



Management Plan for the South Australian Commercial Lakes and Coorong Fishery

1 March 2022

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Information current as of 31 March 2021

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All Enquiries

Department of Primary Industries and Regions

2 Hamra Ave, West Beach, SA, 5024

GPO Box 1671, Adelaide SA 5001

T 08 8226 0900 F 08 8226 0434

www.pir.sa.gov.au/fisheries

The South Australian Fisheries Management Series Paper number 82: Management Plan for the South Australian Commercial Lakes and Coorong Fishery

ISBN: 978-0-6482204-7-3

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1 Fishery to which this plan applies

This plan applies to the Lakes and Coorong Fishery, which is formally constituted by the Fisheries Management (Lakes and Coorong Fishery) Regulations 2009 (the Regulations).

The Regulations define the Lakes and Coorong Fishery as consisting of:

- a) The taking of aquatic resources specified in Schedule 11 in the Lakes and Coorong; and
- b) The taking of Razorfish (*Pinna bicolor*) in the Lakes and Coorong for the purpose of bait.

The Regulations define the Lakes and Coorong as the waters of the Coorong, Lake Alexandrina, Lake Albert, and the coastal waters adjacent to South Australia between the location on Mean High Water Springs closest to 35°31'23.50" South, 138°46'23.83" East (Beach Road, Goolwa) and the location on Mean High Water Springs closest to 36°49'34.59" South, 139°50'55.95" East (Kingston SE Jetty).

2 Consistency with other management plans

This management plan has been developed so that it can be integrated with any Aboriginal traditional fishing management plans that are made in the future that apply to the waters of this management plan.

3 Term of plan

This management plan applies from the date fixed by the Minister for a period of five years.

Section 44 of the *Fisheries Management Act 2007* prescribes the requirements for replacing or extending this management plan upon expiry.

¹ Schedule 1 of the Regulations is also included as Schedule 1 to this management plan.

4 Natural Resource Management Governance in the Lower Lakes and Coorong Region

The Lakes and Coorong Fishery operates in a very challenging multi-jurisdictional environment. The area in which the fishery operates is subject to a wide variety of arrangements managed by State and Commonwealth government bodies, other authorities and Indigenous organisations. These organisations manage a broad range of different plans with different objectives in order to protect or enhance the regions environment including surface and ground water, as well as its aquatic and terrestrial species.

In addition to the fisheries legislation under which the fishery operates there are also the following regulatory or planning bodies with obligations that govern the region's resources and capacity:

Organisations:

- Department of Environment, Water and Resources - National Parks & Wildlife and Marine Parks
- Upper South East Land Management Authority
- Landscape South Australia, Limestone Coast Board
- Landscape South Australia, Murraylands & Riverland Board
- Murray Darling Basin Authority
- Narrindjerri Regional Authority
- South Eastern Water Conservation and Drainage Board

Plans

- Coorong, Lakes Alexandrina And Albert Ramsar Management Plan
- Encounter Marine Park Management Plan
- Limestone Coast Landscape Management Plan
- Murraylands and Riverland Landscape Management Plan
- Ngarrindjeri Nation Sea Country Plan
- South Australian Murray-Darling Basin Natural Resources Management Plan
- The Basin Plan
- The Living Murray - Lower Lakes, Coorong And Murray Mouth Icon Site Plan
- The Lower Lakes and Coorong Recovery Plan
- The National Park Management Plan
- The Native Fish Recovery Strategy for The Murray-Darling Basin
- Upper South East Marine Park Management Plan

The purpose of these plans and how they relate to the region and therefore influence the fishery is comprehensively described in the Management Plan for The South Australian Commercial Lakes and Coorong Fishery (PIRSA, 2016).

5 Description of Fishery

5.1 Introduction

The South Australian Lakes and Coorong Fishery is a small scale, multi-species, multi-method community based fishery that operates within a highly modified very dynamic environment, recognised internationally for its unique ecological character. The Lakes and Coorong Fishery include the waters of three separate, but closely linked, ecosystem components. These are: (i) the northern and southern lagoons; (ii) the freshwater Lower Lakes of Lake Alexandrina and Lake Albert; and (iii) the adjacent coastal marine waters along the Sir Richard and Younghusband Peninsulas. The fishery boundaries are described in detail in the *Fisheries Management (Lakes and Coorong Fishery) Regulations 2009* and *Fisheries Management (General) Regulations 2007*. In 1984/85, the Lakes and Coorong Fishery was subdivided into 16 areas for the purpose of collecting more detailed commercial catch and value data.

The fishery contributes to the socio-economic well-being of regional communities in the Lakes and Coorong region through commercial and recreational activity and harbours significant cultural, spiritual and livelihood significance for the Ngarrindjeri people.

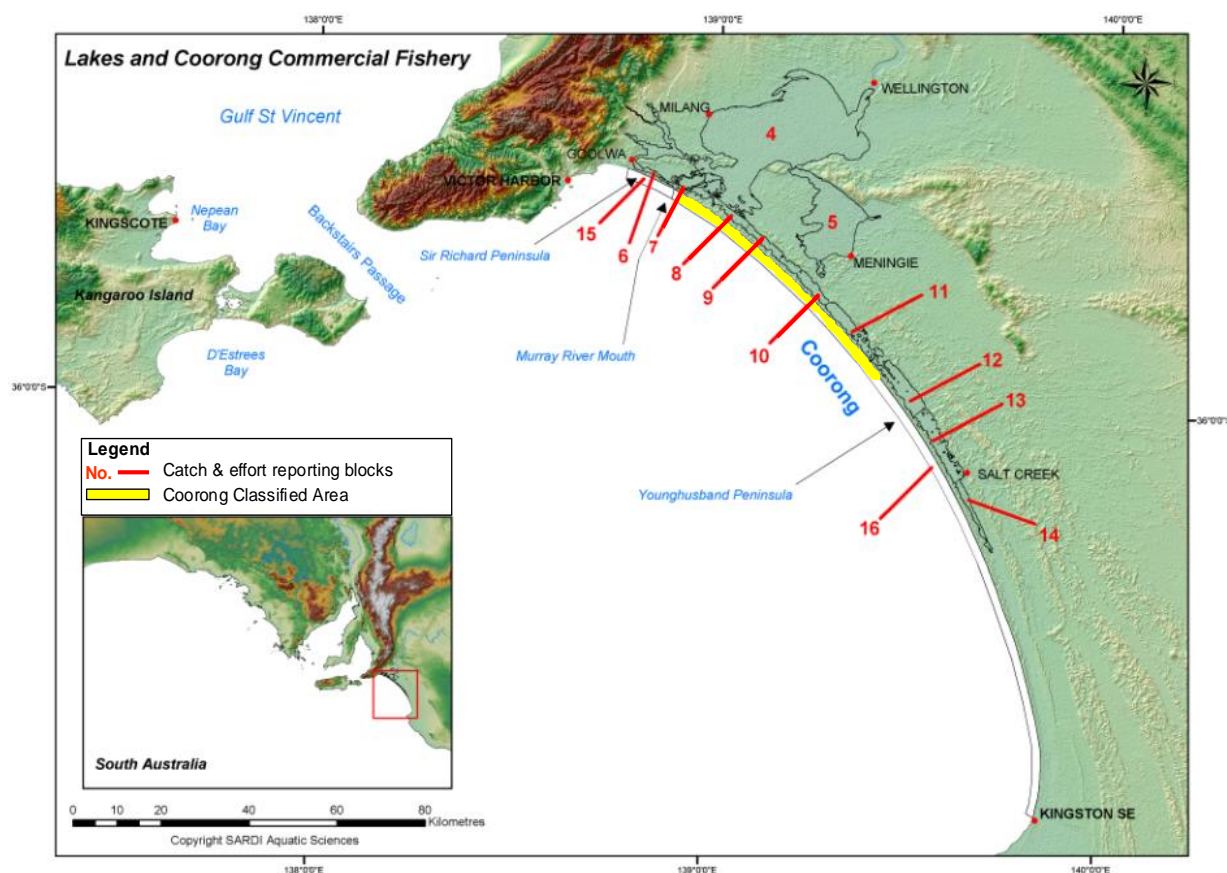


Figure 1 Map of the South Australian Murray Mouth, Lower Lakes and Coorong region.

Figure 1 shows the Coorong Coastal waters from Goolwa to Kingston, including the Murray River mouth and Sir Richard and Younghusband Peninsulas. Also shown are the catch and effort reporting blocks and Coorong Classified Area from which Pipi for human consumption must be taken.

5.2 Historical overview

Detail of the history of the Lakes and Coorong Fishery is provided in the Management Plan for the South Australian Commercial Lakes and Coorong Fishery (PIRSA, 2016). This includes the Aboriginal (Ngarrindjeri) history associated with the Lakes and Coorong region that extends over at least 45,000 years. Historically the number of Lakes and Coorong licence holders has been as high as 106 (1972), before being substantially reduced with the introduction of new licencing criteria (Table 1). Today, the fishery is a limited entry fishery, with the number of licences controlled by regulation, with commercial access limited to a total of 36 licences. As of 2020, there were 36 licences, with 13 Pipi quota holders (11 Lakes and Coorong Fishery and 2 Marine Scalefish Fishery) within the Lakes and Coorong Fishery (Table 2).

A summary of key management milestones throughout the history of the Lakes and Coorong Fishery is provided in the table below.

Table 1 Management milestones for the Lakes and Coorong Fishery.

Date	Milestone
1906	The South Australian Government introduced a requirement for all commercial fishers to hold a commercial fishing licence.
1972	Licensed commercial fishers required to provide monthly catch data
1982	South Australian Fisheries Act, 1982
1984	Scheme of Management (Lakes and Coorong Fishery) Regulations 1984
1984	The Lakes and Coorong Fishery was divided into 16 areas for the purpose of data collection and more detailed fishing location information was collected from operators.
1986	Further restrictions on commercial net type, mesh size, net depth and net length. Limit of one registered recreational net per person, with 70 m total length and maximum of 1 m drop.
1990	Regulation of the amount of gear that may be endorsed on an individual licence upon licence transfer or amalgamation.
1991	Fisheries (Scheme of Management—Lakes and Coorong Fishery) Regulations 1991 Fisheries (Scheme of Management—Marine Scalefish Fisheries) Regulations 1991
1997	Review of the recreational fishery

2003	Closure of the River fishery for the taking of native freshwater fish
2004	Amendments to the Scheme of Management to allow an individual to hold more than one licence
2005	Management Plan for the South Australian Lakes and Coorong Fishery
2006	Fisheries (Scheme of Management – Lakes and Coorong Fishery) Regulations 2006 Fisheries (Scheme of Management – Marine Scalefish Fishery) Regulations 2006
2007	<i>The Fisheries Management Act 2007</i> commenced requiring formal Management Plans
2009	Pipi quota management arrangements implemented into regulations
2009	Fisheries Management (Lakes and Coorong Fishery) Regulations 2009
2011	Development of a Pipi harvest strategy
2013	Amendments to the <i>Fisheries Management (Lakes and Coorong Fishery) Regulations 2009</i> to allow licence holders to transfer all entitlements to family members
2013	Development of a finfish harvest strategy
2016	First Lakes and Coorong Fishery Management Plan under <i>Fisheries Management Act 2007</i> which incorporated Pipi quota and net fishing effort allocations
2016	Lakes and Coorong Fishery Management Advisory Committee established

Table 2 Commercial participation in the Lakes and Coorong Fishery for selected years between 1906 and 2020.

Year	Lakes and Coorong		Coorong Only	
	No. of Fishers	No. of Vessels	Full Time Fishers	Part Time Fishers
1906	15	*	*	*
1930	70	*	*	*
1932	63	43	11	26
1937	65	39	13	27
1940	64	46	16	28
1945	52	33	15	26
1950	54	34	17	28

1955	46	31	16	25
1960	34	25	10	10
1965	27	22	9	8
1970	13	13	5	1
1972	106	*	*	*
1982	49	47	**	**
1984	42	42	**	**
1990	41	41	**	**
1992	39	39	**	**
2002	37	37	**	**
2006	36	36	**	**
2013	36	36	**	**
2020	36	34	**	**

* Data unavailable

** Majority of fishers are assumed to have operated on a full time basis.

Source: Historical data source: Olsen and Evans (1991); PIRSA Fisheries Licensing records

5.3 Commercial industry initiatives

The Lakes and Coorong Fishery is active in promoting improved environmental practices in the fishery including receiving, in June 2008, third party accreditation for the fishery's operation under the Marine Stewardship Council (MSC) assessment framework. The Lakes and Coorong Fishery was reassessed in 2013 with the Pigi sector being re-certified and the finfish sector in review. The MSC is an independent, global, non-profit organisation whose role is, via a certification program, to recognise well-managed fisheries and to harness consumer preference for seafood products bearing the MSC label of approval (Marine Stewardship Council, 2014). The successful accreditation of the fishery under the MSC assessment framework has provided improved opportunities for commercial fishers to increase domestic and overseas market demand for species harvested from the fishery.

The Lakes and Coorong Fishery is also active in supporting the management of the fishery by providing industry resources and in-kind contributions to core and non-core research and extension projects. The Lakes and Coorong Fishery has also produced numerous articles and educational materials about improvements in their fishery operations, including producing the first environmental management plan in the seafood industry.

5.4 Biological and environmental characteristics

5.4.1 Ecosystem and habitat

The Coorong, Lower Lakes and Murray Mouth (CLLMM) region is situated at the end of the largest freshwater catchment in Australia, the Murray-Darling Basin, where the river system meets the Southern Ocean. The region was recognised internationally as one of Australia's most significant wetlands and was listed under the Ramsar Convention in November 1985 (DoE, 2014) as the 'Coorong, Lakes

Alexandrina and Albert Wetland of International Importance'. This listing recognises the site's diverse range of wetland ecosystems, habitats and birds, fish and plant species. The area is a popular recreational site, while also supporting a range of commercial activities including tourism, irrigated agriculture, and commercial fishing. The Ngarrindjeri Indigenous people have a long association with the Coorong and Lower Lakes and the site has great cultural significance for them. They retain these close links with the wetland and its biodiversity through these cultural links (DoE, 2014).

The 142,500 ha site supports a complex array of many bioregions and environments including permanent and seasonal freshwater lakes and marshes, streams, estuarine waters, coastal lagoons, intertidal mudflats and forested wetlands (DEH, 2010). These habitats provide for more than 1,000 species including many listed under the EPBC Act such as the Southern Emu Wren (*Stipiturus malachurus*), migratory wader birds protected under international agreements, the Orange-bellied Parrot (*Neophema chrysogaster*), the Southern Bell frog (*Litoria raniformis*), and several threatened native fish species (DEH, 2010).

To describe the ecosystem and habitat of the CLLMM, the freshwater system includes Lake Alexandrina, Lake Albert and surrounding wetlands and the estuarine system includes the Murray Mouth and estuary and the Coorong north and south lagoon (DEH, 2010). Surface freshwater water inflows are predominately from the River Murray into the north of Lake Alexandrina, with other surface flows provided by the tributary streams draining from the Eastern Mount Lofty Ranges and from the Upper South East drainage scheme (DEH, 2010).

The Lower Lakes form a natural wetland system with associated shoreline marshes at the Murray Mouth. The Coorong is a long narrow wetland complex consisting of saline marshes, samphire, freshwater soaks and open water, with a hypersaline area at the southern end. The CLLMM is significantly important area for around 80 species of fish (Bice, 2010). It is widely recognised that the fish species within the CLLMM utilise the area as breeding and nursery areas, which also provide spawning and migratory pathways for a variety of higher trophic level organisms (Noell et. al, 2009). Freshwater flows from the River Murray provide mixing in the Coorong, creating estuarine conditions critical for the recruitment success of estuarine dependent species. The Coorong is significant to the survival of many juvenile fish and freshwater flows provide fish passage between the sea, Coorong and Lower Lakes, which are critical for the migration needs of diadromous species to complete their life cycle (Bice, 2010).

5.4.2 Habitat modifications

The natural ecosystems supporting fisheries resources throughout the River Murray and CLLMM have been dramatically modified since early European settlement across the Murray Darling Basin. Most of these modifications have been directed at water flow control and water extraction. An extensive barrage network was constructed in the 1940's between the mainland and Hindmarsh, Mundoo, Ewe and Tauwitchere Islands. They were constructed to prevent saltwater intrusion into the Lower Lakes and to maintain freshwater conditions during times of low flows, ensuring use for irrigation stock and human consumption (DEH, 2010).

This flow regulation has had a generally negative impact on the overall health of the ecosystem, in particular the habitat available for a range of diadromous and catadromous dependant fish species, native plants and waterbirds. The barrage network has significantly reduced the flow of water into and out of the river mouth under tidal influence. 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. 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.

The connectivity between the Coorong and the sea is also critical to the fishery's success as access through the Murray Mouth is critical for the movement of Mulloway, Yelloweye Mullet, Greenback Flounder and many other marine or estuarine species. Any disconnection of these two systems, by stopping or limiting the flows from the River into the sea or ingress from the sea will severely impact the integrity of the lakes and the Coorong and therefore compromise the fishery and fisher's capacity to maintain their activities provided for under this Plan. In circumstances that the integrity of the Lakes and Coorong are comprised, a review may be undertaken as per section 13 of this Plan.

The South East drainage system has been altered so that it delivers a proportion of freshwater to the ocean via a drainage scheme, rather than it historically flowing into the South Lagoon. The State Government is currently working with the Federal Government to realign the drainage system to provide additional land based freshwater to the South Lagoon.

5.4.3 Flow and drought

The fish assemblages in most major river systems in the world have been negatively affected by river flow regulation, the associated barriers to fish migration, habitat modification, the introduction of exotic flora and fauna, pollution from agricultural runoff and reduced water quality (Humphries, *et al.*, 1999). The amount of water flowing into the Lower Lakes, then into the Coorong and through the Murray Mouth to the ocean, has decreased dramatically since water flow control measures were introduced throughout the Murray-Darling Basin and in the Coorong. On average, the annual flow through the Murray Mouth is limited to about ~39% of the natural median flow recorded before water flow regulation (CSIRO, 2008). Prior to flow regulation, the river would cease to flow through the mouth 1% of the time. The river now ceases to flow through the mouth 40% of the time (CSIRO, 2008) (Figure 2). Reduced river flows and less frequent flooding have changed the morphology of the Mouth, causing sand to build up in and around the Mouth. The Murray Mouth closed in 1981 during a period of extended drought and would almost certainly have closed again in 2002/2003 had extensive dredging operations not been undertaken. Dredging continued for a further eight years to ensure the Murray Mouth remained open before a high flow event in 2010 broke the drought. Dredging recommenced in 2015 after the return of low flows caused the condition and openness of the Murray Mouth to deteriorate (Landscape SA, 2020).

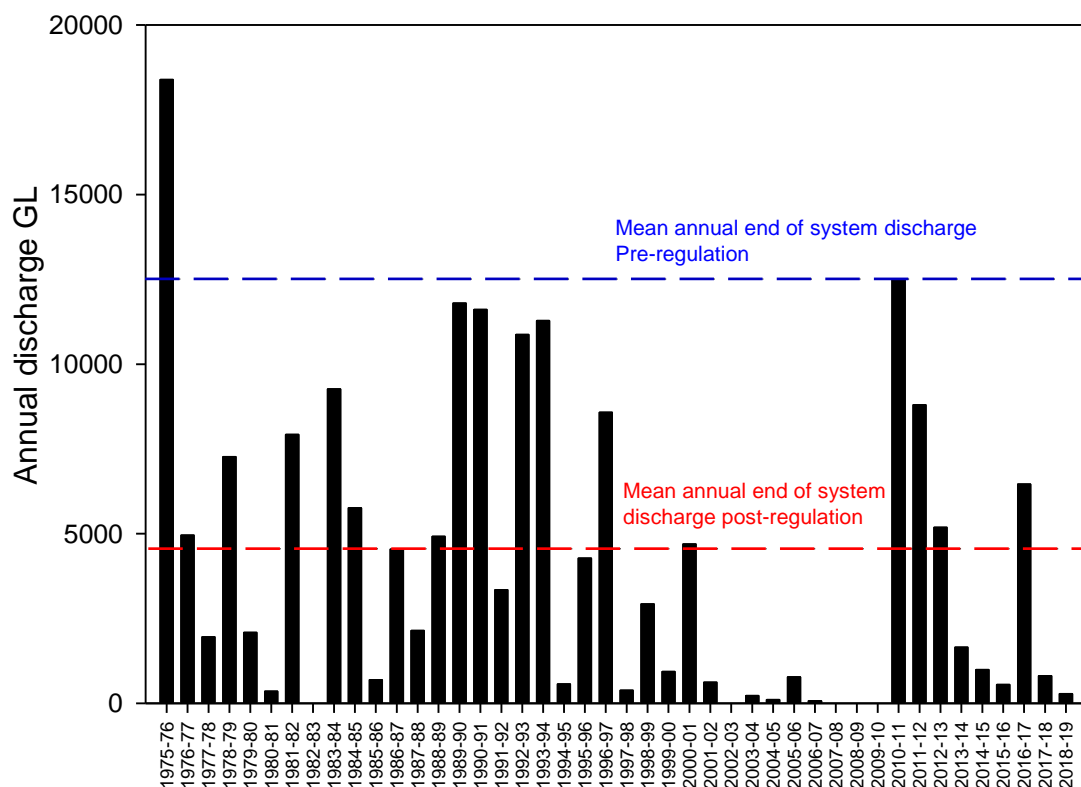


Figure 2 Annual freshwater discharge (GL) through the Murray Barrages into the Coorong estuary from 1975-June 2019. Dashed lines represent mean annual end of system discharge pre- (blue) and post-regulation (red) (Reprinted from Fish assemblage structure, movement and recruitment in the Coorong and Lower Lakes in 2018/19, by Bice, C. M., Zampatti, B. P. and Fredberg, J, 2019, SARDI Research Report Series 1043, Adelaide. Reprinted with permission).

5.4.4 Long-nose Fur Seals

Long-nosed fur seals are found throughout South Australian waters and are protected under both State and Commonwealth legislation. The net sector of the Lakes and Coorong Fishery have reported a decline in profits due to depredation of catches and damage caused by long-nosed fur seals. Commercial fishers are working closely with PIRSA and the Department for Environment and Water (DEW) to identify any potential short and long-term solutions to seal interactions. These include alternative fishing gear, methods and deterrent devices, including seal crackers, in an effort to reduce impacts of fur seals in the Lakes and Coorong Fishery.

5.4.5 Exotic species

A total of 43 exotic fish species have been established and recorded on mainland Australia (Koehn and Mackenzie, 2004). The Murray-Darling Basin contains at least 13 established exotic fish species (MDBC, 2003). The abundance, distribution and characteristics of some exotic species continue to cause damage to native fish populations and habitats. The most attention has been given to Carp because of its highly visible presence throughout the Murray-Darling system. However, there are many other exotic fish species which can have significant impacts through predation, competition and disease introduction. The following exotic fish species are established in the Lower Lakes (Lake Alexandrina and Lake Albert):

- Carp and hybrids (*Cyprinus carpio*)
- Goldfish (*Carassius auratus*)
- Gambusia (*Gambusia holbrooki*)
- Rainbow Trout (*Oncorhynchus mykiss*)
- Redfin Perch (*Perca fluviatilis*)
- Brown Trout (*Salmo trutta*)
- Tench (*Tinca tinca*)

The Murray-Darling Basin Authority (MDBA) Native Fish Strategy identifies exotic fish species as one of eight key threatening processes to native fish management in the Basin. The main threats to native fish management posed by exotic species are related to predation, competition, disease introduction, habitat destruction and reduced water quality.

There are also threats posed by future introductions of other exotic species, especially from the aquarium fish trade (MDBC, 2003). Since 2010, Oriental Weatherloach (*Misgurnus anguillicaudatus*) has been captured in research nets at numerous locations between the SA/NSW border and the Noonawirra wetland in the mid Murray region (~15 km downstream of Lock 1) (Thwaites and Fredberg 2014) and the MDBA has also focused its attention on preventing the incursion of a serious noxious species Tilapia (*Oreochromis spp.*) (MDBA, 2011).

The focus of exotic species management is on minimising and controlling impacts rather than on complete eradication. This management plan aims to support the integrated management approach suggested in the Murray-Darling Basin Authority (MDBA) Native Fish Strategy, which could include a range of strategies such as commercial harvesting, rehabilitating wetting and drying cycles for floodplain wetlands and the use of fish screens and traps to prevent adult migrations (MDBC, 2003).

Carp are harvested commercially from the waters of Lake Alexandrina and Lake Albert, as well as in other sections of the River Murray. Commercial harvesting is currently the most direct method available to minimise the ecological impact of Carp populations in the Lakes and Coorong region. However, when considered within the context of the integrated management approach proposed in the Native Fish Strategy, commercial harvesting is only one component of a broader strategy aimed at reducing the overall ecological impact of Carp populations. Other Carp population control methods will be adopted and integrated as part of a broader Carp control strategy, as they become available.

5.5 Biology of key species

The production and value of the Lakes and Coorong Fishery is largely driven by the four primary species; Pipi, Golden Perch, Mulloway and Yelloweye Mullet. Other species that make a significant contribution to the fishery include Bony Bream and Carp.

The following descriptions provide background information on the biological characteristics of the four primary species. More detailed information on stock status is provided in stock assessment and stock status reports prepared by the SARDI Aquatic Sciences. All completed reports are available at: <https://www.pir.sa.gov.au/fishing/publications> or <https://pir.sa.gov.au/research/publications>.

5.5.1 Pipi (*Donax deltoides*)

Pipi are a fast growing, short-lived, highly fecund species of surf clam. Populations of Pipi (*Donax deltoides*) occur along the south coast of Australia from Eyre Peninsula to Kingston in South Australia, through Tasmania to Fraser Island in south-eastern Queensland (King, 1985; McLachlan et al., 1996). Pipi on Sir Richard and Youngusband Peninsulas likely represents the largest population of this species in Australia (King, 1976). The Coorong population of *D. deltoides* is managed as a self-recruiting population distinct from other stocks distributed throughout other South Australian ocean beaches. The first stock assessment of *D. deltoides* in South Australia was completed in 2003 (Murray-Jones and Johnson, 2003)

Pipi are generally referred to as 'dribble spawners' however, in South Australia, the peak spawning period for Pipi occurs in September-October of each year (King 1976; 1985). Large natural fluctuations in abundance are a feature of Pipi populations worldwide and also appear to be characteristic of the South Australian population (Coe 1955; King 1976; McLachlan *et al.* 1996; Murray-Jones 1999). Fluctuations may be driven by environmental factors such as wind, or associated hydrological conditions, during the larval phase (King 1976; 1985). It has been suggested that smaller freshwater flows may benefit Pipi spawning and recruitment by providing nutrients, however, periods of high river discharge may have the potential to cause widespread mortalities (King 1985; Saenger and Keyte 1990; Murray-Jones and Johnson 2003). Growth of Pipi is rapid during the first 15 months of life (King 1985; Ferguson 2013). For the population on the Youngusband Peninsula 50% and 95% of Pipi are mature at 28 mm and 33 mm, respectively (Ferguson, 2013).

5.5.2 Golden Perch (*Macquaria ambigua*)

Golden Perch (*Macquaria ambigua*) naturally occur in inland rivers, creeks, billabongs, floodplains and lakes throughout the Murray-Darling River system (except at higher altitudes), Lake Eyre, and the Bulloo-Bancannia and Dawson-Fitzroy drainage systems (Ferguson and Ye, 2012). Translocated fish also occur in numerous other waterways throughout south-eastern Australia. In South Australia, Golden Perch are most common in anabranches, wetlands and main channel habitats of the lower Murray River, and in Lakes Alexandrina and Albert where they occupy areas of deep, slow-flowing water and/or in areas comprising large woody debris and snags. They are well adapted to the dynamic flood conditions of the Murray-Darling system and can withstand significant changes in temperature and salinity. Like other freshwater native species, the natural range and abundance of Golden Perch has declined steadily since European settlement, due mainly to the construction of numerous dams and weirs which have impeded natural migration patterns and altered natural water flow and temperature regimes.

Golden Perch are known to spawn during spring and summer, with extended spawning periods (autumn, winter and spring) also possible (Ebner et al., 2012). Spawning commonly involves the release of a single batch of eggs at one time and may occur more than once in a season if conditions are favourable (Battaglione and Prokop, 1987). The main stimulus for spawning is river flooding or rising water levels at temperatures ranging from 20° to 25°C (Ebner et al., 2012). If suitable spawning stimuli do not occur, females reabsorb their eggs and defer spawning until the following year (Mackay, 1973). The lakes stock is thought to reproduce at base levels even during periods of low river flow (Ye, 2005). Females mature at 4-5 years and males at 2-3 years (Battaglione and Prokop, 1987). Golden Perch are highly fecund, with a female of 2.3 kg (~500 mm TL) capable of producing up to 500,000 eggs at one time. Fecundity increases with fish size and age (Battaglione and Prokop, 1987). Eggs are pelagic and hatch between 24 and 33 hours after fertilisation.

5.5.3 Mulloway (*Argyrosomus japonicus*)

Mulloway *Argyrosomus japonicus* (Teminck and Schlegel, 1843) have an Indo-Pacific distribution where they inhabit coastal waters and estuaries in both northern and southern hemispheres. The species occurs from the east coast of South Africa, along the Chinese coast from Hong Kong to southern Korea and Japan, and the along the south coast of Australia from North West Cape in Western Australia to the Burnett River in Queensland (Kailola et al., 1993). In South Australia, juveniles are most common in estuaries, whereas adults occupy deeper habitats and shallow high-energy surf beaches.

Research investigating the stock structure of Mulloway concluded that populations in South Australia likely form two discrete stocks, i.e. a western stock and eastern stock. The results of these studies suggest that the eastern stock occupies marine and estuarine waters including the gulfs and the State's south-east including the Coorong estuary and coastal waters along the Younghusband Peninsula, while the western stock occurs on the State's far west coast and may have some association with populations in southern Western Australia (Barnes et al. 2014).

The Lakes and Coorong Fishery is the dominant commercial sector in the South Australian fishery for Mulloway, accounting for ~85% of the annual state-wide commercial catch since 1984/85 (Earl, 2020). In the Lakes and Coorong Fishery, catches are taken from a large area of estuarine habitat in years when there is freshwater inflow to the estuary (Earl, 2020).

5.5.4 Yelloweye Mullet (*Aldrichetta forsteri*)

Yelloweye Mullet, *Aldrichetta forsteri*, are found in bays, estuaries and inshore waters in New Zealand and along the southern coast of Australia, from Shark Bay in Western Australia to Newcastle in New South Wales, and around Tasmania (Gomon et al., 2008). Yelloweye Mullet typically occur in schools in brackish and inshore coastal waters and beaches over sandy and muddy substrates in depths to 20 m (Kailola et al., 1993), but can also be found in the lower reaches of rivers (Kailola et al., 1993; Gomon et al., 2008). Yelloweye Mullet are well adapted to the dynamic environmental nature of estuaries and the nearshore coastal environment. They have a wide tolerance of water temperature, e.g. from 14°C to 33°C (Chubb et al., 1981; Jones et al., 1996), and have been recorded in salinities up to 95 parts per thousand (ppt) in the Coorong.

In the Coorong, catches of Yelloweye Mullet by the Lakes and Coorong Fishery are seasonal with most of the annual catch taken from November to March (Earl, 2020).

5.6 Economic characteristics

Detailed economic information for the Lakes and Coorong Fishery has been collected regularly since 1996/97, providing a valuable reference regarding the economic status and trends of the commercial Lakes and Coorong Fishery. These assessments are presented in an annual report 'Economic Indicators of the Lakes and Coorong Fishery' prepared by BDO EconSearch Pty Ltd on behalf of PIRSA. Information presented in the annual report includes gross value of production, financial performance (revenue, costs, and return on investment), costs of management and economic impact of the fishery. BDO EconSearch reports are available at: <https://www.bdo.com.au/en-au/econsearch/industries/fishing-aquaculture>

5.6.1 Catch and gross value of production

The total catch in the Lakes and Coorong Fishery in 2018/19 (1,861 tonnes) was 3% above that in 1999/00, with catches fluctuating over this period (Figure 3). The key species that saw increases in catch were Yelloweye Mullet, Carp and Mulloway. Fishers attribute fluctuations in catch since 2014/15 to the expansion of the Long-nosed Fur Seal population in the fishery (Econsearch, 2020).

The Gross Value of Production (GVP) of the fishery increased by 174% in nominal terms over the last 20 years, from \$4.7 million in 1999/00 to \$12.8 million in 2018/19. In real terms, the Gross Value of Production (GVP) in 2018/19 was 67% higher than in 1999/00, a result of an increase in prices over this period. This is largely attributed to the shift in Pipi production and the move to value added human consumption markets (Figure 4).

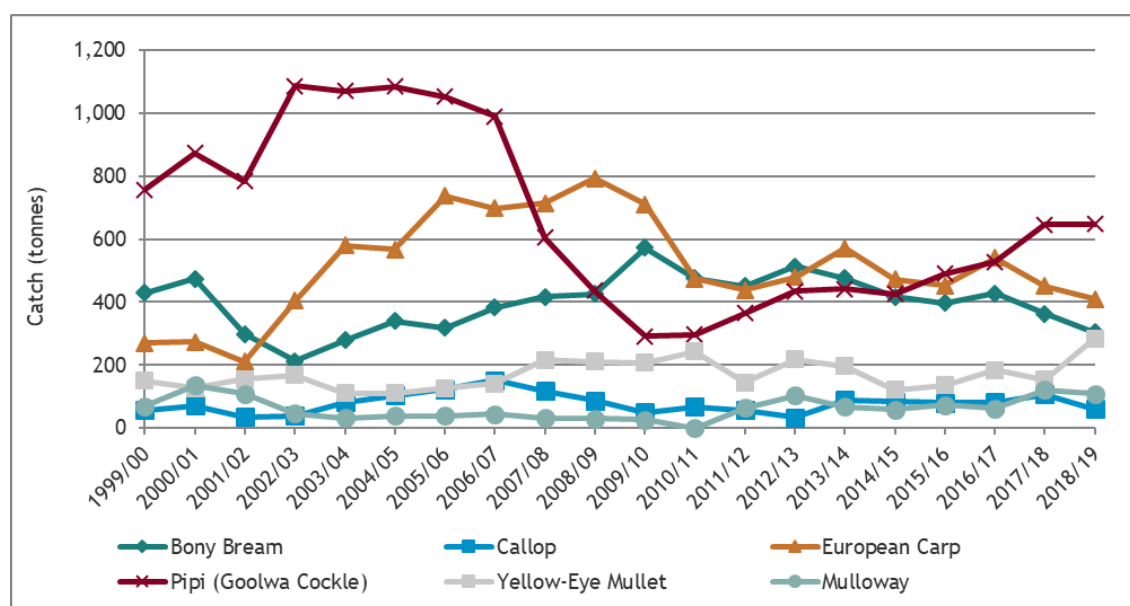


Figure 3 Catch of higher volume species, Lakes and Coorong Fishery, 1998/99 to 2018/19

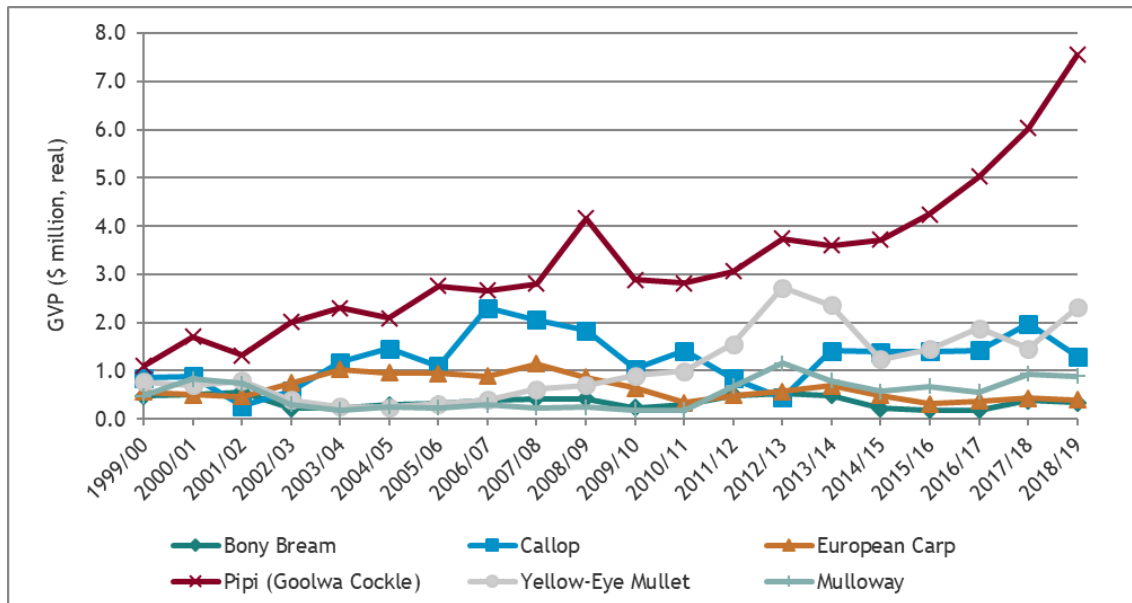


Figure 4 Gross value of production of major species, Lakes and Coorong Fishery, 1998/99 to 2018/19

5.6.2 Contribution to South Australian economy

In the South Australian Lakes and Coorong Fishery output, household income and contribution to Gross State Product (GSP) all followed a slightly increasing trend between 1999/00 and 2018/19.

In 2018/19, total Lakes and Coorong fishing industry related contribution to GSP in South Australia was \$21.6 million; \$10.5 million generated by fishing directly, \$2.9 million generated by downstream activities and \$8.1 million generated in other sectors of the state economy.

In 2018/19 there were an estimated 176 full time equivalent (fte) jobs generated by fishing directly (70 fte), in downstream activities (41 fte) and in other sectors in the economy (65 fte).

5.7 Social characteristics

The Lakes and Coorong Fishery has been commercially fished since 1846, with a number of generational fishing families still conducting activities in the region. Given this history, the Lakes and Coorong fishers have an intimate knowledge of the environment, an understanding of the history that has shaped the development of the fishery and a strong connection to the local community. Many of the fishers that work in the Lakes and Coorong Fishery contribute to the communities and economies in the Lakes and Coorong region. Many of the fishers return to their homes every night after a day on the water, purchase goods locally, socialise in the local pubs and clubs, support local sporting teams, and send their children to local schools.

In 2018, the economic indicators survey of commercial fisheries was extended to include the collection of social indicators. The results of the social indicators component of the survey are detailed in EconSearch (2019).

5.7.1 Social profiles and fishing profile of those working in the Lakes and Coorong Fishery

The number of years that individual licence holders in the Lakes and Coorong Fishery had owned fishing licences ranged from one to 35 years, with an average length of ownership of 20 years. The corresponding average length of ownership by licence holders for the 2003, 2006 and 2010, 2013 and 2016 surveys were 14, 15, 23, 21 and 23 years, respectively (Econsearch, 2019).

Several fishing families have held licences for a number of generations. On average, each family had held a licence for 24 years, however, some licences had been held by fishing families for up to 64 years. The corresponding average length of ownership by fishing families for the 2003, 2006, 2010 and 2013 surveys were 15, 17, 25 and 24 years, respectively (Econsearch, 2017).

The majority of licence holders (76%) were aged between 41 and 60 years at the time of the 2018 economic survey of fishers, with the highest number of licence holders in the 51-55 year age bracket (29%) (Econsearch, 2019).

6 Co-management Arrangements

Co-management is an arrangement whereby responsibilities and obligations for sustainable fisheries management are negotiated, shared and delegated at appropriate levels between government, the commercial fishing industry, recreational fishers, Aboriginal traditional fishers and other key stakeholders such as conservation groups (Neville, 2008). Co-management is recognised as a collection of positions, starting from centralised government regulation with no industry input at one end to more autonomous management by industry groups and key stakeholders at the other, where government plays more of an audit role. It is designed to achieve efficient regulatory practice (among many other things) and is by no means a way of industry or other key stakeholders avoiding regulatory scrutiny and influence (PIRSA, 2013).

PIRSA has adopted a *Policy for the Co-Management of Fisheries in South Australia* to inform discussion with the wider commercial fishing industry and other stakeholder groups as to how best to promote and implement co-management. The policy proposes that implementation of a preferred co-management model should be through a phased approach that allows industry and key stakeholders to build their capacity over time and allows for a government audit process to measure performance and success.

Section 20 of the Fisheries Management Act 2007 provides that the Minister, or delegate of the Minister, may establish committees to provide advice to the Minister on any matter related to the administration of the Fisheries Management Act 2007.

A co-management committee known as the Lakes and Coorong Fishery Management Advisory Committee operates as the key co-management forum for the fishery. The key focus of the Lakes and Coorong Fishery Management Advisory Committee is to support the implementation of this management plan for the Lakes and Coorong Fishery by providing advice on the management of the fishery to PIRSA. This advice includes:

- a) Providing a recommendation on the annual finfish TACE
- b) Providing a recommendation on the annual Pipi TACC
- c) Reviewing the performance of the management plan through its key performance indicators
- d) Reviewing management arrangements of the Lakes and Coorong Fishery
- e) Advising on programs to deliver on the management plan

- f) Supporting communication and extension with licence holders

7 Allocation of Access Between Sectors

The *Fisheries Management Act 2007* (the Act) provides that a management plan must specify the share of the fishery to be allocated to each fishing sector under Section 43(2)(h) of the Act – General nature and content of management plans. Section 43(3) of the Act also provides that, in determining the share of aquatic resources to be allocated to a particular fishing sector under the first management plan for an existing fishery, the share of aquatic resources to which that fishing sector had access at the time the Minister requested the preparation of the plan (based on the most recent information available to the Minister) must be taken into account

The Minister formally requested preparation of the first management plan on 17 June 2010. Therefore, this plan must take into account the share of key target species Lakes and Coorong Fishery, other commercial fisheries, the recreational sector and the Aboriginal traditional sector had access to at that time. The best available information regarding sector shares at this time is the catches from 2007/08, the year in which the most recent recreational catch information was available.

To guide the allocation process within management plans, the Minister for Agriculture, Food and Fisheries issued a policy directive in the form of the *Allocation Policy: Allocation of access to fisheries resources between fishing sectors* (PIRSA, 2011)

https://www.pir.sa.gov.au/data/assets/pdf_file/0003/254523/Allocation_Policy.pdf). The policy addresses issues related to the allocation of access between extractive used groups.²

7.1 Sectors of the Lakes and Coorong Fishery

Shares within the Lakes and Coorong Fishery are allocated to each of the following extractive stakeholders.

7.1.1 Commercial sector

Commercial fishing sector licences that provide some form of access to the Lakes and Coorong Fishery species include the Lakes and Coorong Fishery, Marine Scalefish Fishery, Southern Zone Rock Lobster Fishery and Northern Zone Rock Lobster Fishery. All fisheries with access were included in the initial allocation process. The Lakes and Coorong Fishery has two components:

- The net fishery: where access to species is provided through a permitted species list, and gear entitlements on fishery licences.
- The Pipi fishery: where access is provided through a quota management system with quota and gear entitlement on specific fishery licences. Access to the Pipi fishery is also provided to all Marine Scalefish Fishery, Northern Zone Rock Lobster Fishery and Southern Zone Rock Lobster Fishery licence holders through a 10 kg daily limit for bait purposes only, that can be taken on all beaches of the State.

² The allocation section may change subject to the review of the PIRSA allocation policy.

In recent years the traditional owners, in recognition of the relationship to the region have taken up commercial opportunities through ownership of Lakes and Coorong Fishery licences and Papi quota.

7.1.2 Recreational sector

The recreational fishing sector accounts for a significant proportion of the total catch of a number of species taken in the Lakes and Coorong Fishery, including high value species such as Mulloway, Yelloweye Mullet and Golden Perch. Papi is also an important recreational species with people traditionally collecting Papi for bait purposes and more recently for human consumption.

The recreational fishing sector is managed through a combination of input and output controls aimed at ensuring the total catch is maintained within sustainable limits and access to the fishery is equitably distributed. These controls include limitations on the type and amount of fishing gear that may be used, spatial and temporal closures, legal minimum lengths (LML) for individual species (which are consistent with those in place for the commercial sector), and bag and boat limits for individual species.

7.1.3 Aboriginal Traditional sector

The Act acknowledges Aboriginal or indigenous fishing in the form of Aboriginal traditional fishing. This is defined in part as being “non-commercial” in nature. It should be noted that, under the Act, the Minister may create separate management plans for Aboriginal traditional fishing where an Indigenous Land Use Agreement (ILUA) exists with any Native Title group.

In respect of any future traditional fishing management arrangements, they will be subject to any ILUA’s and Traditional fishing management plans and any claims of Native Title as they relate to the taking of aquatic resources in SA waters.

In this management plan, a share of access has been allocated and set aside for the purpose of resolving any native title claims.

It should be noted that subject to meeting the requirements of section 211 of the *Native Title Act 1993*, indigenous fishers are entitled to take aquatic resources in SA outside requirements of the *Fisheries Management Act 2007* provided that it is established that they are:

- a) an Aboriginal person and native title holder in respect of the land/sea in which the activity is occurring;
- b) the fishing activity in question forms part of the exercise of their customary native rights and interests; and
- c) the fishing activity was for the purpose of satisfying their personal, domestic, non-commercial community needs.

7.2 Spatial scale of allocation

Shares of aquatic resources relating to the Lakes and Coorong Fishery are subject to two separate allocations: one for the Lakes and Coorong Fishery and one for the Marine Scalefish Fishery.

The allocations provided in this management plan for the Lakes and Coorong Fishery includes the ocean beach area of the fishery (Kingston SE jetty to Beach Road, Goolwa). All commercial Lakes and Coorong Fishery catch in this region has been considered and allocated within this fishery allocation. The allocation within the inland waters component of the Lakes and Coorong Fishery (referred to as

Lakes and Coorong Fishery inland) incorporates catches exclusively within the Coorong and Lake regions.

7.3 Species allocated

The list of permitted fish species and fish families for the commercial Lakes and Coorong Fishery is extensive with over 45 species allowed to be taken. Of those species permitted to be taken for commercial purposes only the key species have been considered for allocation within this management plan.

In order to prioritise species for allocation a number of factors have been considered, including:

- Importance to the fishery (both commercial and recreational);
- Production (total catch);
- Commercial value;
- Level of exploitation;
- Inter-annual variability in catches and reliability of catch estimates; and
- Aboriginal cultural value.

There has been no further decision to allocate shares to additional species since the initial allocation.

Species have been classed as primary, secondary and tertiary. Only primary and some secondary species have been allocated.

Not all species allocated are individual species, some include a number of similar species grouped together. This is because some species are difficult to identify and there may be misreporting, or non-differentiation by species by both commercial and recreational fishers. Where multiple species are included within a single species, the species name is followed by the abbreviation 'spp', e.g. Mullet spp.

Future allocations will be undertaken in accordance with the review of the management plan and will be consistent with the Allocation Policy 'Allocation of access to fisheries resources between fishing sectors' (PIRSA, 2011) (https://pir.sa.gov.au/_data/assets/pdf_file/0003/254523/Allocation_Policy.pdf).

7.4 Sector allocations of the resource

7.4.1 Primary species

Pipi, Golden Perch, Mulloway, Mullet spp and Carp

Pipi, Golden Perch, Mulloway, Mullet spp., Carp and Bony Bream are the highest ranked commercial species in terms of total production and value. As Carp are a pest species they were not considered for an allocation. Due to the low level of recreational catch of Bony Bream they were also not allocated.

Table 3 Allocated shares of primary species for the Lakes and Coorong Fishery

Species		Commercial	Recreational	Aboriginal traditional	Total
Mullet spp. (catch)	Marine	54.2%	44.8%	1%	100%
	L&C (Inland)	98.9%	0.55%	0.55%	100%
Mulloway (catch)	Marine	19.9%	79.1%	1%	100%
	L&C (Inland)	71.4%	27.6%	1%	100%
Golden Perch (catch)	SAMDB	71.6%	27.4%	1%	100%
Pipi (area – refer Figure 5)		73 %	26%	1%	100%

For information on the historical data used for the allocations refer to Management Plan for the South Australian Commercial Lakes and Coorong Fishery (PIRSA, 2016).

Given the area fished for Pipi commercially was largely along Younghusband Peninsula and the areas of commercial catch monitored for the purposes of food safety (SASQAP zone), it was determined to allocate the Pipi fishery on the basis of area, rather than catch. As such, the fishery has exclusive commercial and recreational zones and a shared access zone (refer Figure 5 below).



Figure 5 Commercial and Recreational access to Pipi

7.4.2 Secondary species

Greenback Flounder, Black Bream and Bony Herring

Greenback Flounder and Black Bream are medium-to high value species and make a contribution to the total production value of the commercial Lakes and Coorong Fishery.

The allocations for Flounder and Black Bream are provided in Table 4.

Table 4 Allocated shares of secondary species for the Lakes and Coorong Fishery.

Species	Commercial	Recreational	Aboriginal traditional	Total
Black Bream (catch)	50.6%	48.4%	1%	100%
Greenback Flounder (catch)	88.7%	10.3%	1%	100%

7.4.3 Tertiary species

Snapper and Australian Herring (Tommy Ruff)

An allocation of 0.03% of the Snapper resource has been allocated to the commercial Lakes and Coorong Fishery in other fishery management plans (

Table 5).

Australian Herring (Tommy Ruff) are of low-to medium value and make a minor contribution to the total production value of the commercial Lakes and Coorong Fishery. A commercial allocation of Australian Herring is detailed in the Management Plan for the South Australian Commercial Marine Scalefish Fishery (PIRSA, 2013).

Commercial catches of these species can vary significantly from year to year depending on a range of factors including availability, availability of other species, price and fishing effort.

Other tertiary species have not been allocated within this management plan.

Table 5 Allocated share of Snapper for the Lakes and Coorong Fishery.

Species	Commercial		Recreational		Aboriginal traditional	Total
Snapper (catch)	MSF	79%	REC	8%	1%	
	SZRL	1.45%	CHARTER	10%		
	NZRL	0.55%				
	LCF	0.03%				
Total	81%		18%		1%	100%

7.5 Information used to allocate shares

In determining the share to be allocated to a particular fishing sector under the first management plan for an existing fishery, the share to which that sector had access at the time the Minister requested the preparation of the plan (based on the most recent information available to the Minister) was taken into account.

Quantifying current shares was an estimate based on the best available information on the current level of use of all sectors.

The Allocation Policy requires that information about current use by sectors must be –

- Real – that is, data must be available – it must have been collected and published;
- Recent – data on which the information is based should be the most recent available, and in any case no more than five years old; and
- Reliable – the data on which the information is based should have been obtained, and the information or report collated or prepared, in a way that is verifiable. The process for obtaining the data and preparing the information should be properly documented.

The information used to allocate shares of aquatic resources in this management plan is derived from the following sources:

- 2007/08 South Australian Recreational Fishing Survey (Jones, 2009).
- The South Australian Recreational Charter Boat Fishery Report 2009 (Knight, 2010).
- South Australian Wild Fisheries Information and Statistics Report (Knight and Tsolos, 2009).

- South Australian Wild Fisheries Information and Statistics Report 2008/09 (Knight and Tsohos, 2010).
- SARDI Aquatic Sciences catch and effort database of licensed commercial fishers' logbook returns from 2007/08.

Access to South Australia's fisheries resources by Aboriginal communities under the Act will be provided through Aboriginal traditional fishing management plans where necessary. These plans may be developed by the Minister where an ILUA has been negotiated and a final settlement is in place in relation to a particular Native Title claim area with the relevant native title group.

7.6 Process for managing within existing shares

Appropriate management structures will be used to manage each sector within their share allocation.

Catch estimates are available annually for all commercial fisheries and good estimates of recreational catches for the primary and secondary species of the Lakes and Coorong Fishery will be available a minimum of once every five years.

Without assuming levels of recreational catch it is not possible to undertake an accurate assessment of all sector shares in years when recreational survey data are not available. Therefore comprehensive reviews of all sector shares will only be undertaken in years for which recreational catch information is available.

If a share has been breached management action will be implemented to ensure future catch is maintained within the share.

7.7 Review of allocations

The Allocation Policy (PIRSA, 2011) specifies that it is a fisheries management responsibility to ensure that sectors are managed within their allocated share in line with the process for managing within existing shares above. Allocations between sectors will be reviewed in accordance with the Allocation Policy.

The Allocation Policy prescribes a process to review allocations under specific scenarios with trigger values set out in Table 6.

Table 6 Allocation triggers (percentages – portion of harvest) for primary species of the Lakes and Coorong Fishery

Species		LCF	MSF	NZRL	SZRL	REC	CHTR	ABT
Pipi (Area)	Fishery Allocation	73		-	-	26	-	1
	Trigger 1	80.3						

		Commercial Allocation	100		-	-			
		Trigger 2	N/A						
		Trigger 3	N/A						
Mulloway (catch)	Marine	Fishery Allocation	10.61	9.21	0.05	0.0	79.0	0.09	1
		Trigger 1	15.96	13.82	1	0.75			
		Commercial Allocation	53.46	46.27	0.25	0.02			
		Trigger 2	56.13	48.58	0.75	0.75			
		Trigger 3	58.81	50.90	1	1			
	Inland (L&C)	Fishery Allocation	71.4	-	-	-	27.6		1
		Trigger 1	78.5						
		Commercial Allocation	100	-	-	-			
		Trigger 2	N/A						
		Trigger 3	N/A						
Mullet Spp. (catch)	Marine	Fishery Allocation	0.06	51.55	0.0	2.59	44.8		1
		Trigger 1	1	56.71	0.75	7.77			

		Commercial Allocation	0.1	95.1	0.5	4.8			
		Trigger 2	0.75		0.75	7.2			
		Trigger 3	1			14.4			
	Inland (L&C)	Fishery Allocation	98.9	-	-	-	0.55		0.55
		Trigger 1	N/A						
		Commercial Allocation	100	-	-	-			
		Trigger 2	N/A						
		Trigger 3	N/A						
Golden Perch (catch)		Fishery Allocation	71.6	-	-	-	27.4		1
		Trigger 1	75.2						
		Commercial Allocation	100	-	-	-			
		Trigger 2	N/A						
		Trigger 3	N/A						

7.7.1 Secondary species

Secondary species allocations will be assessed on a regular basis following the publication of recreational data. Trigger limits for secondary species have also been set at a level that is commensurate with the initial allocation and allows for inter-annual variability in catches. Where a sector

has been allocated over 91%, no trigger limits have been set as any shares greater than this amount are considered to be within normal fluctuation ranges.

Secondary Trigger: Exceed sector allocation by relevant percentage in the assessment year.

Table 7 Allocation triggers (%) for secondary species of the Lakes and Coorong Fishery

Species		Commercial	Recreational	Aboriginal traditional	
Black Bream (catch)	Allocation	50.6	48.4	1	
	Trigger limit (%)	55.7	-	-	
Greenback flounder (catch)	Allocation	88.7	10.3	1	
	Trigger limit (%)	93.1	-	-	
Snapper (catch)	Fishery Allocation	Trigger 1	Commercial Allocation	Trigger 2	Trigger 3
MSF	79.0	84.0	97.5	na	na
SZRL	1.45	2.9	1.78	2.68	3.58
NZRL	0.55	1.65	0.68	1.3	2.0
MISC	-	-	-	-	-
Lakes and Coorong Fishery	0.03	1.0	0.04	0.75	1.0
GSVP					
SGP					
WCP					
REC	8.0				
CHTR	10.0				
ABT	1.0				

8 Ecosystem Impacts

The *Fisheries Management Act 2007* requires that ecological impacts be identified and assessed as the first step in developing a management plan. A goal of this plan is the management of the Lakes and Coorong Fishery resources as a part of the broader ecosystem, using an ecosystem-based fisheries management (EBFM) approach. The Act specifically requires that the following impacts are identified:

- Current known impacts of the fishery on the ecosystem
- Potential impacts of the fishery on the ecosystem
- Ecological factors that could have an impact on the performance of the fishery

These risks must be assessed to determine the most serious risks and strategies for addressing those risks must be developed.

The ecological impacts associated with the fishery have been identified and assessed through the process of conducting an ecologically sustainable development (ESD) risk assessment for the fishery. The 'National ESD Reporting Framework for Australian Fisheries' (Fletcher et al., 2002) was used to conduct the risk assessment.

In accordance with the ESD objective in the *Fisheries Management Act 2007*, this approach is aimed at assisting PIRSA to identify and prioritise all of the important ecological, social and economic factors that affect the management of the fishery. Full details about the risks identified and their relevant priorities are provided in the report from the risk assessment, Ecologically Sustainable Development (ESD) Risk Assessment for the commercial Lakes and Coorong Fishery (Bryars, 2011). These risk ratings were reviewed in November 2019 and any additional risks and emerging important issues in the fishery were identified in consultation with stakeholders and can be reviewed in the [Revised ecologically sustainable development \(ESD\) risk assessment of the South Australian Commercial Lakes and Coorong Fishery \(PIRSA, November 2019\).](#)

Specific management strategies to minimise these risks and associated performance indicators have been developed and are provided in Table 8.

9 Objectives, Goals and Strategies

Section 7 of the *Fisheries Management Act 2007* sets out the objects of the Act. ESD is established as the overall object of the Act and a number of biological, social and economic factors are identified that must be balanced when trying to achieve this. However, in pursuing sustainable development, the principle of protecting resources from over-exploitation is deemed to take precedence over all other principles.

Objectives for the Lakes and Coorong Fishery are set out below under the four broad goals. These goals and objectives capture all of the factors identified in the Act that must be balanced to pursue ESD and are shown in Table 8.

9.1 Goal 1 – Ensure the Lakes and Coorong Fishery resources are harvested within ecologically sustainable limits

Ensuring the sustainable harvest of all Lakes and Coorong Fishery resources is a challenge given the complexities of the fishery. The current levels of catch and effort are considered within the levels the fishery can sustain for the majority of primary and secondary species.

The objectives of this management plan in relation to sustainability are:

- Manage total catch and effort against the performance targets set out in this plan to ensure species are harvested at sustainable levels; and
- Monitor the biological and environmental performance of the fishery against performance indicators and reference points set out in this plan and ensure the collection of biological and fishery information is undertaken to measure fishery performance.

Prescribing performance indicators for the harvest of Lakes and Coorong Fishery resources and measuring those indicators against target, trigger or limit reference points is broadly referred to as a harvest strategy. Harvest strategies for the Lakes and Coorong Fishery resources are described in detail in Section 10.

9.2 Goal 2 – Optimum utilisation and equitable distribution of the Lakes and Coorong Fishery resources

This goal relates to the economic and social benefits derived from the fishery. The objectives of this management plan in relation to these benefits are:

- Manage allocated shares to deliver optimum utilisation and equitable distribution in accordance with the Government's allocation policy;
- Increase the flow of social and economic benefit from the fishery to the broader community;
- Improve economic efficiencies and financial returns within the constraints of sustainability imperatives;
- Improve measures of economic and social value for stakeholders of the Lakes and Coorong Fishery; and
- Minimise external impacts on the ESD of the Lakes and Coorong Fishery.

9.3 Goal 3 – Minimise impacts on the ecosystem

This goal relates to the management of the fishery using an ecosystem-based fisheries management (EBFM) approach. The objectives of this management plan in relation to minimising the impacts of the fishery on the ecosystem are:

- Minimise fishery impacts on by-catch species and the ecosystem;
- Minimise fishery impacts on fisheries habitat;
- Minimise external impacts on ecosystem; and
- Minimise the incidental mortality of threatened, endangered and protected species (TEPS).

Australian Government guidelines for the ecologically sustainable management of Australian fisheries acknowledge the need to minimise the impacts of fishing on the ecosystem. Three key objectives were identified to achieve this goal: ensure sustainability of by-catch and by-product species; minimise interactions with TEPS; and minimise impacts on benthic habitats and associated communities.

9.4 Goal 4 – Cost effective and participative management of the fishery

This goal relates to co-management of the fishery, planning of management activities and the recovery of the costs of management of the fishery. The objectives of this management plan in relation to co-management, planning and cost recovery are:

- Provide cost-effective and efficient management of the fishery,
- In line with Government's cost recovery policy, set fees to recover the attributed share of management costs, and
- Support industry bodies to participate and function within the co-management framework of the fishery.

The key objectives of this goal are to ensure that representative industry body has involvement in the decision-making processes for developing and implementing management arrangements and to ensure that management arrangements are complied with. The cost effectiveness of management arrangements also needs to be taken into account in the development process as the costs of management are recovered from fishers in accordance with the Government's cost recovery policy.

Table 8 Summary of management goals, objectives, strategies, performance indicators and reference points for the Lakes and Coorong Fishery

Goal	Objective	Strategies		Addressing Risk	Performance Indicator	Description	Reference Point
Goal 1 Ensure Lakes and Coorong Fishery resources are harvested within ecologically sustainable limits	1a Manage total catch and effort across the fishery to ensure species are harvested at sustainable levels	1a(i)	Regulate permitted fishing methods	Fishery impacts on fish stocks	Performance indicators described for selected gear types, spatial components of the fishery and species as detailed in the Pipi and finfish harvest strategy	Biological and environmental indicators relate to variables including habitat availability, fishable biomass, recruitment, exploitation rate, age structure and effort	Reference points are detailed in the Pipi and finfish harvest strategy
		1a(ii)	Apply spatial and temporal restrictions to protect fish species during critical stage of their life cycle	Fishery impacts on ecosystem			
		1a(iii)	Regulate size at which fish may be captured using minimum and/or maximum size limits	Management effectiveness			
		1a(iv)	Maintain capacity for licence holders to transfer effort between species within sustainability constraints				
	1b Monitor the biological and environmental performance of the fishery and ensure the collection of fishery, biological and environmental data	1b(i)	Obtain adequate and regular biological and environmental information for primary and selected secondary species, including fishery-dependent catch sampling program	Fishery impacts on fish stocks	Stock and environmental assessment and stock status reports produced to a high standard and on schedule Licence holders providing timely and accurate catch and effort information through logbook Industry participation in research projects as required Proposed research schedules and deliverables achieved	Good quality fishery data is essential to on-going monitoring of fishery status	Sufficient data collected to undertake stock and environmental assessments Regular reviews of research programs undertaken
		1b(ii)	Undertake and further refine stock and environmental assessments for primary species	Research information			
		1b(iii)	Review and refine biological and environmental reference points as scheduled in the Pipi and finfish harvest strategy	Management effectiveness			
		1b(iv)	Review and update the strategic research and monitoring plan regularly				
		1b(v)	Periodically review and update information collected through commercial logbooks				
		1b(vi)	Develop catch validation processes to improve integrity of fishery-dependant data				
		1b(vii)	Explore opportunities for cost-effective fishery-independent monitoring as required				
Goal 2 Optimum utilisation and equitable	2a Allocate access to fishery resources and manage shares to deliver optimum	2a(i)	Monitor and manage catches of each sector within allocated shares	Allocation Access security Recreational access pressure	Catch and effort managed within allocations and changes in shares detected and acted on appropriately		N/A

Goal	Objective	Strategies		Addressing Risk	Performance Indicator	Description	Reference Point
distribution of Lakes and Coorong Fishery resources	utilisation and equitable distribution			Information			
	2b Increase the flow of economic and social benefit from the fishery to the broader community	2b(i)	Positively influence the fishery's socio-economic benefits for the broader community	Relationships with community Employment (regional)	Contribution of fisheries to the local economic and social activity	<p>The Economic Indicators report provides detailed regional information on the economic performance including data on employment and expenditure</p> <p>Community support activities include non-paid work such as attendance of meetings, conservation activities and community service volunteering</p> <p>At the review of the plan, consider potential impacts the fishery may have on Aboriginal cultural practices (in particular Aboriginal cultural fishing) and traditional knowledge systems (specifically traditional fishing knowledge) and incorporated into the plan, where appropriate. This may include:</p> <ul style="list-style-type: none"> Identifying 'sea country' relevant for this fishery Support for cultural practices included in management considerations 	A downward trend in employment, expenditure and community support activities over a three year period
		2b(ii)	Communicate information about ESD outcomes of the fishery to the broader community	Re-investment (regional) Social capital (regional)	Proportion of direct and indirect employment in a region dependant on fishing		
		2b(iii)	Develop and maintain positive relationships with the regional communities in the area of the fishery		Demonstrate availability of Lakes and Coorong Fishery information through website, correspondence, media releases, licence holder letters, Fishcare volunteer program, industry publications and compliance officers		
		2b(iv)	Consider the fishery roles in Aboriginal cultural practices (in particular Aboriginal cultural fishing) and traditional knowledge systems (specifically traditional fishing knowledge) as information becomes available		Level of community support activities		
	2c Improve economic returns within the constraints of sustainability imperatives	2c(i)	Implement management arrangements that allow commercial operators to maximise operational flexibility, economic efficiency, value and returns	Profit Asset value Employment Lifestyle Fishing costs Business diversification	Key economic indicators: rate of return on capital		A declining trend in economic indicators over a three year period
	2d Monitor the economic and social performance of the fishery and ensure the collection of economic and social fishery data	2d(i)	Undertake periodic economic and social surveys of the commercial fishery to assess performance against a set of economic and social indicators	Management effectiveness Research/Information Product value	Delivery of annual economic reports assessing economic performance of the fishery from periodic economic surveys	<p>Economic indicator reports are currently prepared annually. Steps are being taken to provide indicators associated with key target species</p> <p>Social indicator data to be collected with the economic survey data (to minimise survey costs) and reported when data is available, in consultation with industry.</p>	Economic and social data not collected on an annual basis
		2d(ii)	Review and update the research and monitoring plan regularly	Profit Asset value Employment	Social fishery surveys undertaken periodically and reported when data is available		
		2d(iii)	Develop appropriate indicators of social performance of the fishery	Social capital Relationships with community Lifestyle			

Goal	Objective	Strategies		Addressing Risk	Performance Indicator	Description	Reference Point
	2e Monitor and where possible, facilitate minimising external impacts on the ecologically sustainable development of the fishery			Fishing costs			
		2e(i)	Monitor, report on and influence other management processes that impact on the ecologically sustainable development of the fishery as appropriate	Marketing Other fisheries (market demand) Fuel price Other fishing costs, Interest rates Marine park planning Conservation groups and NGOs DEWNR, DoE and DTEI RecFish SA & Recreational fishing	None measured	Participation in external processes to mitigate external impacts on sustainable development of the fishery	N/A
		2e(ii)	Implement short and long term options to reduce impacts from interactions with Long-nosed fur seals.	Fishing costs Employment Profit value Product value OHS Business development Long-nosed fur seal working group	Identification of short or long term options to reduce interaction. Research to identify possible changes to equipment and operation to support reduced interactions	Long-nosed fur seals are impacting on the Lakes and Coorong Fishery. Short and long term options could provide some relief to reducing the impacts of interactions with Long-nosed fur seals.	N/A
Goal 3 Minimise impacts on the ecosystem	3a Minimise fishery impacts on by-catch species, fisheries habitat and the ecosystem	3a(i)	Regulate gear types, construction material and mode of operation to minimise by-catch as appropriate	General ecosystem impacts of fishing Diseases Exotic species Industry codes of conduct	Quantification of by-catch associated with key gear types and operations Estimates of discard rates Number of reported breaches of relevant regulations Risk ratings from regular ecological risk assessment Opportunistic fishery-independent research Presence of codes of conduct	Aim is to reduce unwanted or discarded by-catch to lowest possible levels	Increasing trend in discarded by-catch Level of by-catch mortality is considered to adversely affect population dynamics of the species and ecosystem Increases in number of risks to ecosystem rated as moderate or higher during the risk assessment
		3a(ii)	Quantify impact of fishing operations on discarded by-catch through targeted research and on-going monitoring				
		3a(iii)	Promote the adoption of industry codes of conduct				
		3a(iv)	Adoption of national biofouling guidelines for commercial fishing vessels and other specific guidelines/protocols as relevant (e.g. <i>Caulerpa taxifolia</i>)				
	3b Minimise any external impacts on ecosystem, where possible	3b(i)	Where appropriate, influence other management processes that impact on the ecosystem	Water quality Effluent Disease Exotic species Marine park planning	None measured. Effectiveness of whole of government processes	It is acknowledged that management of the risks identified is outside the scope of this management plan yet PIRSA and industry should endeavour to participate in external processes as appropriate	N/A

Goal	Objective	Strategies		Addressing Risk	Performance Indicator	Description	Reference Point
	3c Avoid the incidental mortality of threatened, endangered and protected species			National park planning			
		3c(i)	Continue and improve commercial data recording systems to capture fishing interactions with threatened, endangered and protected species (TEPS)	Fishery impacts on TEPS	Annual report on TEPS interactions available for stakeholders	Recording of TEPS interactions is mandatory and all licence holders have been issued with a specific logbook	Real trend of increasing frequency of TEPS mortalities taking account of recent improvements in reporting accuracy
		3c(ii)	Develop management measures to avoid interactions with threatened, endangered and protected species as required				
Goal 4 Cost-effective and participative management of the fishery	4a Provide cost-effective and efficient management of the fishery, in line with government's cost recovery policy	4a(i)	Develop and implement management arrangements that are efficient and cost effective at achieving management objectives.	Management effectiveness Management costs	Total cost of management, research and compliance for the fishery.		Sufficient resources to maintain core management, research and compliance tasks Programs delivered consistent with cost recovery policy
		4a(ii)	Establishing the agreed level of research and compliance for the fishery and determine the real cost of management.	Management plan and allocation Sufficient management resources			
		4a(iii)	Recover licence fees from commercial licence holders, sufficient to cover the commercial fishery share of costs of fisheries management, research and compliance in accordance with the Government's cost recovery policy	Strategic policy Industry costs / profit Cost recovery policy			
	4b Improve the ability of fishers to participate effectively in management advisory processes	4b(i)	Promote stakeholder input to the management of the fishery, through co-management processes and communication strategies	Management effectiveness Reporting (Management Advisory Committee) Consultation Industry communication and participation Recognised and functioning industry associations Industry relationship with community	Level of satisfaction fisher representatives have with their overall representation skills and resources	Stakeholders are effectively participating in management advisory processes	>50% of representatives are dissatisfied with their participation in management advisory processes
	4c Ensure transparency of decision-making process by management bodies	4c(i)	Documentation of fisheries management decisions is provided to all stakeholders	Access to information Reporting (PIRSA)	Documentation of fisheries management decision-making process	Fishers understand how fisheries management decisions are made, and feel that the reasoning behind decisions as well as the process are consistent and clearly communicated	The process by which fisheries management decisions will be made is clearly documented and accessible to all stakeholders; and this documented process has been followed in all decision-making
				Industry communication and participation Recognised and functioning industry associations			

Goal	Objective		Strategies		Addressing Risk	Performance Indicator	Description	Reference Point
	4d	Stakeholders have a high level of trust in the management of fisheries	4d(i)	Open and transparent discussions on management decisions	Management effectiveness Industry relationship with government	The level of fishers trust / confidence in PIRSA Fisheries and Aquaculture	Stakeholders indicate a high level of trust in the both the process of fisheries management, and the outcomes of this management	The proportion of fishers indicating they don't trust the fisheries management agency is <50%, and stable or continuing to decline
	4e	Maximise stewardship of fisheries resources	4e(i)	Where possible simplify and standardise the regulatory rules, to ensure the rules are easier to comply with, easier to enforce and that fisheries management will be more efficient	Improve fishers and the community understanding and recognition of the high level of fishery management and regulation	Proportion of fishers who believe that, overall, most fishers comply with fishing rules (fisher survey)	Fishers understand the rules and undertaking their practices in an appropriate way and improve community perception of the industry fishery.	Fishers agree that it is easy to comply with fishing rules and regulations
			4e(ii)	Ensure any management changes (and reasoning) are communicated		Extent fishers accurately understand regulations (fisher survey)		
			4e(iii)	PIRSA/industry collaborating to promote fishery stewardship		Fishers find it easy to comply with fishing rules and regulations (fishery survey)		If sought, the industry obtain external accreditation. EPBC approval maintained.
			4e(iv)	Strengthen links with licence holders through improved communication		Seeking external accreditation		
			4e(v)	Support the use of external accreditation processes to underpin the integrity of management processes		Meets Commonwealth requirements under EPBC Act		
	4f	Effective compliance program for the fishery to maximise voluntary compliance and create effective deterrence	4f(i)	Undertake annual compliance risk assessment and deploy resources to address those risks	Compliance Management effectiveness	Compliance risk assessment reviewed annually Identified risks are minimised	The compliance risk assessment provides the opportunity to assess compliance status in fishery and prioritise work functions on high risk areas to fishery	Risk assessments not undertaken Insufficient resources to implement compliance plan
			4f(ii)	Review existing reporting and monitoring arrangements where necessary	Illegal take (including sale of recreationally caught fish)	Knowledge of requirements under a licence		
			4f(iii)	Undertake compliance induction meetings with new licence holders and/or registered masters	Resources	Number of prosecutions.		
			4f(iv)	Develop and implement management arrangements that are clear and uncomplicated so as to promote voluntary compliance and assist with successful enforcement	Legal framework	Number of reliable Lakes and Coorong Fishery offences reported to Fishwatch		
			4f(v)	Where possible, develop and implement licensing, compliance and monitoring arrangements that are consistent with other fisheries to reduce administrative costs	Resource sustainable	Relationship between Industry and Compliance		
			4f(vi)	Encourage the community and industry to report fisheries offences to the Fishwatch number				
			4f(vii)	Develop formal relationships between industry and fisheries officers to improve effective compliance				

10 Harvest Strategies

10.1 Introduction

The following section outlines harvest strategies that aim to provide strategic frameworks to guide annual decision-making on harvest from the Pipi and finfish sector of the fishery.

10.2 Pipi harvest strategy

The purpose of this harvest strategy is to ensure that the Pipi fishery is fished on a sustainable basis in accordance with the objects of the *Fisheries Management Act 2007*. This harvest strategy for the Pipi fishery has been developed using the best available information, during a period of stock rebuilding following a period of stock decline. As such, this harvest strategy will be reviewed in three years' time.

10.2.1 Framework for annual decision-making process

This harvest strategy provides a structured framework for decision making that pursues the ecologically sustainable development objectives of the *Fisheries Management Act 2007*. This decision making framework involves three main steps and will be undertaken each year prior to the start of the new fishing season. The primary aim of this harvest strategy is to ensure that the Pipi resource is harvested within ecologically sustainable limits, in accordance with the objectives set out in the strategy.

- Step 1 uses biological performance indicators to assess the current status of the Pipi fishery.
- Step 2 uses fishery economic performance indicators and market price estimates to analyse economic returns over a range of sustainable TACC levels and include an opportunity for industry to provide structured and direct input on the impacts of external factors on expected future prices over a range of TACCs.
- Step 3 uses reference points and decision rules to guide the TACC setting process to ensure the Pipi resource is harvested within ecologically sustainable limits and also to maximise economic returns from the fishery within those limits.

The decision rules used in this framework are based on results from fishery independent sampling; they require that a specific response will be triggered in terms of TACC adjustment based on fishery performance. In addition, the rules utilise estimates of maximum economic return to potentially further modify the TACC.

The resulting TACC that meets the decision rules will then be recommended to the Minister or their delegate for the upcoming season by PIRSA Fisheries and Aquaculture. The Minister or their delegate has responsibility for determining the value of a quota unit on an annual basis and setting the TACC under the *Fisheries Management (Lakes and Coorong Fishery) Regulations 2009*.

10.2.2 Objectives

The harvest strategy has the following objectives:

- To maintain a target Pipi relative biomass above the target reference point of 12 kg/4.5 m² and not less than the trigger reference point of 9 kg/4.5 m².

- To ensure that the Pipi relative biomass does not drop below the limit reference point of 4 kg/4.5 m².
- To maximise Fishery Gross Margin.

Note: the figure of 9 kg/4.5 m² has been chosen as it represents a conservative level of relative biomass that would allow sustainable production. The figure of <4 kg/4.5 m² represents a historically low level of biomass that may result in a risk of recruitment overfishing.

The harvest strategy aims to achieve these objectives via the following strategies:

1. Maintain the stock at sustainable levels by setting an appropriate annual TACC.
2. Sustainability of the Pipi fishery.
 - a. Providing management decisions responsive to changes in relative abundance of Pipi (fishery independent catch rates) and the presence/absence of pre-recruits into the fishery.
3. Improved business certainty and viability.
 - a. Implement decision rules to provide greater certainty to the annual TACC decision making process for all stakeholders.
 - b. TACC is only altered in years when fishery conditions have significantly changed such as a substantial rise or fall in relative biomass (from fishery independent surveys).
 - c. The harvest strategy has been reviewed to support retaining higher levels of biomass on the beach and smooth out variability of outputs from the current harvest strategy decisions rules.
 - d. Facilitate structured industry input into the decision making process.
4. Profitability
 - a. TACC to be set at a level that maximises returns for the fishery within biologically sustainable limits.

10.2.3 Biological performance indicators

To ensure that the Pipi resource is harvested within ecologically sustainable limits, performance of the fishery will be assessed annually. This assessment will be undertaken using the primary biological indicator as the main factor to inform TACC decision making, balanced against the values of the secondary indicator.

Primary biological performance indicator

The primary biological performance indicator for this fishery is **fishery independent relative biomass of legal-sized Pipi** (kilograms per 4.5 m²), because it provides representative estimates of Pipi stock relative abundance, and therefore overall changes in stock size. The method for estimating fishery independent relative biomass of legal-sized Pipi is described in Ward et al (2010) and further evaluated in Ferguson et al (2015). Annual estimates of fishery independent relative biomass have been available since 2007/08 and it is recognised as a reliable and well-understood measure of fishery performance.

Fishery independent relative biomass is estimated from structured research fishing across the fishing ground on Younghusband Peninsula (0-60 km south-east from the Murray Mouth). Surveys are conducted in October/November (early-season), February/March (mid-season) and April/May (late-season) each year, during the main part of the fishing season. Individual transects are located at permanent sites located at 2 km intervals along the 60 km fishing ground. i.e. 10 transects are located within each of three 20 km sections of beach. In each survey: (i) efficiency of individual fishers is estimated to allow variability in fisher efficiency to be measured/standardised (Day 1); (ii) variability in

relative abundance within sites is estimated (Day 2); and (iii) variability in relative abundance between days is estimated (Days 1 and 3). The final fishery independent relative biomass for a given year is calculated by combining relative biomass from each transect from (Days 1 and 3), from all of the early, mid and late season surveys. Spatial and temporal trends in fishery independent relative biomass have been presented in the annual pre-season stock status presentation for Pipi and will also be included in fishery stock assessment reports for Pipi.

Secondary biological performance indicator

The secondary biological performance indicator is population size structure based on length frequencies from fishery independent surveys. During one day of each survey, length frequency samples will be collected at 2 km intervals along Younghusband Peninsula (0-60 km south-east from Murray Mouth) using a fine mesh (10 mm) net. Data are aggregated into three 20 km sections of beach. Size-frequency distributions provide: (i) information on legal and sub-legal sized Pipi; (ii) an indication of the **presence/absence of pre-recruits** to the fishery, and (iii) assist with determining whether the fishery is being exploited at a sustainable level. Trends in this indicator are summarised both spatially and temporally and presented in the annual pre-season stock status of Pipi as well as in fishery stock assessment reports for Pipi.

The purpose of the secondary performance indicator is to understand recruitment and provide information on the potential future stock size.

10.2.4 Reference points for biological performance indicators

In this harvest strategy, reference points have been developed for the primary biological performance indicator, which is fishery independent relative biomass of legal size Pipi. These reference points provide a benchmark against which the performance of the fishery can be assessed.

Primary biological performance indicator

A modified 'traffic light' method will be used to inform the current status of the fishery relative to a target, trigger and limit relative biomass reference range, where 'green' is the target range, 'yellow' is within the trigger range and 'red' is below the trigger range (see Figure 1).

Target reference point

The target reference point will be reached if the average annual fishery independent relative biomass of legal-sized Pipi is greater than or equal to 12 kg/4.5 m². This will allow the fishery to be exploited at historically sustainable levels.

Trigger reference point

The trigger reference point will be reached if the average annual fishery independent relative biomass of legal-sized Pipi is less than or equal to 9 kg/4.5 m². This trigger has been implemented to be more conservative at the lower levels.

Limit reference point

A lower limit reference point will be breached if the average annual fishery independent relative biomass of legal-sized Pipi is less than 4 kg/4.5 m². At this level there is a significant risk of spawning stock being

insufficient to ensure sustainable levels of recruitment (i.e. recruitment overfishing). Should relative biomass fall below this level, the fishery will be closed.

Secondary biological performance indicator

The presence/absence of pre-recruits currently provides the secondary biological performance indicator. If pre-recruits are present, i.e. they represent at least 30% of the overall length frequency, a decision to increase to the top level of the available range will occur. If pre-recruits are absent (i.e. less than 30%), a decision for the TACC to remain in the lower part of the range for the upcoming season will occur

Re-opening strategy

In the event that closure of the fishery occurs, the Minister or their delegate will determine when fishery performance is at a sufficient level for commercial fishing operations to recommence and at what level an initial TACC will be set. Fishery independent sampling will be continued during fishery closure to determine when fishery performance meets the decision rules to reopen the fishery. By following the decision rules, a precautionary approach to setting the TACC will be taken to ensure that fishery independent relative biomass does not fall back below the limit reference point of 4 kg/4.5 m².

However, this harvest strategy aims to avoid the average annual fishery independent relative biomass falling below 9 kg/4.5 m² as it represents a conservative level of biomass.

10.2.5 Economic performance indicators

The primary economic objective of the harvest strategy is to ensure that sustainable harvest levels maximise Fisheries Gross Margin (FGM) as a proxy for maximum economic yield (MEY) from the Pipi resource. Measuring MEY requires sophisticated modelling tools which are cost prohibitive in this case.

FGM is considered to be an acceptable proxy given that large shifts in capital investment in the fishery are not expected in the future and changes in harvest rates over different TACC levels are expected to be marginal to the analysis.

To achieve this objective, the current and expected economic performance of the fishery will be assessed using the total commercial catch multiplied by the (actual or estimated) net market price averaged across all market segments, less fishery and operator costs that vary with the TACC level.

The measure will be used to assess historical performance and estimate future performance under alternative future TACC scenarios. The FGM assessment will be undertaken, where required, by an independent economic research provider and reported on to be considered as part of the TACC setting process. It is anticipated the FGM won't be required if biological indicators do not allow an increase in TACC.

The key variable business costs used to determine FGM include:

- Fuel, oil and grease for the boat and vehicles
- Provisions
- Crew payments
- Fishing equipment, purchase and repairs
- Repairs and maintenance (boats and vehicles)

Industry Input

Estimating future economic performance is imprecise and is unlikely to provide an exact answer. Measuring FGM requires interpretation and sensitivity assessments due to the influences of various external factors that cannot be predicted about the future. While estimates of volumes and costs can be made with greater certainty, future price and market share is particularly uncertain.

Where required, the FGM assessment will be undertaken via an industry survey to provide factual and credible evidence to support the impacts of external factors on expected future prices over a range of TACCs in the estimation of FGM each year in the decision making process (as part of Step 2 of this harvest strategy).

The external factors to be considered by the independent economic provider include, but are not limited to:

- Market failures
- Fluctuations in the Australian dollar and other currencies
- Imports
- Aquaculture products
- New processing techniques
- Impacts of marketing programs
- Timing of harvest
- Other factors impacting on price (logistics costs, fluctuations in supply of product from other jurisdictions)
- Fluctuations in fuel prices
- High-Grading

10.2.6 Decision rules for TACC setting

The decision rules used in this harvest strategy have been designed to provide clear guidance to the TACC setting process by defining how estimates of fishery independent relative biomass of legal-sized Piri, presence/absence of pre-recruits and maximising FGM for Piri should be interpreted when adjusting the TACC. These rules are structured around (1) relative biomass and (2) FGM increments of 2.5% so as to avoid annual adjustments as a result of minor fluctuations in (1) relative biomass and (2) expected economic performance.

Table 9 Pipi harvest strategy decision rule table.

Relative Biomass (kg/4.5m ²)	Tonnage- Recruits present	Tonnage – Pre-recruits absent
>20	600	575
>17 - <20	550	525
>12 - <17	500	475
>9 - <12	450	400
>4 - <9	350	300
<4	Closed	Closed

DECISION RULES

Dependant on the relative biomass (kg/4.5m²) in the decision rule table the following rules apply:

DECISION RULE 1*

The upper maximum biologically acceptable TACC or any lower value can be taken when pre-recruits are present.

And

The Fishery Gross Margin is expected to increase by at least 2.5%.

DECISION RULE 2*

Any of the biologically acceptable TACC's in the lower ranges can be taken when pre-recruits are not present.

And

The Fishery Gross Margin is expected to increase by at least 2.5%. If the FGM is not expected to increase by 2.5% at any of the lower TACC ranges, the lower TACC range for the relative biomass in the decision rule table can be taken.

Note the following decision rules apply to the decision rule framework:

*¹ An 100t increase is considered biologically acceptable and is the maximum increase that can be taken when moving from a lower to a higher relative biomass.

*² When moving to a higher relative biomass from below the trigger reference point (9 kg/4.5m²) the maximum allowable increase will be 50 t.

*³ If pre-recruits are present, i.e. they represent at least 30% of the overall length frequency, the top of the TACC for the relative biomass (kg/4.5m²) will be considered. If pre-recruits are absent (i.e. less than 30%), a decision for the TACC to remain in the lower part of the relative biomass (kg/4.5m²) for the upcoming season will occur.

*⁴ The starting point for the FGM is the previous years TACC. An FGM will not be required if the biological TACC is equal to or below the previous year's TACC.

10.2.7 TACC decision making process and timelines

The decision making process will be undertaken each year prior to the start of the fishing season as follows:

1. Industry will be provided with the opportunity to receive a verbal presentation of stock status report with fishery independent relative biomass (legal size) and pre-recruit data from the research provider and a report of maximum FGM estimates by 1 May each year, if required. An annual meeting of the Lakes and Coorong Fishery Management Advisory Committee will be convened to consider the information on the biological and economic performance indicators and feedback from industry.
2. PIRSA will provide recommendations to the Minister or their delegate in enough time to allow industry to be notified of the TACC at least four weeks prior to the commencement of the upcoming fishing season.

10.3 Exceptional circumstances

The development of this harvest strategy requires that considerations are made for exceptional circumstances. These circumstances may include stressors on the stock which result in poor Fishery Independent Survey results that are deemed outside the impacts considered as a part of the harvest strategy at the time of development and may include mass mortality events, disease out-breaks, natural or human-induced disasters.

10.4 Review of the harvest strategy

This management plan, including this harvest strategy, may be reviewed at any time under section 49(1) of the *Fisheries Management Act 2007* to incorporate such measures into the harvest strategy required to address any significant issues (biologically, environmentally or in its design) not anticipated when this plan and harvest strategy were developed.

At the time of developing this management plan, PIRSA was developing a policy to provide guidance on circumstances appropriate in South Australia quoted-managed fisheries for applying quota under-catch and/or over-catch provisions. On adoption of this policy, specific provisions for allowing for ongoing arrangements for carry-over of uncaught quota entitlements, or quota over-catch arrangements may be considered for Piri in the future.

10.5 Finfish harvest strategy

10.5.1 Overview

This harvest strategy provides a structured framework for decision-making that ensures the finfish resources in the Lakes and Coorong Fishery are fished on a sustainable basis in accordance with the objects of the *Fisheries Management Act 2007*. This harvest strategy has been developed differently to that of a traditional harvest strategy, as it is based upon habitat condition that links to the availability of the fished resources. Environmental processes play a significant role in the Lakes and Coorong Fishery and the aim of this finfish harvest strategy is to manage the sustainable take of finfish species in line with environmental conditions. This harvest strategy has been developed using the Sloan *et al.* (2014) *National Guidelines to Develop Fishery Harvest Strategies*.

This harvest strategy was developed during a period where interactions with Long-nosed Fur Seals are having an impact on the Lakes and Coorong Fishery. Given the above, this harvest strategy will be reviewed in three years' time. The Lakes and Coorong Management Advisory Committee (LCFMAC) will oversee the management of this harvest strategy.

10.5.2 Framework for annual decision-making process

This decision-making framework involves four main steps and will be undertaken by the LCFMAC prior to 1 June each year. The primary aim of this harvest strategy is to ensure that the Golden Perch, Mulloway and Yelloweye Mullet resources are harvested within ecologically sustainable limits, in accordance with the objectives set out in the harvest strategy.

Step 1 uses environmental performance indicators to specify the condition of the freshwater (Lower Lakes) and estuarine (Coorong) environments within which the fishery operates. The environmental performance indicators were developed as surrogate measures for fishable biomass of key finfish species, based on the fact that historical levels of exploitation, which typically varied in relation to the condition of the environment, have effectively maintained sustainability for key species over a long period (Knuckey *et al.* 2015).

Step 2 uses environmental reference points and decision rules to guide the process of setting the Total Allowable Commercial Effort (TACE) for three habitat-based gillnet sectors of the fishery. The three sectors are: (i) Freshwater – Large Mesh Gillnet (FLMGN); (ii) Estuarine – Large Mesh Gillnet (ELMGN); and (iii) Estuarine Small Mesh Gillnet (ESMGN).

Step 3 uses biological performance indicators (non-standardised annual targeted catch per unit effort; CPUE) to assess fishery performance for key species in each habitat-based gillnet sector. The biological performance indicators were developed as secondary indicators of relative abundance for key species in the absence of a formal biomass estimate.

Step 4 uses biological reference points and decision rules to supplement the management process, including TACE setting process for each sector to ensure the finfish resources are harvested within ecologically sustainable limits.

The decision rules used in this framework have been guided by historical levels of commercial fishing effort and provide that a specific response will be triggered in terms of TACE adjustment based on environmental conditions and fishery performance. The resulting TACE for each habitat-based gillnet sector will then be recommended to the Minister or their delegate for the upcoming fishing season by

PIRSA Fisheries and Aquaculture. The Minister or their delegate has responsibility for determining the value of a net unit on an annual basis and setting the TACE under the *Fisheries Management (Lakes and Coorong Fishery) Regulations 2009*.

10.5.3 Objectives

The harvest strategy aims to achieve the following management objectives:

1. Set an appropriate TACE to ensure sustainability of the finfish fishery.
2. Maintain catches within agreed allocations for each sector.
3. Improve economic efficiency and financial returns to commercial fishery.
4. Implement decision rules to provide greater certainty to the annual TACE decision-making for all stakeholders.

10.5.4 Primary environmental performance indicators

To ensure that the finfish resources available to the fishery are harvested within ecologically sustainable limits, the condition of the environment within which the fishery operates will be assessed annually. This assessment will be undertaken using the environmental performance indicators as the main factor to inform TACE decision making, balanced against the values of the biological (secondary) performance indicators.

Environmental performance indicators are used to monitor environmental changes within the freshwater and estuarine areas of the fishery. Specific indicators were developed to align with the proposed three gear/habitat-based sectors of the fishery:

Freshwater Large Mesh Gillnet (FLMGN)

The environmental performance indicator for the FLMGN sector is **mean annual water level (m AHD) in the Lower Lakes**. This indicator represents the area available for fish to occupy within the spatial constraints of the fishery. Monitoring of water levels will identify situations in the Lower Lakes (e.g. a reduction in the size of the fishable area) for which management intervention is required to ensure that exploitation of key species (Golden Perch) is controlled to levels that maintain stock levels above the point at which reproductive capacity (recruitment) may be impaired. Water level in the Lower Lakes is influenced by freshwater inflows from the storages upstream in the main river channel and other small tributaries (Finniss, Bremer and Angas Rivers), and the amount of water released through the barrages to maintain environmental flows into the Coorong estuary. Estimates of mean annual water level in the Lower Lakes will be derived from data recorded daily on up to twelve fixed water monitoring stations located throughout the Lakes system. Data will be obtained from the DEW.

Estuarine Large Mesh Gillnet (ELMGN)

The environmental performance indicator for the ELMGN sector is the **amount (%) of suitable habitat available for Mulloway** (the primary target species) in the Coorong estuary for this gear type. Annual estimates of this indicator will be determined using: (i) modelled daily salinity estimates for 109 locations, at 1-km increments along the longitudinal gradient of the Coorong estuary from Goolwa Barrage to Salt Creek, as determined by the Coorong Hydrodynamic Model developed by CSIRO (Webster, 2010); and (ii) information on the salinity tolerance of Mulloway (51 ppt), as determined by Ye et al. (2013). An estimate of the amount of suitable habitat available for Mulloway in each year will be calculated as a percentage of the total amount of habitat in the Coorong.

The Coorong Hydrodynamic Model considers a broad range of input data including estimates of daily freshwater discharge through the barrages, local rainfall, wind speed and direction, sea levels (tidal data) and freshwater inflows to the Coorong from Salt Creek. A full description of the model is provided in Webster (2010).

Estuarine Small Mesh Gillnet (SMGN)

The environment performance indicator for the ESMGN sector is the **amount (%) of suitable habitat available for Yelloweye Mullet** (the primary target species for this gear type) in the Coorong estuary. Annual estimates of this indicator will be determined using: (i) Coorong Hydrodynamic Model outputs (as described above); and (ii) information on the salinity tolerance (68 ppt) of Yelloweye Mullet, as determined by Ye et al. (2013). The study by Ye et al. (2013) demonstrated that Yelloweye Mullet are able to tolerate higher salinity than Mulloway. An estimate of the amount of suitable habitat available for Yelloweye Mullet in each year will be calculated as a percentage of the total amount of habitat in the Coorong.

10.5.5 Reference points for environmental performance indicators

The environmental performance indicators are assessed against reference points to identify situations in the fishery for which an adjustment to the available fishing (TACE) is required to ensure finfish resources are harvested within ecologically sustainable limits. The reference points (Table 10) provide a benchmark against which the performance of the fishery can be assessed.

Table 10 Target, trigger and limit references points for environmental performance indicators used in the finfish harvest strategy.

Habitat – gear sector	Primary performance indicator	Limit	Trigger	Target	Assessment
Freshwater - LMGN	Water level (m AHD)	-1.2	-0.71	+0.4	Annual
Estuarine - LMGN	Amount of available habitat (%) for Mulloway	10	24.9	55	Annual
Estuarine - SMGN	Amount of available habitat (%) for Yelloweye Mullet	10	30.9	50	Annual

Freshwater Large Mesh Gillnet (FLMGN)

The target reference point will be reached if the mean annual water level in the Lower Lakes is greater than or equal to +0.4 m AHD. This target was determined based on the current operational rules (and agreed basin plan operations) for the lower Murray River (below Lock 1), which aim to manage lake levels between +0.4 m and +0.85 m AHD (MDBA, 2014). The Lakes and Coorong Fishery for Golden Perch has effectively operated within ecologically sustainable limits under similar water levels in most years since at least 1984/85.

The trigger reference point will be breached if the mean annual water level in the Lower Lakes is less than or equal to -0.71 m AHD. This trigger represents the lowest mean annual water level (2009/10) recorded in the Lower Lakes since 1984/85, and a situation for which precautionary management intervention is required to address the deteriorating state of the environment. Since the environmental low point in 2009/10, the Golden Perch population in the Lower Lakes has sustained high levels of productivity and regular recruitment of young fish to the fishable biomass (Ferguson and Ye, 2012). This demonstrates that a mean annual water level of -0.71 m AHD will not present an unacceptable risk to the Golden Perch stock exploited by the Lakes and Coorong Fishery.

The limit reference point will be breached if the mean annual water level in the Lower Lakes is less than or equal to -1.2 m AHD. This limit represents a level of environmental deterioration that would only occur during a prolonged period of drought and a situation for which significant management action is required to maintain reproductive capacity for the Golden Perch population. The Golden Perch population in the Lower Lakes is part of a biological stock (spawning biomass) that extends well beyond the spatial constraints of the fishery (upstream to Renmark) (Keenan *et al.*, 1995). In 2012/13, the spawning biomass in the main channel of the Murray River between the Lower Lakes and Renmark, which is fully protected from commercial fishing, comprised numerous strong age classes (Ye, unpublished data). Thus, in a situation whereby lake levels decline to -1.2 m AHD, stock levels for Golden Perch are likely to be above the point where there is an appreciable risk of recruitment failure for the stock.

Estuarine Large Mesh Gillnet (ELMGN)

The target reference point will be reached if the amount of suitable habitat available for Mulloway in the Coorong estuary is greater than or equal to 55%. This target represents a situation in the environment in which the Mulloway population has sustained high levels of fishery productivity in recent years.

The trigger reference point will be breached if the amount of suitable habitat available for Mulloway in the Coorong estuary is less than or equal to 24.9%. This trigger represents a level above the lowest level of habitat availability for Mulloway recorded in the Coorong since 1984/85 (17%), and a significant reduction in the size of the area available for fish to occupy within the spatial constraints of the fishery. This environmental low point occurred during the Millennium drought, during which time a sand dredging program was implemented to maintain the opening of the Murray Mouth. Despite the extreme environmental degradation during this period, the Mulloway population that supports the Lakes and Coorong Fishery has since sustained relatively high levels of productivity, regular recruitment of young fish to the fishable biomass and a spawning biomass which includes numerous relatively strong size/age classes (Earl 2020). This demonstrates that a level of habitat availability for Mulloway of 17%, will not present an unacceptable risk to the Mulloway stock exploited by the Lakes and Coorong Fishery.

The limit reference point will be breached if the amount of suitable habitat available for Mulloway in the Coorong estuary is less than or equal to 10%. This limit represents a level of environmental deterioration that would occur during a prolonged period of no freshwater inflow or tidal ingress that resulted in the closure of the Murray Mouth. Given the Mulloway population in the Coorong is part of a biological stock, of which the majority of the spawning biomass exists in areas well beyond the spatial constraints of the Lakes and Coorong Fishery (Barnes *et al.*, 2014), a level of habitat availability of 10%, is likely to be well above the point where there is an appreciable risk of recruitment failure for the stock.

Estuarine Small Mesh Gillnet (SMGN)

The reference points for the ESMGN sector are less precautionary compared to those developed for the ELMGN sector. This reflects the life history characteristics of Yelloweye Mullet which are more resilient to the impacts of environmental degradation compared to Mulloway (Ferguson et al., 2014).

The target reference point will be reached if the amount of suitable habitat available for Yelloweye Mullet in the Coorong estuary is greater than or equal to 50%. This target represents a situation in the environment in which the fishery for Yelloweye Mullet has sustained high levels of fishery production for many years (Earl and Ferguson, 2013).

The trigger reference point will be breached if the amount of suitable habitat available for Yelloweye Mullet in the Coorong estuary is less than or equal to 30.9%. This trigger represents the lowest level of habitat availability for Yelloweye Mullet recorded in the Coorong since 1984/85, and a significant reduction in the size of the area available for fish to occupy within the spatial constraints of the fishery. During the late 2000s when habitat availability in the Coorong declined to 30.9%, the Yelloweye Mullet population maintained high levels of fishery productivity, with regular recruitment of young fish to the fishable biomass and a spawning biomass that comprised numerous relatively strong size/age classes (Earl and Ferguson, 2013). This demonstrates that a level of habitat availability for Yelloweye Mullet of 30.9%, will not present an unacceptable risk to the Yelloweye Mullet stock exploited by the Lakes and Coorong Fishery.

The limit reference point will be breached if the amount of suitable habitat available for Yelloweye Mullet is less than or equal to 10%. This limit represents a level of environmental deterioration that would likely only occur during a prolonged period of no freshwater inflows or tidal ingress that resulted in the closure of the Murray Mouth. The sand dredging program implemented during the recent drought period successfully maintained the opening of the Murray Mouth and level of habitat availability for Yelloweye Mullet above 31%. Given the Yelloweye Mullet population in the Coorong is part of a biological stock, of which the majority of the spawning biomass exists in areas well beyond the spatial constraints of the Lakes and Coorong Fishery (Thomson 1957), a level of habitat availability of 10%, is likely to be well above the point where there is an appreciable risk of recruitment failure for the stock.

10.5.6 Secondary biological performance indicators

A range of secondary biological performance indicators are used to continue to monitor fishery performance for key species, as they provide the only long-term (up to 35 years) time-series available for assessing the status of the fishery. The secondary indicators are:

- non-standardised annual targeted catch per unit effort (CPUE) for the dominant gear type(s);
- total annual commercial catch (t);
- commercial catch composition (among key target species); and
- age composition.

Age composition is a useful indicator of fishery status, particularly for long-lived species such as Mulloway, Golden Perch and Black Bream. Age structure will continue to be monitored to understand population structure, and compared over time to monitor the impact that fishing pressure, the environment and demographic processes (i.e. recruitment and movement) may be having on population health.

10.5.7 Reference points for secondary biological performance indicators (CPUE)

The secondary biological performance indicator based on *non-standardised annual targeted catch per unit effort* (CPUE) for key finfish species will be assessed annually against a set of reference points, and may trigger additional management responses at a species level.

Reference points for the secondary biological performance indicators provide benchmarks of fishery performance and define acceptable levels of biological impact on fish stocks (see Table 11). The reference points were determined based upon historical CPUE data from the reference period of 1985–2017. Catch rates during this period effectively maintained stocks at, or above sustainable levels.

The target reference point for each species represents the 10th highest annual catch rate during the reference period. The target represents a catch rate level that the fishery aims to be at or above.

The trigger reference point for each species represents the 10th lowest annual catch rate during the reference period. It is set at a level above which the fishery is considered to be sustainable (i.e. the biomass of this stock is considered to be at a level sufficient to ensure that, on average, future levels of recruitment to the fishery will be adequate).

The limit reference point for each species represents the lowest annual catch rate during the reference period from which there is evidence of stock recovery. It is set at a catch rate level below which may require management action to ensure that the stock does not further reduce to a point where recruitment levels are significantly impaired. It is the benchmark for undesirable fishery performance.

Table 11 Target, trigger and limit references points for biological (secondary) performance indicators used in the finfish harvest strategy. ^P = Primary species; ^S = Secondary species.

		Biological Performance Indicator (targeted CPUE, kg.net-day ⁻¹)		
Gillnet sector	Key species	Limit RP	Trigger RP	Target RP
Freshwater LMGN	Golden Perch ^P	0.24	0.49	1.04
	Bony Herring ^S	2.32	3.54	5.42
Estuarine LMGN	Mulloway ^P	0.80	1.39	2.68
	Black Bream ^S	0.30	0.53	1.67
	Greenback Flounder ^S	0.65	0.93	1.86
Estuarine SMGN	Yelloweye Mullet ^P	6.32	7.23	11.11

10.5.8 Harvest strategy decision rules

The decision rules for each of the three habitat-gear specific sectors of the fishery is based primarily on the relationships between the inter-annual trends of the primary performance indicator and three measures of fishing effort that were available from daily commercial fishery log book data collected for the period from 1984/85 to 2012/13.

The rationale for this approach was based on evidence compiled in recent fishery assessment reports (Ferguson and Ye, 2012; Earl and Ferguson, 2013; Earl and Ward, 2014; Earl 2020) that indicate that historical levels of fishing pressure applied to stocks of key species (i.e. Mulloway, Yelloweye Mullet and Golden Perch) relative to the state of the environment, have been sufficient to maintain the capacity for future high levels of fishery and biological productivity and ensure stock levels remain well above the point at which reproductive capacity (recruitment) may be impaired. The decision rules in this harvest strategy have been designed to provide clear guidance for the TACE setting process by defining a level TACE dependant primarily on environmental conditions. The decision rule table below has recently been updated to incorporate the secondary performance indicators (CPUE) and reflect changes in the number of net units in the fishery over the past couple of years (from 1250 to 1175). Incorporating secondary indicators into the decision rules table provides clear guidance on how secondary indicators will affect the TACE setting process in the event that CPUE falls below the trigger or limit reference point for consecutive years for primary species and secondary species, as described in the decision rules below. This ensures that other factors that have a negative impact on fishery performance are considered as part of the TACE setting process.

The following table provides the decision rule table and decision rules:

Table 12 Decision rule table and decisions rules

Freshwater large mesh gillnet sector – secondary PI for Golden Perch

	Primary PI (Mean annual water level in Lower Lakes; m AHD)					
Secondary PI* (Golden Perch CPUE; kg.net-day ⁻¹)	>0.4 m	-0.04 to 0.4	-0.7 to -0.05	-0.95 to -0.71	-1.2 to -0.96	<-1.2
>1.04	1175	1175	1175	799	423	0
≥0.49 to 1.04	1175	1175	1175	799	423	0
≥0.24 to <0.49	779	779	799	423	423	0
<0.24	779	423	423	423	0	0

Estuarine large mesh gillnet sector – Secondary PI for Mulloway

	Primary PI (habitat available to Mulloway in the Coorong estuary, %)					
Secondary PI* (Mulloway CPUE; kg.net-day ⁻¹)	>55	40 to 55	25 to 39.9	17.5 to 24.9	10 to 17.4	<10
>2.68	1175	987	658	376	329	0
≥1.39 to 2.68	1175	987	658	376	329	0
≥0.8 to <1.39	987	658	376	329	329	0
<0.8	658	376	329	329	0	0

Estuarine small mesh gillnet sector – Secondary PI for Mullet

	Primary PI (habitat available to Yelloweye Mullet in the Coorong estuary, %)					
Secondary PI* (YE Mullet CPUE; kg.net-day ⁻¹)	>50	40.5 to 50	31 to 40.4	20.5 to 30.9	10 to 20.4	<10
>11.11	1175	987	611	235	188	0
≥7.23 to 11.11	1175	987	611	235	188	0
≥6.32 to <7.23	987	611	235	188	188	0
<6.32	611	235	188	188	0	0

The decision rules for the secondary (biological) performance indicators (SPI) are:

1. For Primary species (Mulloway, Yelloweye Mullet, Golden Perch):
 - a. Where the secondary performance indicators falls below the trigger reference point for a primary species for two consecutive years, the Harvest Strategy will apply one step down in the Decision Rule table^[1] for the respective habitat/gear sector, as part of the next annual TACE allocation process.
 - b. When the SPI falls below the limit reference point for a primary species for two consecutive years, the Harvest Strategy will apply two steps down in the Decision Rule table¹ for the respective habitat/gear sector, as part of the next annual TACE allocation process.
2. For Secondary species (Greenback Flounder, Black Bream, Bony Herring):
 - a. Where the SPI falls below the trigger reference point for a secondary species for four consecutive years, the Harvest Strategy will trigger a species-specific response (e.g. spatial or temporal closure) as part of the next annual TACE allocation process.
 - b. Where the SPI falls below the limit reference point for a secondary species after four consecutive years, the Harvest Strategy will apply one step down in the Decision Rule table¹ for the respective habitat/gear sector (consistent with 1a above), and trigger a

[1]

species-specific response (e.g. spatial or temporal closure) as part of the next annual TACE allocation process.

10.5.9 Transferability of net units

To support flexibility and economic viability in unfavourable conditions, temporary transfers would be permitted in the yellow zone (to a maximum of a licence holder entitlement) within each habitat (e.g. large mesh net units in the Coorong would only be transferable for use as large mesh net units in the Coorong). It is suggested that temporary transfers be trialled for the first three years and consideration of permanent transferability could be considered after this time.

10.5.10 Reporting of fishery performance

Performance indicators will be reported and assessed against associated reference points in reports. These will: (i) assess primary performance indicators against their associated reference points; and (ii) present a historical summary of the commercial fishery statistics for key finfish species harvested in Lakes and Coorong Fishery.

10.5.11 Decision-making process and timelines

The information that would be used to provide a Freshwater LMGN, Estuarine LMGN and SMGN TACE recommendation to the Minister or their delegate for the following fishing season would be data collected from the previous 12 months being 1 February to 31 January. This would include all seasons/environmental conditions over the previous 12 months and also give enough notification for industry to plan their next 12 months fishing activity, aligning with the licencing year.

The decision-making process will be undertaken each year prior to the start of the fishing season by the Lakes and Coorong Fishery Management Advisory Committee and includes the following steps:

1. Industry will be provided with the opportunity to receive a verbal presentation and an annual fishery performance report by 1 May each year. The Lakes and Coorong Fishery Management Advisory Committee will then convene a meeting to consider the information on the fishery's primary performance indicators.
2. The Lakes and Coorong Fishery Management Advisory Committee will provide recommendations based upon the decisions rules to the Minister or their delegate before 30 May to allow time for industry to be notified of the TACE at least 2 weeks prior to 1 July each year.

10.5.12 Management responses

There may be circumstances under this harvest strategy that effort may increase significantly and/or the sustainability of fish species are compromised. PIRSA and the Lakes and Coorong Fishery Management Advisory Committee will take action to undertake a detailed review of the issue; including an examination of the causes and implications for the specie/s being compromised. The outcome of this review may include recommendations for other management arrangements being implemented.

10.6 Exceptional circumstances

The development of this harvest strategy requires that considerations are made for exceptional circumstances. These circumstances may include stressors on the environmental indicators that are deemed outside the impacts considered as a part of the harvest strategy at the time of development and may include mass mortality events, disease out-breaks, natural or human-induced disasters.

10.7 Review of the harvest strategy

This management plan, including this harvest strategy, may be reviewed at any time under section 49(1) of the *Fisheries Management Act 2007* to incorporate such measures into the harvest strategy required to address any significant issues (biologically, environmentally or in design) not anticipated when this plan and harvest strategy were developed.

11 Stock Assessment and Research

11.1 Research services

PIRSA contracts research services for each of its managed fisheries. SARDI Aquatic Sciences is the primary research provider for core research for the Lakes and Coorong Fishery. Costs associated with research, monitoring and reporting for the fishery are recovered through licence fees.

The cost-recovered funding through licence fees is not the only stream of funding from which research relevant to the management of the fishery is undertaken. External sources such as the Fisheries Research and Development Corporation (FRDC), the MDBA and universities also provide opportunities. The industry contributes to the FRDC through an annual levy base which is also collected through licence fees and also provides in-kind contributions to other research in the fishery.

11.2 Data collection and analysis

A range of fishery-dependent and independent data is collected to assist in the monitoring of the Lakes and Coorong Fishery. Fishery-independent information derived from scientific surveys (Pipi), hydrodynamic modelling and biological sampling provides the primary data on which the performance of the Lakes and Coorong Fishery is assessed and on which the majority of fishery management decisions are based.

For the Pipi fishery, scientific surveys undertaken annually along the length of the area accessed by the commercial fishery provide information to determine biomass estimates and presence/absence of pre-recruits, i.e. the key biological data for the setting of the annual TACC. Commercial catch and CPUE data is an important source of fishery-dependent information for monitoring fishery performance, as they provide the only long-term (27 years) data available for assessing the performance of the fishery. However, such information is not explicitly used in TACC decision-making for the fishery. The annual decision-making process for the finfish fishery requires model output data from the hydrodynamic model developed by CSIRO (Webster, 2010) to determine the amount of habitat available for key species, and estimates of water level derived from data recorded daily on up to 12 fixed water monitoring stations located throughout the Lakes system. Water level data will be obtained from DEW, and/or the MDBA.

The primary source of fishery-independent biological information for the finfish fishery is derived through research sampling of commercial catches for Mulloway, Golden Perch, Yelloweye Mullet, Black Bream, and Greenback Flounder. Research sampling is undertaken at the SAFCOL fish market and at the point of landing or targeted research fishing, and provides important information such as age and length data which is subsequently used to monitor population health and determine stock status for individual species. While such information is not formally considered in the decision-making process for finfish, it

supports a weight-of-evidence approach to determining stock status for individual species and may be used to identify the need for a review of management arrangements. Furthermore, continued development of a time-series of age structures would provide an ongoing indication of population status for some species, e.g. Golden Perch, Mulloway, Black Bream, which should be considered when developing future harvest strategies.

Commercial catch and effort data is an important source of fishery-dependent information for monitoring population health and fishery performance for finfish. These data have been collected since 1984/85 by fishers in the Lakes and Coorong Fishery completing a research logbook for each fishing day and submitted by registered masters in accordance with the regulations. Daily catch and effort data include catch (kg), effort (days, fisher days, number of nets) for targeted and non-targeted species, as well as the location the fishing activity took place. These data are submitted to SARDI Aquatic Sciences on a monthly basis and provide a time series that constitutes the most fundamental dataset available for assessing the status of the fish stocks harvested by the fishery.

From 1 July 2007 a logbook was also introduced for commercial licence holders to report interactions with TEPs. This process continues to provide information on fishery relationships with a number of non-target species encountered in the fishery.

11.3 Reporting

As the primary research provider, SARDI Aquatic Sciences will publish two key reports on the Lakes and Coorong Fishery: a fishery and environmental assessment report annually; and a stock assessment report for Pipi once every three years. These reports will provide the necessary biological, environmental and fishery information to support decision-making for the sustainable management of the fishery. Those reports are:

1. *Fishery and environmental assessment report*. Published annually following the collation of fishery catch and effort statistics and key environmental and biological information for the previous financial year, this report is structured to align with the three habitat-based gillnet sectors of the fishery, and the Pipi fishery. The report will provide:
 1. a description of the dynamics of the multi-species, multi-gear Lakes and Coorong Fishery fleet;
 2. a historical summary of commercial and recreational fishery statistics for, and assign stock status to, key species harvested by the three habitat-based gillnet sectors of the fishery, and for Pipi;
 3. updated estimates of the environmental and biological performance indicators used in the finfish harvest strategy for the three habitat-based gillnet sectors (Section 10); and
 4. updated estimates of the biological performance indicators for Pipi, including population size / age structure and the abundance of legal and sub-legal sized Pipis, based on fishery-independent sampling (Section 10).

This report will also include a comprehensive ecosystem-based stock assessment once every three years for key species (Mulloway, Yelloweye Mullet or Golden Perch) within each of the three habitat/gear-based sectors of the fishery, providing a triennial reporting cycle upon which the overall performance of each sector will be assessed. In addition to the above information, this stock assessment will provide a synopsis of information available for the species and an assessment of stock status, based on:

- (i) commercial fishery catch and effort statistics for the dominant and non-dominant gear types used to target the species;
- (ii) results from State-wide recreational fishing surveys done since 2000/01; and
- (iii) information on the size and age structures of fishery catches to information on population structure. Management implications and future research needs will also be identified.

2. Stock Assessment report – Pipi. This is a major report that is published every four years as set out in the timetable in this management plan. The report provides a detailed analysis of the biological performance of Pipi and reports on the fishery performance against key indicators outlined within the relevant harvest strategy. It also includes all the relevant research that may have occurred since the last Pipi stock assessment.

In addition to these reports, SARDI Aquatic Sciences also publishes annual wild fisheries information and statistics report and a threatened, endangered and protected species interactions report.

11.4 Strategic research plan

The annual research priorities of the Lakes and Coorong Fishery are outlined in a 10-year research plan (Table 13) The plan is centred on the production of fishery and environmental performance reports, ecosystem-based stock assessment reports, stock assessment reports for Pipi, as well as the collection of biological information and the maintenance of data to support the production of these reports. A strategic research plan for key knowledge gaps will be developed to support management of the fishery. This research plan may be reviewed or updated at any time. Provision is also made within the research plan to be flexible in that some species need to be evaluated as the opportunity presents and environmental conditions allow. Also, the research plan needs the flexibility to allow projects to run for more than a 12-month period.

Table 13 Outline of the Strategic research plan for the Lakes and Coorong Fishery

	Fishery and environmental performance report	Ecosystem-based stock assessment report – finfish			Stock Assessment report - Pipi	Collection of commercial catch and effort data	Collection of fishery-independent biological data
		Freshwater LMGN	Estuarine LMGN	Estuarine SMGN			
2020/21	X			X	X	X	X
2021/22	X					X	X
2022/23	X		X			X	X
2023/24	X			X	X	X	X
2024/25	X	X				X	X
2025/26	X		X			X	X
2026/27	X			X	X	X	X
2027/28	X	X				X	X
2028/29	X		X			X	X
2029/30	X			X	X	X	X

12 Compliance and Monitoring

12.1 Objectives

PIRSA Fisheries and Aquaculture administers a compliance program that has dual objectives:

- To maximise voluntary compliance with fisheries rules
- To create effective deterrence to breaching fisheries rules.

These objectives are consistent with the National Fisheries Compliance Policy.

Voluntary compliance is maximised through ensuring that fishers are aware of the rules that apply to their fishing activities, understand the rules and the purpose of those rules and operate in a culture of compliance.

Effective deterrence is created through the presence of Fisheries Officers and awareness of compliance operations, as well as through detection and prosecution of illegal activity.

13 Review of the Plan

A review of this management plan may be conducted at any time and a full review will be conducted prior to the expiry of this plan.

Under the *Fisheries Management Act 2007* management plans are subject to periodic review by the PIRSA. Section 49 of the Act outlines the process of reviewing a management plan.

If new ideas and initiatives become available during the life of this plan, they will be considered for incorporation into the management plan in consultation with the Lakes and Coorong Fishery Management Advisory Committee.

14 Resources Required to Implement the Plan

South Australia's fisheries resources are managed in accordance with the Fisheries Management Act 2007 established to protect, manage and develop the aquatic resources of the State in a manner that is consistent with ecologically sustainable development to the benefit of the community, and management should occur in an efficient and cost effective manner with targets set for the recovery of management costs.

The recovery of costs associated with the management of the commercial fisheries as required by the *Fisheries Management Act 2007* has been intended to ensure specific industry sectors fund the government products and services required as a direct result of their commercial activities derived from access to the State's community-owned aquatic resources. The cost for the provision of these services is recovered by PIRSA Fisheries and Aquaculture through the administration of annual fees applied to regulated licences, or fee for service work applied on a per-transaction basis if required.

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16 Acronyms

CLLMM	Coorong, Lower Lakes and Murray Mouth
CPUE	Catch per unit effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEH	Former Department of Environment and Heritage (South Australia)
DENR DEWNR	Former Department of Environment and Natural Resources (South Australia) Department of Environment, Water and Natural Resources (South Australia)
DoE	Department of the Environment (Commonwealth)
EBFM	Ecosystem-based fisheries management
ESD	Ecologically sustainable development
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FGM	Fisheries Gross Margin
FRDC	Fisheries Research and Development Corporation
FTE	Full time equivalent
GSP	Gross State Product
GVP	Gross Value of Production
ILUA	Indigenous Land Use Agreement
LCF	Lakes and Coorong Fishery

LCFMAC	Lakes and Coorong Fishery Management Advisory Committee
LML	Legal Minimum Length
LMGN	Large Mesh Gill Net
MDBA	Murray-Darling Basin Authority
MDB	Murray-Darling Basin
MDBC	Murray-Darling Basin Commission
MEY	Maximum Economic Yield
MSC	Marine Stewardship Council
NRM	Natural Resource Management
PIRSA	Department of Primary Industries and Regions
SARDI	South Australian Research and Development Institute
SASQAP	The South Australian Shellfish Quality Assurance Program
SMGN	Small Mesh Gill Net
TACC	Total Allowable Commercial Catch
TACE	Total Allowable Commercial Effort
TEPS	Threatened, endangered and protected species

17 Glossary of Common Fisheries Management Terms

These terms are intended to be used for the purposes of this management plan only and are intended to be consistent with fisheries legislation.

Aboriginal traditional fishing Fishing engaged in by an Aboriginal person for the purposes of satisfying personal, domestic or non-commercial, communal needs, including ceremonial, spiritual and educational needs, and using fish and other natural marine and freshwater products according to relevant aboriginal custom.

Age structure A breakdown of the different age groups within an individual population, or population sample.

Allocation Distribution of the opportunity to access fisheries resources, within and between fishing sectors.

Benthic Describes animals that live on, in or near the substrate.

Biodiversity The variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part) and includes: (a) diversity within species and between species; and (b) diversity of ecosystems.

Biological reference point An indicator of the status of an exploited stock and a standard for comparison between years. Two types are often used when sufficient biological data are available: those based on fishing mortality and those based on the sustainability of recruitment. In data poor fisheries, other BPIs related to estimates of relative biomass may be used (i.e. total catch and catch per unit effort). Reference points can be either desirable targets (target reference points) or minimum biologically acceptable limits (limit reference points).

Biomass The total weight or volume of individuals in a fish stock.

By-catch At a broad level, fisheries by-catch includes all material, living and non-living, other than targeted species which is caught while fishing. It includes discards (that part of the catch returned to the water) and also that part of the catch that is not landed but is killed as a result of interaction with fishing gear.

By-product Non-targeted catch that is commercially valuable and retained by fishers.

Catch The total amount (weight or number) of a species captured from within a specified area over a given period of time. The catch includes any animals that are released or returned to the water.

Catch per unit effort (CPUE) The weight or number of a species caught by a specified amount of effort. Typically, effort units are defined using a combination of the following factors: gear type; gear size; the amount of gear; the amount of time the gear is used; and the number of people operating the gear. CPUE is often used as an index of relative abundance in fisheries stock assessment. In modern assessments, CPUE is standardised to account for the diverse range of factors that can affect CPUE.

Co-management Arrangements between governments and stakeholder groups to allow joint responsibility for managing fisheries resources on a cooperative basis.

Commercial fishing Fishing undertaken for the purpose of trade or business.

Ecologically Sustainable Development Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.

Ecosystem A dynamic complex of plant, animal, fungal, and micro-organism communities and the associated non-living environment interacting as an ecological unit.

Effort Amount of fishing taking place, usually described in terms of gear type and frequency or period during which the gear is in use; for example, 'hook-sets', 'trawl-hours', 'searching hours'.

Fecundity Number of eggs an animal produces each reproductive cycle; the potential reproductive capacity of an organism or population.

Fish An aquatic animal other than an aquatic bird, an aquatic mammal, a reptile or an amphibian.

Fishery A term used to describe the collective enterprise of taking fish. A fishery is usually defined by a combination of the species caught (one or several), the gear and/or fishing methods used, and the area of operation.

Fishery dependent data Information collected about a fishery or fish stock by the participants of a fishery, e.g.. catch and effort information from fishery log sheets.

Fishery independent data Information collected about a fishery or fish stock by researchers, independent of the fishery, e.g.. scientific surveys, observer reports.

Fishing mortality The rate of deaths of fish due to fishing.

Gross value of production (GVP) Value of the total annual catch for individual fisheries, fishing sectors or the fishing industry as a whole, and is measured in dollar terms. GVP, generally reported on an annual basis, is the quantity of catch for the year multiplied by the average monthly landed prices.

Habitat The place or type of site in which an organism naturally occurs.

Harvest The total number or weight of fish caught and kept from an area over a period of time.

Indicator species A species whose presence or absence is indicative of a particular habitat, community or set of environmental conditions.

Indigenous Land Use Agreement (ILUA) This is an agreement between a native title group and others about the use and management of land and waters. They were introduced as a result of amendments to the *Native Title Act* in 1998.

Length Frequency An arrangement of recorded lengths of a species of fish, which indicates the number of times each length or length interval occurs in a population or sample.

Limited entry Fishing effort is controlled by restricting the number of operators. It usually requires controlling the number of licences in a fishery. It can also include restrictions on the number and size of vessels, the transfer of fishing rights, and the replacement of vessels.

Logbook An official record (statutory declaration) of catch and effort data made by commercial fishers.

Mortality Rate of deaths (usually in terms of proportion of the stock dying annually) from various causes. Comprises (i) Natural Mortality - deaths in a fish stock caused by predation, pollution, senility, etc., but not fishing and (ii) Fishing Mortality - deaths in a fish stock caused by fishing.

Ngarrindjeri are a nation of 18 "tribes" (lakinyeri) consisting of numerous family clans who speak similar dialects of the Ngarrindjeri language and are the traditional owners of the lower Murray River, western Fleurieu Peninsula, and the Coorong of southern, central Australia.

Non-target species Any part of the catch, except the target species, and including by-catch and by-product.

Output controls Limitations on the weight of the catch (quota), or the allowable size, sex or reproductive condition of individuals in the catch.

Owner-operator and Unpaid Family Labour In many fishing businesses there is a component of labour that does not draw a direct wage or salary from the business. This will generally include owner/operator labour and often also include some unpaid family labour. The value of this labour needs to be accounted for which involves imputing a labour cost based on the amount of time and equivalent wages rate. In the above calculations this labour cost can be included simply as another cost so that GOS takes account of this cost. Alternatively, it can be deducted from GOS to give a separate indicator called boat cash income. Owner-operator and unpaid family labour is separated into variable labour (fishing and repairs and maintenance) and overhead labour (management and administration).

Population A group of individuals of the same species, forming a breeding unit and sharing a habitat.

Quota A limit on the weight or number of fish that may be caught of a particular stock or from specified waters.

Quota entitlement The proportion of a quota that is allocated to a particular licence, which limits the total amount of a species that is permitted to be taken pursuant to that licence.

Recruitment The addition of new individuals to a stock.

Reference point Provide a reference against which the performance of the indicator can be assessed.

Relative abundance An index of fish population abundance used to compare fish populations from year to year. This does not measure the actual numbers of fish, but shows changes in the population over time.

Sample A proportion or a segment of a fish stock which is removed for study, and is assumed to be representative of the whole. The greater the effort, in terms of both numbers and magnitude of the samples, the greater the confidence that the information obtained is a true reflection of the status of a stock (level of abundance in terms of numbers or weight, age composition, etc.).

Socio-economic Relating to both social and economic considerations.

Spatial Of or relating to space.

Species A group of organisms capable of interbreeding freely with each other but not with members of other species.

Stakeholder An individual or a group with an interest in the conservation, management and use of a resource.

Stock A group of individuals of a species occupying a well defined spatial range independent of other groups of the same species, which can be regarded as an entity for management or assessment purposes.

Stock assessment A detailed analysis of stock status (abundance, distribution, age structure, etc.) to support the management of the species/fishery.

Target species The most highly sought component of the catch taken by fishers.

Traditional fishing Fishing for the purposes of satisfying personal, domestic or non-commercial communal needs, including ceremonial, spiritual and educational needs and utilising fish and other natural marine and freshwater products according to relevant indigenous custom.

Temporal Of or relating to time.

Threatened A species or community that is vulnerable, endangered or presumed extinct.

Total allowable catch (TAC) For a fishery, a catch limit set as an output control on fishing. The total amount of a species that may be taken during a specified time period.

Total allowable commercial catch (TACC) For a fishery, a catch limit set as an output control specifically on commercial fishing. The total amount of species that may be taken by commercial fishing during a specified time period.

Total allowable commercial effort (TACE) For a fishery, a level of effort is set as an output control specifically on commercial fishing. The total amount of species that may be taken by commercial fishing during a specified time period.

Trigger points Events or measures that, if they occur or if they reach specified levels, are used to determine when a response should be made. Not usually used as a criterion for overfishing, but to indicate the need for review of management.

Uncertain A fish stock that may be underfished, fully fished or overfished, but for which there is inadequate or inappropriate information to make a reliable assessment of its status.

Yield Total weight of fish harvested from a fishery.

18 Schedule 1

Aquatic resources prescribed for the Lakes and Coorong Fishery under schedule 1 of the *Fisheries Management (Lakes and Coorong) Regulations 2009*.

Annelids
Bloodworm (Class Polychaeta)
Tubeworm (Class Polychaeta)
Crustaceans
Crab of all species (Family Portunidae)
Freshwater Prawn (*Macrobrachium australiensis*)
Yabby (*Cherax* spp)
Molluscs
Southern Calamari (*Sepioteuthis australis*)
Cockle
Mussels (*Mytilus* spp)
Freshwater Mussels (Family Hyriidae)
Pipi (*Donax* spp)
Gould's Squid (*Nototodarus gouldi*)
Vongole
Scalefish
Australian Anchovy (*Engraulis australis*)
Barracouta (*Thyrskites atun*)
Black Bream (*Acanthopagrus butcheri*)
Bony Bream (*Nematalosa erebi*)
Carp of all species (Family Cyprinidae)
Cod of all marine species (Family Moridae)
Congolli (*Pseudaphritis urvilli*)
Dory of all species (Family Zeidae)
Flathead (*Platycephalus* spp)
Flounder of all species (Family Bothidae or Pleuronectidae)
Garfish (*Hyporhamphus melanochir*)
Australian Herring (*Arripis georgianus*)
Mullet of all species (Family Mugilidae)
Mulloway (*Argyrosomus japonicus*)
Murray Cod (*Maccullochella peelii*)
Golden Perch (*Macquaria ambigua*)
Redfin (*Perca fluviatilis*)
Bight Redfish (*Centroberyx gerrardi*)
Redfish (*Centroberyx affinis*)
Western Australian Salmon (*Arripis truttaceus*)
Australian Sardine (*Sardinops sagax*)
Snapper (*Chrysophrys auratus*)
Snook (*Sphyrna novaehollandiae*)
Southern Sole (*Aserragodes haackeanus*)
Swallowtail (*Centroberyx lineatus*)
Sea Sweep (*Scorpius aequipinnis*)

Blue-eye Trevalla (*Hyperoglyphe antarctica*)
Trevally (*Carangidae* spp)
Brown Trout (*Salmo trutta*)
Rainbow Trout (*Oncorhynchus mykiss*)
Whiting of all species (Family Sillaginidae)
Wrasse (*Labridae*) (other than Western Blue Groper (*Achoerodus gouldii*))
Shark
Rays of all species (Class Elasmobranchii)
Shark of all species (Class Elasmobranchii) other than White Shark (*Carcharodon carcharias*)
Skate of all species (Class Elasmobranchii)



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