mostly speculative arguments presented in an unpublished report (Murray-Jones and Johnson 2003).

Yellow eye mullet

Score 79/60

Most mullet in South Australia are taken from the Coorong. Closure of the mouth will affect movement between the estuary and the lagoons. Salinity will affect distribution, growth and survival of the species. The influence of environmental variables on life history of mullet has not investigated.

1.1.2 Knowledge about the fishery for each target stock.

1.1.2.1. All major sources of fishing mortality, including illegal fishing on the target stock, are measured or estimated. (this should be... “or reliably estimated”).

Mulloway

Score 65/50

Commercial catches are entered daily and reported monthly by fishers and are considered to be accurate records of true catches. How is these data validated? Has there been any independent observer coverage?

The recreational catch of mulloway is significant (maybe 90 tonnes between May and April for marine component – and note that this is outside peak season). Note also that this estimated catch is about 70–80% of the commercial catch (see Figure 3 in the draft assessment). Additional recreational catch comes from the Coorong lagoons, but this is admittedly unreliable. Some mulloway (unknown number) are released but mortality unknown. What about traditional harvest? Given that catches from a significant sector are effectively unknown, the guidepost score of 60 cannot be supported.

Golden Perch

Score 65/55

Quantity and fate of undersized fish caught by commercial fishers is not known, or at least recorded (by Ye 2004). No estimates of illegal catch are available. What about traditional harvest?

Goolwa cockles

Score 65/55

Commercial catches submit details of monthly catches and the data are “considered” to be reliable. What about the spatial resolution of the data? It is difficult to assess changes in the distribution of the species i.e. the aggregation structure in relation to fishing (serial depletion). The only catch estimate for the recreational fishery is from the recent National survey (Henry and Lyle 2003) but this is before cockles became popular as a food source (rather than bait). What about traditional harvest?

Yellow eye mullet

Score 65/55

Commercial catches are reported monthly and are “considered” to be accurate records. Quantity and fate of discards (undersized fish) are not reported. Recreational harvest from Lakes and Coorong (from National rec fish survey) estimated to be 9 tonnes compared with 145 tonnes commercial. But this is probably an underestimate because of lack of representation of rec gill netters. No information is available on release mortality. Not good enough.

1.1.2.2.

Size and age structure of catches and sex ratios are measured.

Mulloway

Score 79/60

Size composition of commercial gill net catches, catches taken by research gill nets in the lagoons, and from swinger net catches are available but in a non-peer reviewed internal report (Ferguson and Ward 2003). There is a point estimate of sex ratio but only for the swinger net fishery (less than 10% of the catch). There are no data that can be used to assess temporal trends in size composition in relation to fishing effort, location of fishing among other factors. Simple, non-costly commercial catch sampling would have yielded useful information. Why hasn't this been done in this fishery? Age composition studies ae

apparently in progress (incomplete PhD study). “Preliminary” estimates of selectivity of large mesh gill nets used in the Lagoon and the swinger nets used in the ocean. Additional monitoring of the age/size structure is required for the fishery.

Golden Perch

Score 79/65

A method for ageing golden perch has been validated from fish taken from commercial catch samples in 2002. However, there are no data on the size or age composition of the catches taken by recreational or illegal fishers. Size composition data of the commercial catch is available but variability in growth makes these data less informative than age data. No data on mesh selectivity of the gill nets used to capture golden perch. What about sex ratios? What about a time series of size composition data?

Goolwa cockles

Score 65/50

Length composition data are available (1973/74!) and samples taken from Goolwa Beach between 1992 and 1998. Similar data not available for the ocean beach where most of the extractions occur. Sex ratios? Age composition? Nowhere near the guidelines. Given the importance of this fishery, the lack of applicable information relevant to management is reprehensible.

Yellow eye mullet

Score 60/50

Length data reported from early 1980s (reported in Higham et al. 2005). Mesh selectivity determined by Thomson (1957)! (at last a peer-reviewed study). No information on the size and age composition of discarded fish reported. What about age composition of commercial catch? Sex ratio? Catch sampling? As above.

1.1.2.3 Fishing methods and patterns are well understood. Implies commercial fishing only.

Mulloway

Score 80/55

Effort by commercial fishers is available by location and effort (days fished) and by gear type. However, recreational fishing catch and effort data are limited (and this is a major extraction). There is an admittedly coarse measure of commercial fishing effort (fisher day). Estimates on the fishing effort expended by a significant fishing sector (recreationals) are not available. Thus reliable estimates on fishing effort for at least one significant fishing sector (recreationals) are not available. This cannot sustain 60 let alone a score of 80.

Golden Perch

Score 80/fair enough

It is possible that efficiency of effort may increase with increased usage of nets (but this was not measured). Effort measure is coarse (fisher or net days). Difficult to see what impact closure of River Murray (to native fisheries) will have on Lakes fishery. CPUE data for Golden Perch probably OK because no recreational fishery reported for the Lakes.

Goolwa cockles

Score 79/50

Effort data by commercial fishers are reported but major harvests by recreational fishers. Needs better spatial resolution for commercial data and information on extractions by recreationalists to justify a score of 60.

Yellow eye mullet

Score 80/60

Estimates of fishing catch and effort by gear type for commercial fishers are available. There is an unresolved issue of changes in effective effort brought about by changes in fishing operations. There is poor data availability on recreational fishing catch and effort particularly gill netters.

1.1.3 There is a well-defined and effective strategy for managing exploitation of each target stock.

Input controls mostly except for size limits (but limited information on size at maturity for most target species). Effective effort change is an unresolved issue.

1.1.3.1 The rules and procedures for limiting effort or catch are adequately defined and effective.

Upper and lower limits for CPUE derived from historical data rather than formal stock assessments. An issue is that effort is coarsely measured and effective effort can change substantially through changes in fishing operations e.g. netting density. Throughout the fishery is managed on unvalidated fishery dependent data as virtually the sole measure of stock status. Does this constitute “an acceptable range of catches and abundance indices” relative to (unknown) sustainable yields for the fisheries involved?

Mulloway

Score 85/60

Size limit of 460 mm TL within the Coorong maybe too small. There is insufficient information on size at maturity to make an effective judgement about the efficacy of size limits. Procedures to monitor the fishery appear coarse and imprecise. What about the recreational fishing effort?

Biological reference points use data provided by fishers. There is an obvious conflict here given that the implications of reporting accurate catch rates (if they exceed or go below historical catch rates).

Golden Perch

Score 85/60

As above but recreational catches not as big an issue. There is doubtless interannual recruitment variability due to river flows but how are pre-recruits (and therefore future recruitment patterns) monitored? There are five to six pre-recruit year classes.

Goolwa cockles

Score 85/60

As above particularly given increasing commercial catch and unconstrained recreational catch. CPUE can be maintained through serial depletion of stocks. Harvest rules relating to catch rate are inappropriate for this fishery. There needs to be some fishery independent surveys (size composition and relative abundance). What are the empirically defined upper or lower reference values (derived from catches recorded in the reference period)? This deficiency is acknowledged by MSC.

Yellow eye mullet

Score 85/60

As above. Problem with historical CPUE data with small mesh gill nets.

1.1.3.2 The harvest strategy is precautionary.

60.

There is an implemented harvest strategy that includes at least one control point that triggers a required management response. An easy hurdle to jump but what about effectiveness?

80.

The harvest strategy includes multiple and diverse control points, all of which trigger specified management responses. If any control point is triggered, the management response requires that data are collected and analysed to assess whether the fishery and stock responds in accordance with expectation. The control points all appear related to historical catch rates which are unreliable for a number of reasons stated above. There are no indicators relating to recruitment e.g. abundance of pre-recruits, size distribution etc. How do we know that the management strategy is precautionary?

Mulloway

Score 80/80

Golden Perch

Score 80/80

Cockles

Score 80/80

Yellow eye mullet

Score 80/80

Difficult to justify this even though technically correct as noted above.

1.2. Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity.

1.2.1 To maintain the reproductive capacity of the target species, the level of spawning biomass of the stock is assessed to ensure that it remains above threshold levels.

No explicit assessment of trends in spawning biomass has been undertaken for any of the species. But MSC regards the indices of abundance (catch rates) as a proxy for spawning biomass. This assumes that catch rates are a reliable indicator of biomass. What about

fecundity variation with age? An egg-per-recruit analysis would help in determining the efficacy of size limits. But this requires reliable estimates of growth, length at age, fecundity at age, mortality all of which are lacking for the four assessed species.

Mulloway

Score 85/60

Index is calculated annually from commercial fisheries statistics and compared against historical data. *Provided that cpue is an accurate index of abundance, the mature biomass is likely to be sustained at a level consistent with previous experience.*

Golden Perch

Score 85/60

Older age classes “appear” to dominate the age composition of catches taken within the lakes. These are data taken in 2002 mainly from gill nets. Small samples also taken in 2003.

Goolwa cockles

Score 85/55

CPUE is assumed to represent abundance but serial depletion and mortality of discarded individuals maybe threatening stocks even with stable catch rates.

Yellow eye mullet

Score 85/60

Size limit set at 21 cm (less than size at maturity determined by Harris in 1968!). Higham et al 2005 note that that Harris’s data were not derived using formal size at maturity ogives and recommended that such ogives be constructed to provide more reliable estimates of the size at maturity.

Changes in the environment of the fishery particularly salinity and related water flows are likely to profoundly change the life histories of commercial species particularly those that depend on movement from the ocean into the estuary and freshwater lower lakes for reproduction and recruitment.