



Australian Government

Department of the Environment and Heritage

Assessment of the
South Australian Lakes and Coorong Fishery

November 2005

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This document is an assessment carried out by the Department of the Environment and Heritage of a commercial fishery against the Australian Government *Guidelines for the Ecologically Sustainable Management of Fisheries*. It forms part of the advice provided to the Minister for the Environment and Heritage on the fishery in relation to decisions under Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999*. The views expressed do not necessarily reflect those of the Minister for the Environment and Heritage or the Australian Government.

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Assessment of the ecological sustainability of management arrangements for the South Australian Lakes and Coorong Fishery

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EXECUTIVE SUMMARY

Background

The Agriculture, Food and Fisheries Division of the Department of Primary Industries and Resources, South Australia (PIRSA) has submitted a document for assessment under Part 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The draft document *Ecological Assessment of the South Australian Lakes and Coorong Fishery* (the submission) was received by the Department of Environment and Heritage (DEH) on 5 September 2005. The submission was released for a thirty-day public comment period that expired on 14 October 2005. One public comment was received. PIRSA provided a response to the issues raised however no amendment to the submission was necessary.

The submission reports on the South Australian Lakes and Coorong Fishery (LCF) against the Australian Government *Guidelines for the Ecologically Sustainable Management of Fisheries*. The DEH assessment considers the submission, associated documents, public comments and PIRSA response to the comments.

Table 1: Summary of the South Australian LCF

Area	The lower River Murray lakes (Lake Alexandrina and Lake Albert), the Coorong lagoons, and coastal marine waters adjacent to the Sir Richard and Youngusband Peninsulas (out to three nautical miles from the low water mark).
Fishery status	Goolwa cockles, black bream and golden perch are fully exploited. Other key species are of unknown status.
Target Species	Key species are: <ul style="list-style-type: none"> • Goolwa cockles (<i>Donax deltoides</i>); • mullocky (<i>Argyrosomus japonicus</i>); • yellow-eye mullet (<i>Aldrichetta forsteri</i>); • black bream (<i>Acanthopagrus butcheri</i>); • greenback flounder (<i>Rhombosolea taparina</i>); • golden perch (<i>Macquaria ambigua</i>); and • European carp (<i>Cyprinus carpio</i>).
Byproduct Species	Principle byproduct species: <ul style="list-style-type: none"> • bony bream (<i>Nematolosa erebi</i>); and • yabbies (<i>Cherax destructor</i>). Over 40 other species are also harvested.
Gear	Multi-gear fishery including mesh nets, swinger nets, hauling nets, bait net, drop/hook nets, dab net, drum net, cockle rake, cockle net, crab rake, yabbie trap, shrimp trap, set line, razor fish tongs, fish spear and electro-fishing gear.
Season	Spatial and temporal closures for the commercial sector of the LCF: <ul style="list-style-type: none"> • Goolwa cockles (ocean beaches) closed from 1 June to 31 October; • Murray cod (Lake Alexandrina and Lake Albert) closed from 1 September to 31 December; • all nets (Area 1 of the Coorong) closed from 25

	<p>December to 7 January;</p> <ul style="list-style-type: none"> • small mesh nets, set and haul (Area 1 of the Coorong) closed 1 November to 31 March; • all nets (within 500m of Murray Mouth) closed all year round; and • all nets (Goolwa channel) closed between midnight on Friday and sunset on the following Sunday.
Commercial harvest (2002/03)	Commercial catch for entire LCF was 1,979 tonnes.
Value of commercial harvest (2002/03)	Approximately AUD\$4.5 million
Recreational harvest (2000/01)	<p>Estimates for key species:</p> <ul style="list-style-type: none"> • Mulloway – 38 t; • Black bream – unknown; • Yellow-eye mullet – 12 t; • Goolwa cockles – 23 t; • Greenback flounder – unknown; • Golden perch – nil; and • European carp – 3.6 t.
Commercial licences issued	<p>LCF:</p> <ul style="list-style-type: none"> • 37 licenses, with a variety of different gear entitlements. <p>Other Fisheries with some degree of access to species in the LCF:</p> <ul style="list-style-type: none"> • Licence holders in the Marine Scalefish Fishery (371); • Northern Rock Lobster Fishery (68); and • Southern Rock Lobster Fishery (181).
Management arrangements	<p>Output control:</p> <ul style="list-style-type: none"> • size limits on key species. <p>Input controls include:</p> <ul style="list-style-type: none"> • limited entry (37 licenses); • gear restrictions; • spatial and temporal closures; and • restrictions on number of commercial agents permitted to assist fishing operations.
Export	Licence holders are investigating opportunities for export markets of Goolwa cockles.
Bycatch	Bycatch consists of undersized/oversized target species, beach worms, shore crabs, unwanted bony bream, target species during closed seasons, silver perch and Murray River catfish.
Interaction with Threatened Species	Murray cod are taken in the Lakes sector as byproduct or bycatch. Interactions with water birds, silver perch, Murray River catfish, syngnathids and cetaceans are possible.

The area of the LCF includes freshwater, estuarine and marine waters of the lower Murray River lakes (Lake Alexandrina and Lake Albert), the Coorong lagoons and the coastal marine waters adjacent to the Sir Richard and Youngusband Peninsulas, to three nautical miles from the low water mark. The LCF does not operate in Commonwealth waters.

The LCF is a multi-species and multi-gear fishery harvesting a variety of scalefish, crustaceans, molluscs, annelids, sharks, skates and rays. There is no limit to the quantity of specified taxa that may be taken in the fishery. The LCF can be divided into three sectors: Coorong Lagoon and Ocean Beach Fishery (Finfish), the Goolwa Cockle Fishery and the Lakes Fishery. Greater than 40 species are able to be retained by the fishery however all but key species (described below) are caught in small quantities only.

The main target species of the LCF include: Goolwa cockles (*Donax deltoides*) in the Goolwa Cockle Fishery; mulloway (*Argyrosomus japonicus*), black bream (*Acanthopagrus butcheri*), yellow-eye mullet (*Aldrichetta forsteri*), and greenback flounder (*Rhombosolea taparina*) in the Coorong Lagoon and Ocean Beach Fishery; and golden perch (*Macquaria ambigua*) and European carp (*Cyprinus carpio*) in the Lakes Fishery. During 2002/03, 212 tonnes of bony bream (*Nematolosa erebi*) were taken in the LCF, and between 1992/93 and 2002/03 inclusive, a total of 6,318 tonnes of the species were harvested. Bony bream are caught in larger numbers than a number of other key target species, and in 2002/03 was the third most harvested species in the LCF, after Goolwa cockles and European carp. Although bony bream are designated as a byproduct species in the submission, they will be considered along with target species in this assessment in recognition of the considerable proportion they contribute to total harvests in the LCF.

Goolwa cockle

Goolwa cockles (also known as pipis or ugari) are distributed on surf beaches from southern Queensland to Eyre Peninsula, South Australia and are found along high-energy coastlines within the surf zone (Kailola *et al.*, 1993). The South Australian cockle population found in the Coorong is likely to be the largest population in Australia (King, 1976). The maximum size reached by the species is >60mm at 3-3.5 years of age, and their maximum age is 4-5 years. Goolwa cockles mature at about 13 months of age (>36mm shell length) and spawn mainly during September and October in South Australia (Kailola *et al.*, 1993). Abundance of cockles from year to year is subject to enormous fluctuations and is affected by environmental variations such as reduced salinity. Like most bivalves, Goolwa cockles are filter feeders, and play an important role in the trophic structure of beaches they inhabit (McLachlan *et al.*, 1996). Surf diatoms are major food items for cockles. Goolwa cockles are a food source for various seabirds, and on New South Wales ocean beaches, the abundance of pied oystercatchers (*Haematopus longirostris*) has been linked to populations of cockles. Areas of beachfront with higher densities and/or larger sized cockles were correlated with higher bird abundance (Owner & Rohweder, 2003).

Mulloway

Mulloway are distributed in Australia from North West Cape in Western Australia, around southern Australia and north to the Burnett River in Queensland. They are prevalent in the lower reaches of rivers and mouths of estuaries especially after periods of high summer rainfall (Kailola *et al.*, 1993). In South Australia juveniles are most commonly found in estuaries whereas adults are found mainly in the high-energy surf zone (Kailola *et al.*, 1993). In South Australia, the major commercial fishery for mulloway is the LCF. Mulloway are also a popular target species for recreational anglers, a candidate for aquaculture ventures and are captured as byproduct and bycatch in other commercial fisheries of South Australia.

Mulloway generally spawn in coastal marine waters adjacent to the surf zone (Kailola *et al.*, 1993). In South Australia spawning occurs between October and February. The spawning behaviour and locations of mulloway in South Australia are not clear, although during late spring and early summer adults are attracted to the Murray River mouth by freshwater outflows and an abundance of food and may possibly use these aggregations as a reproductive strategy. Juveniles may travel in loose schools, but adults are usually solitary (Kailola *et al.*, 1993). They grow quickly in their first few years and in South Australian waters fish 2-3 years old average 46 cm total length and 1.5 kg in weight; and fish 5-6 years old average 80 cm and 8 kg. Maturity is reached at a large size and it has been estimated that 50% of mulloway mature at around 75 cm length (Hall, 1986). Estimates of size at maturity of the same species from South Africa are higher and are differentiated by sex; males found to reach maturity at 92 cm and females at 107 cm (Griffiths & Hecht, 1995). More research is currently being undertaken in SA that suggests the length at maturity may be greater than earlier research had indicated. Mulloway are fast moving fish and movements between estuaries several hundred kilometres apart have been recorded. According to the 2003 stock assessment, current fishing practices and levels of harvest appear to be sustainable under current flow conditions, however, continued increases in the levels of extractions of water from the Murray River for agriculture could alter this situation (Ferguson & Ward, 2003).

Mulloway feed on smaller fish including yellow-eye mullet, leatherjackets, garfish, blue mackerel, bony bream, tommy-ruff, pilchards and yellowtail. They also feed on crabs, prawns and worms. Adult mulloway may also feed on juvenile mulloway (Kailola *et al.*, 2003).

Yellow-eye mullet

Yellow-eye mullet are schooling fish that inhabit bays, estuaries and coastline from Shark Bay in Western Australia around southern Australia including Tasmania and up the eastern coast to Newcastle, New South Wales, and are also found in estuaries around New Zealand. Yellow-eye mullet are a popular target for recreational fishers in all areas that they are found.

Yellow-eye mullet spawn once per year in coastal waters and protected marine areas. Fecundity of females increases with age and may produce 125,000 eggs at 24.5 cm total length (2-3 years of age) to 630,000 eggs at 39 cm (close to their maximum length of 40 cm attained at about 5 years of age). Juveniles enter estuaries at a length of 3-4 cm, where they remain until they reach 25-30 cm, at which point they gradually move into more open waters. In the Coorong, yellow-eye mullet grow to 20-22 cm within 2 years (Kailola *et al.*, 2003). Yellow-eye mullet feed on plankton as juveniles and detritus, seagrass, algae, small animals including amphipods, gastropods and polychaetes and epiphytes as adults. They are a common prey item of mulloway (Kailola *et al.*, 2003).

Black bream

Black bream are endemic to Australia and inhabit estuarine waters from the Murchison River in Western Australia to central New South Wales, including waters of Tasmania and the islands of Bass Strait (Kailola *et al.*, 1993). Stock structure is uncertain but black bream do not appear to frequently move between estuaries, suggesting stocks may be separated geographically. In South Australia, most of the commercial catch is from the Coorong, although black bream are common in estuaries from the Victorian border to Port Lincoln on the west coast, including Kangaroo Island. The species is also popular with recreational anglers.

The spawning season for black bream in South Australia is between November and January (Kailola *et al.*, 1993). Spawning usually occurs in the upper estuary near the interface between fresh and brackish waters (Kailola *et al.*, 1993); 300,000 to 3,000,000 small, pelagic eggs may be released by each female during the spawning season. In the Coorong, it is believed that temperature dependent freshwater inflows provide a critical spawning stimulus for black bream as well as other estuarine-dependent species. The magnitude, timing and duration of freshwater flows affect larval

survival and development, suggesting that an improved barrage flow strategy in the Coorong could potentially lead to improved black bream stock production.

Black bream are a slow growing, relatively long lived species that reach a maximum age and size of more than 29 years and 40cm, respectively (Cashmore *et al.*, 2000). Growth rates are variable between locations (Kailola *et al.*, 1993). Males reach sexual maturity at 3 years old at lengths of between 14-18 caudal fork length (CFL), while females reach maturity at 4 years old at lengths of between 21-25cm CFL (Hall, 1984). They are a demersal species that feed opportunistically on a range of plant and animal species including bivalve and gastropod molluscs, prawns, crabs, polychaetes and small fish (Kailola *et al.*, 1993).

Greenback flounder

Greenback flounder are a common species in temperate estuaries, embayments and inshore coastal waters; distributed throughout New South Wales, Victoria, Tasmania, South Australia and eastern Western Australia (Kailola *et al.*, 1993). The stock structure of Western Australian and South Australian greenback flounder populations has not been studied. However, Hall (1984) documented that greenback flounder were rarely captured in marine waters outside of the Coorong, suggesting that the Coorong population is estuarine resident, completing its life cycle in the sheltered waters of the Coorong lagoons. Adults feed nocturnally with the incoming tide on shallow mud banks, whereas larvae feed during daylight hours (Cox & Pankhurst, 2000). Limited information is available on the growth and age characteristics of greenback flounder populations in South Australia. The small amount of information that exists suggests that greenback flounder are a fast growing species that reach a maximum length of 40cm and weight of 0.6kg, at an age of between 3 and 4 years (Hall, 1984; Kailola *et al.*, 1993); maturity is reached between 19-30 cm in length. Larval abundance is greatest between June and August (Kailola *et al.*, 1993). Larval flounder feed on zooplankton (Jenkins, 1987) and juvenile fish feed largely on harpacticoid copepods (Shaw & Jenkins, 1992).

Golden perch

Golden perch are endemic to Australia, and are distributed throughout the Murray-Darling river system with the exception of streams at altitudes greater than 600 m. Golden perch are also found in rivers of the eastern Lake Eyre and Bulloo drainages, the Dawson-Fitzroy river system and in many floodplain lakes of western Victoria and New South Wales (Kailola *et al.*, 1993). The species is Australia's most migratory freshwater fish species, with recorded migrations of up to 2,000 km.

Within South Australia, two separate stocks of golden perch exist; the central stock and the lakes stock. The ranges of these two stocks overlap and both are found in the LCF. The species is managed as a single stock as the two stocks have similar morphology and overlapping range.

Golden perch are long lived, and can reach 26 years of age and 760 mm in length (Ye, 2004). Growth rates are dependent on temperature and food availability. Golden perch grow to approximately 16 cm by one year of age, 29 cm at two years, 50 cm at five years; females grow faster than males after their second year (Kailola *et al.*, 1993). Males mature at 2-3 years of age and females at 4-5 years. Golden perch spawn from early spring to late autumn, most commonly at night and following a rise in water temperature (>23 °C) and inundation of the floodplain. Large females can produce up to 500,000 eggs, and may spawn more than once a season, although in unfavourable seasons, may not spawn at all. Fertilised eggs swell and become semi-buoyant, floating downstream with the current, hatching within 32 hours (at 23 °C). Larvae are attracted to light and the presence of redgum timber in the water and so prefer the shallower waters of the floodplain (Kailola *et al.*, 1993).

The diet of juvenile fish consists of zooplankton, yabbies, small fish and aquatic insects, and shifts to yabbies and a variety of fish species in adulthood. Predators of golden perch include cormorants, redfin perch and Murray cod.

Bony bream

Bony bream are a freshwater species endemic to Australia and are widely distributed throughout all mainland warm water catchments. Bony bream spawn from spring to early summer when water temperatures rise above 21 °C. Spawning aggregations occur off sandy shores in the Lakes (Kailola *et al.*, 1993).

Males and females mature at one year of age, when males are 16 cm and females are 20 cm in length. Fecundity increases with size, and females produce from 90,000 to 880,000 demersal adhesive eggs. Maximum age recorded is 10 years. Adult bony bream feed primarily on algae and aquatic plants, as well as insects and small crustaceans. Bony bream fill an important position in the trophic dynamics of the LCF, being important dietary items for a variety of water birds, freshwater fish (including golden perch and Murray cod) and estuarine fish (including mulloway).

European carp

European carp are introduced freshwater fish native to Asia. Their range in Australia consists of catchments in southern Western Australia and Queensland, NSW, Victoria and South Australia. European carp are now the most common fish species in the Murray-Darling Basin. Their range in South Australia includes the Murray River and the lower lakes, as well as other South Australian rivers and streams. Of the three stocks of carp in Australia, the South Australian population is a part of the Boolarra stock; distributed throughout the Murray-Darling Basin (Kailola *et al.*, 1993).

Carp are thought to live to 20 years and reach a total length of 85 cm, weighing more than 15 kg. Females mature between 3-5 years of age at 26 cm length, and males between 2-4 years at 20 cm (Kailola *et al.*, 1993).

In 2002/03 the total harvest in the LCF was estimated to be 1,979 tonnes, at a gross value of production of AUD\$4.5 million. Catches and values of key species in that year were: mulloway 45 t (value \$306,000); yellow-eye mullet 167 t (value \$392,000); black bream 12 t (value \$110,000); greenback flounder 6 t (value \$53,000); Goolwa cockles 1,086 t (value \$2,013,000); golden perch 38 t (value \$583,000); European carp 404 t (value \$748,000) and bony bream 212 t (value \$227,000) (EconSearch, 2004).

The LCF has played an important role in the establishment of coastal settlements in the region since European settlement. The commercial fishery has helped to shape the social and economic structure of communities by providing employment and provision of fresh seafood products. Records of fishing enterprises in the lower Murray Lakes and Coorong have been traced as far back as 1846. Prior to this date, the area was undoubtedly a valuable fishing ground for Indigenous people of the region. Early commercial fishing enterprises took large amounts of mulloway, as the swim-bladder could be dried to produce isinglass used for brewing (Olsen, 1991). After 1953, following the development of the steamer-barge transport system in the Murray River, fishing developed in the area and the main species taken were mulloway, bream, yellow-eye mullet, Australian salmon (*Arripis truttacea*) and tommy-ruff (*A. georgiana*). Provision by fishers of monthly catch and effort records to the then South Australian Department of Fisheries became compulsory in 1972. In 1984/85 data collection on fishing location became more specific by splitting the fishery into 16 areas for the purposes of logbook records. The logbook is currently being reviewed by PIRSA, and a new management plan was released in July 2005.

All products from the LCF are currently sold on domestic markets, but an export market is being sought for Goolwa cockles.

The LCF is a multi-gear fishery consisting predominantly of mesh nets. Commercial fishing methods permissible under the management plan include: cockle rakes and cockle nets (used only in the Goolwa cockle sector); electro-fishing gear (used only in the Lakes sector); mesh nets, swinger nets, hauling nets, bait nets, drop/hoop nets, dab nets, drum nets, crab rakes, yabbie traps, shrimp traps, set lines, razor fish tongs and fish spears. Various gear restrictions include prescribed mesh size, net drop, length, break strain and number of gears used. Other fishery management arrangements include spatial and temporal closures, minimum and maximum size limits for some species and restrictions on number of commercial agents permitted to assist fishing operations. The LCF is a limited entry fishery with 37 commercial fishers currently operating under licence.

No information is currently available on the amount of bycatch taken by fishers in the LCF. Possible bycatch taxa include out of season or undersized and oversized (where applicable) commercial species, undesirable species or protected species. Possible protected species taken as bycatch in the fishery include water birds, protected finfish (silver perch *Bidyanus bidyanus* and River Murray catfish *Tandanus tandanus* under State protection), protected invertebrates (Murray River freshwater crayfish *Euastacus armatus* under State protection) and Murray cod *Maccullochella peelii peelii* (during the closed season). Interactions with dolphins, great white sharks, seals, sea turtles and freshwater turtles may occur but these taxa are unlikely to be captured in the fishery. These interactions are assessed under Part II, Principle 2 of this report. A Fisheries Research and Development Corporation (FRDC) funded project to determine the level and composition of non-retained species in the LCF commenced in 2005 (project 2005/061).

Mulloway, yellow-eye mullet and Goolwa cockles are taken in other marine fisheries of South Australia, and mulloway are also taken in the Commonwealth Southern and Eastern Shark and Scalefish Fishery. The Marine Scalefish Fishery, Northern Zone Rock Lobster Fishery and the Southern Zone Rock Lobster Fishery may harvest Goolwa cockles in Coorong coastal waters for bait purposes only. Presently there is no catch limit for bait collection, however collections by operators in those fisheries are recorded on their respective catch and effort logbooks and factored into LCF stock assessments.

All target species in the LCF are subject to recreational fishing. PIRSA controls recreational take using gear restrictions, size limits, and spatial and temporal closures. The most recent and comprehensive estimate of recreational harvests of LCF stocks is the National Recreational and Indigenous Fishing Survey conducted in 2000/01 (Henry & Lyle, 2003). Substantial numbers of mulloway and yellow-eye mullet were estimated to have been harvested by recreational fishers in the area of the LCF, and to a lesser extent Goolwa cockle, black bream, greenback flounder and European carp were taken.

Currently there are no separate management arrangements for Indigenous fishing. Under the current South Australian *Fisheries Act 1982*, Indigenous fishers are not recognised independently to recreational fishers and therefore Indigenous people are required to abide by recreational catch arrangements and estimates of indigenous catch are incorporated in recreational catch estimates. However, local indigenous communities are able to access the fishery for cultural and educational purposes under a specific arrangement. A public comment was made to draw attention to Indigenous fishing aspirations and activities in the LCF and consultative mechanisms in place to pursue access to traditional marine resources. PIRSA provided a response to the public comment and advises that Indigenous fishing rights are being addressed as part of the current review of the South Australian *Fisheries Act 1982*. The proposed new legislation specifically recognises cultural

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

The fishery is managed under the Management Plan for the South Australian Lakes and Coorong Fishery, which sets out a formal harvest strategy for the fishery and provides direction for the formulation of regulations contained within the *Fisheries (Scheme of Management – Lakes and Coorong Fishery) Regulations 1991* and the *Fisheries (General Regulations) 2000*. The powers contained under the *Fisheries (Management Committees) Regulations 1995* provide the legal basis for the plan. The responsibility for preparing the plan lies with the Inland Fisheries Management Committee (Inland FMC). In South Australia, the *Fisheries Act 1982* provides the statutory framework for fisheries management.

Overall assessment

The material submitted by PIRSA demonstrates that the management arrangements for the South Australian LCF meet most of the requirements of the Australian Government *Guidelines for the Ecologically Sustainable Management of Fisheries*.

While the fishery has the basis upon which good management arrangements can be implemented, DEH has identified a number of risks that must be managed to ensure that their impacts are minimised:

- un-validated fishery dependent data that is not reported at fine temporal and spatial scales appropriate to the mode of operation in some sectors of the fishery;
- absence of current robust estimates of recreational, Indigenous and illegal take of LCF species;
- limited stock assessment processes and lack of sound sustainable yield estimates;
- primary management control of species size limits not consistent with reproductive biology;
- limited direct control on effort across all sectors of the fishery;
- no ongoing provision for fishers to record bycatch, including interactions with threatened, endangered and protected species; and
- absence of an evaluation of the impact of fishing activity on the ecological character of The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar site.

Recommendations to address these issues have been developed to ensure that the risk of impact is minimised in the longer term. Through the implementation of the recommendations and the continuation of a responsible attitude to the management of the fishery, management arrangements are likely to be sufficiently precautionary and capable of controlling, monitoring and enforcing the level of take from the fishery while ensuring the stocks are fished sustainably.

The recent implementation of a management plan for the LCF has made considerable progress in developing sound management arrangements for the fishery. The management plan aims to ensure that fishing is conducted in a manner that does not lead to over-fishing and for fishing operations to be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem. On balance, the fishery is being managed in an ecologically sustainable manner and is working to address existing problems and minimise environmental risks.

The operation of the fishery is consistent with the objects of Part 13A of the EPBC Act. Given the recent implementation of the Management Plan for the South Australian LCF, its aim to improve

management of the fishery and work towards increasing the available fisheries data, DEH considers that the fishery will not be detrimental to the survival or conservation status of the taxa to which it relates in the short term. Similarly, it is not likely to threaten any relevant ecosystem in the short term. DEH therefore recommends that the fishery be declared an approved Wildlife Trade Operation (WTO) with the actions specified in the recommendations to be undertaken by PIRSA to contain the environmental risks in the long term. DEH considers that the fishery, as managed in accordance with the management plan is not likely to cause serious or irreversible ecological damage over the period of the export decision. Specifically, the WTO declaration would allow the export of product from the fishery for a period of 3 years. The WTO declaration will require annual reporting on the progress of implementing the recommendations of this report and other managerial commitments. The implementation of the recommendations and will be monitored and reviewed as part of the next DEH review of the fishery in 3 years time.

The assessment also considered the possible impacts on the ecological character of The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar Site. Management of the fishery is based largely on the limited number of operators, spatial and temporal closures, gear restriction and size limits for target species. The Management Plan for the South Australian LCF was developed with consideration for The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar Management Plan. On this basis DEH considers that an action taken by an individual fisher, acting in accordance with the Management Plan for the South Australian LCF, would not be expected to have a significant impact on the ecological character of The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar site.

The implementation of recommendations and other commitments made by PIRSA in the submission will be monitored and reviewed as part of the next DEH review of the fishery in 3 years time.

Recommendations

1. PIRSA to advise DEH of any material change to the LCF's management arrangements that could affect the criteria on which EPBC Act decisions are based, within 3 months of that change being made.
2. PIRSA, within 2 years, to complete the review of catch and effort logbooks, and implement methods to enable catch and effort to be monitored over finer temporal and spatial scales.
3. PIRSA, within 12 months, to review available options to validate catch and effort data on target and byproduct species in the LCF. Appropriate validation mechanisms for target and byproduct catch and effort data to be progressively developed and applied in the fishery within 18 months.
4. PIRSA, within 2 years, to further refine stock assessments in a process to develop more robust sustainable yield estimates for key species. As a first step, PIRSA to implement ongoing programs, within 12 months, to obtain necessary biological and environmental data to inform stock assessment and performance criteria of key species.
5. PIRSA to develop precautionary harvest reference points for bony bream in order to identify any substantial alterations in fishing effort or byproduct catch rates which may indicate changes in stock status.
6. Within 18 months, PIRSA to develop a process to improve estimates of all removals of LCF species, including recreational and Indigenous harvests as well as an estimate of illegal take

and factor these into the stock assessments and management controls to ensure overall catch levels are sustainable.

7. PIRSA, within 2 years, to develop and implement management arrangements to control the extent of harvests of all target and key byproduct species at ecologically sustainable levels. Particular consideration should be directed at addressing the presently uncontrolled increases in catch of Goolwa cockles and risk of overexploitation of cockle stocks.
8. PIRSA, within 18 months, to review known biology of harvested species and existing size limits to ensure size limits are sufficiently precautionary and take into account all removals from the fishery.
9. PIRSA, within 2 years, to develop and implement an ongoing program to collect information on the composition and abundance of bycatch across the commercial sectors of the fishery.
10. Within 2 years, PIRSA to conduct an ecological risk assessment of the impacts of the LCF, including any impacts on the listed ecological character and values of The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar site (Site No. 25). PIRSA to develop and implement any mitigation measures considered necessary.

PART I - MANAGEMENT ARRANGEMENTS

The LCF is managed by PIRSA.

The management regime is described in the following documents, all of which are, or will be publicly available:

- the Management Plan for the South Australian LCF;
- the *Fisheries Act 1982*;
- the *Fisheries (Scheme of Management – Lakes and Coorong Fishery) Regulations 1991*;
- the *Fisheries (General) Regulations 2000*; and
- relevant Gazetted notices and licence conditions.

The *Fisheries (Management Committees) Regulations 1995* provide the legislative basis for the preparation of the management plan for the fishery.

There are a number of other documents, including research reports, scientific literature, minutes of management committee meetings and discussion papers, which are integral to the management of the fishery. Fishery information is available on the PIRSA and South Australian Research and Development Institute (SARDI) websites, which can be viewed at <http://www.pir.sa.gov.au/fisheries> and <http://www.sardi.sa.gov.au>.

DEH considers it important that management arrangements remain flexible to ensure timely and appropriate managerial decisions. Because of the importance of the management plan and documents referred to above to DEH's assessment of the fishery, an amendment could change the outcomes of the assessment and decisions stemming from it. Decisions resulting from this assessment relate to the arrangements in force at the time of the decision. In order to ensure that these decisions remain valid, DEH needs to be advised of any changes that are made to the management regime and make an assessment that the new arrangements are equivalent or better, in terms of ecological sustainability, than those in place at the time of the original decision.

Recommendation 1. *PIRSA to advise DEH of any material change to the LCF's management arrangements that could affect the criteria on which EPBC Act decisions are based, within 3 months of that change being made.*

The principle forum for stakeholder consideration of management and research issues for the LCF is the Inland FMC. The Inland FMC consists of an independent chair, three commercial fishers (two from the LCF and one from the River Fishery), two recreational fishers, a Government fisheries manager, a Government scientist, a representative from the South Australian Recreational Fishing Advisory Council and a representative from the South Australian Fishing Industry Council. The *Fisheries (Management Committees) Regulations 1995* prescribe the advisory role and function of FMCs, and the *Fisheries Act 1982* provides the capacity for the Minister or Director of Fisheries to delegate decision-making powers to a FMC. PIRSA have advised that a South Australian Department of the Environment and Heritage observer was involved in the Inland FMC during the development of the management plan and will retain observer status on the committee. In addition, an observer from the Department of Water, Land and Biodiversity Conservation has recently joined the Inland FMC.

In the submission, PIRSA advises that a review of the *Fisheries Act 1982* may result in changes to broaden the co-management arrangements, in particular to include participation by members of the Indigenous community and conservation groups. DEH considers this action would be appropriate to the management of the LCF.

The fishery is managed under the newly developed Management Plan for the South Australian LCF (commencing July 2005). The plan contains goals relating to the sustainable harvest of fishery resources, optimum utilisation and equitable distribution of fisheries resources within the constraints of sustainability imperatives, minimising impacts on the structure, productivity, function and biological diversity of the ecosystem and cost-effective and participative governance of the fishery. Each goal has a number of management objectives and strategies with accompanying performance indicators and trigger points against which the effectiveness of the management arrangements can be measured.

Upper and lower limit reference points are in place for total commercial catch and commercial catch per unit effort (CPUE) for mulloway, yellow-eye mullet, black bream, greenback flounder, Goolwa cockle and golden perch. No reference limits are in place for bony bream, which are harvested in substantial numbers in the Lakes sector and this absence is discussed in more detail in Part II of the report.

The limit reference points are in place to initiate management responses if the fishery is performing outside the reference range established in the management plan. If a reference point is reached, PIRSA and the Inland FMC will take the following actions:

1. Notify the Minister for Agriculture, Food and Fisheries and participants in the fishery, as appropriate;
2. Undertake a detailed review including an examination of the causes and implications for all key species reaching one or more reference values;
3. Consult with key stakeholder groups regarding the need for alternative management strategies for each sector; and
4. Provide a report to the Minister, within three months of the initial notification, on the effects of the reaching one or more limit reference values, including any recommendations on alternative management strategies.

Management of the fishery is based on a mixture of input and output controls which include limited entry and restrictions on number of commercial agents permitted to assist fishing operations, size limits on key species, gear restrictions, spatial and temporal closures. There are no limits on the potential total level of harvest for any species in the LCF.

PIRSA Fishwatch, in association with the Inland FMC, provides an annual risk assessment for compliance with management arrangements in the fishery. Priorities for the commercial aspect of the LCF for 2003/04 include possession of unregistered/illegal/excess gear, failure to supply logbook data, interference with commercial gear, use of excess agents, including licence holder not present during fishing, illegal sales and taking undersized/oversized fish. Compliance actions include conducting awareness programs, conducting vessel patrols, licence holder inspections, random observations and liaison and networking with markets to increase intelligence. DEH considers that these compliance measures contain the means of enforcing critical aspects of the management arrangements for the fishery.

The Management Plan for the South Australian LCF was developed by PIRSA and the Inland FMC and is to operate for a five-year period until 2010. The management plan is subject to annual review and amendments, and guides the annual processes of the Inland FMC for providing advice to the Minister and Director of Fisheries on management and research for the fishery. Annual assessment of fishery performance will be based on stock status reports for individual species and addressing the key performance indicators outlined in the management plan. The process has been designed to improve public accountability on the management of the LCF. Analyses performed in

the annual stock assessments include trends in catch and effort rates, changes in species composition of catch, bycatch levels, recreational effort levels and significant environmental disturbances. DEH considers that annual reviews of the entire fishery policy framework suitable and expects PIRSA to review critical aspects through stock assessments and to act when adverse signals appear in the fishery.

Fishery-dependent data relating to the target species is collected monthly via fishery logbooks. Limited fishery independent information has also been collected for some aspects of the fishery. Discussion of the information collection system can be found in Part II of this report.

An analysis of the fishery's capacity for assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates is contained under Principle 2 of this report.

The management plan takes into account the harvest from other commercial fisheries in South Australia, as well as mulloway taken in the Commonwealth Southern and Eastern Scalefish and Shark Fishery. Information on shared stocks with other jurisdictions is lacking for most species fished. Spatial distribution of stocks is further described in Principle 1 of this report.

DEH considers that the current management arrangements, through the developments of the FRDC project on gear interaction of non-targeted species in the Lakes and Coorong commercial and recreational fisheries, will comply with all relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy. DEH expects that PIRSA will also ensure compliance with any future plans or policies as they are developed.

The prime international regimes affecting the fishery are the United Nations Convention on the Law of the Sea and The Convention of Wetlands (Ramsar 1971). The management regime essentially complies with both of these conventions and The Coorong, and Lakes Alexandria and Albert Wetland Ramsar Management Plan was taken into account during the development of the LCF management plan. Other international regimes are applicable to fisheries management but do not explicitly involve this fishery, for example the 1992 Convention on Biological Diversity and in particular the 1995 Jakarta Mandate requiring that, in relation to the sustainable use of marine and coastal biological diversity, the precautionary principle should apply in efforts to address threats to biodiversity. While these agreements are not specifically addressed in the submission, the fishery's compliance with their requirements can be assessed by examination of Part II of this report. The application of the International Convention for the Prevention of Pollution from Ships to vessels operating in the fishery is also relevant to the LCF.

DEH considers it is incumbent on all authorities to develop a thorough understanding of the framework of national, regional and international agreements and their applicability to export-based fisheries for which they are responsible.

Conclusion

DEH considers that the South Australian LCF management regime is documented, publicly available and transparent, and is developed through a consultative process appropriate to the scale of the fishery. The management arrangements are adaptable and underpinned by appropriate objectives and performance criteria by which the effectiveness of the management arrangements can be measured, enforced and reviewed.

The management arrangements are likely capable of controlling the harvest through a combination of input and output controls appropriate to the size of the fishery. Periodic review of the fishery is provided for, as are the means of enforcing critical aspects of the management arrangements.

The management regime takes into account arrangements in other jurisdictions, and adheres to arrangements established under Australian laws and international agreements.

DEH considers that there is scope to further refine the management arrangements and has provided a recommendation for improvement in the longer term.

PART II – GUIDELINES FOR THE ECOLOGICALLY SUSTAINABLE MANAGEMENT OF FISHERIES

Stock Status and Recovery

Principle 1: *‘A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover’*

Maintain ecologically viable stocks

Objective 1: *‘The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability’*

Information requirements

Fishery dependent data are obtained through compulsory daily logbooks that have been enforced since 1984/85. Information collected is submitted monthly to SARDI. Catch and effort returns include information identifying the fisher and landing location, effort (number of days gear was set), date, area fished, gear used, target species and landed catch and condition. Logbooks are not used to collect data on bycatch or interactions with threatened species (discussed further under Principle 2 of this report).

Fishery-independent data collection in the fishery is limited. PIRSA recognises this inadequacy and have produced a strategic research and monitoring plan as part of the fishery management plan. The focus of the strategic research and monitoring plan is to increase quantitative information to assist management of the fishery. PIRSA recognises that there are significant gaps in the knowledge of basic biological parameters of many of the species targeted in the LCF. As such, research will be directed towards addressing information gaps, with the intent of producing reliable, quantitative stock assessments.

Presently all stock assessment carried out on LCF species is heavily reliant on fishery dependent data sets collected through commercial catch and effort logbooks. For Goolwa cockles, the acquisition of fishery independent data is inherently difficult due to the varying densities of cockles over short spatial and temporal scales. Therefore, fishery dependent data will continue to contribute the majority of management understanding of the Goolwa cockle harvest in the LCF. PIRSA have advised that SARDI Aquatic Sciences has commenced a PhD study of Goolwa cockles and this will provide fisheries managers with improved information about the biology and ecology of the Goolwa cockle population. This study is scheduled to produce a stock status report within six months of commencement and a stock assessment on its completion. Fishery dependent data is also poor for finfish species in the LCF. Stock assessments and reference points for all species are completely based on fishery dependent catch and effort data and this situation is not likely to be rectified in the near future. The current logbook for the LCF uses fishing 'day' as the base unit of fishing effort. DEH is concerned that a daily unit of fishing effort is a poor indication of actual effort in the fishery and therefore may not adequately inform stock assessment reference points. An hourly record of fishing effort in the Goolwa cockle sector might be more appropriate. For Goolwa cockles, finer spatial data would be invaluable for further understanding the spatial characteristics of the stock and identifying any potential process of localised or serial depletion.

The Inland FMC is currently reviewing the existing commercial logbook for the fishery. This review process will expand the scope of the data collected and refine the spatial and temporal scales currently used, improving the robustness of the data analysis currently performed. However, no

timeline for the review and implementation of the logbooks has been indicated. DEH considers that enhancing the quality of data gathered through the catch and return logbooks to be pivotal for the current method of stock assessment in the LCF and that PIRSA should commit to a firm deadline for completing the review and implementing any changes, where necessary.

Recommendation 2. *PIRSA, within 2 years, to complete the review of catch and effort logbooks, and implement methods to enable catch and effort to be monitored over finer temporal and spatial scales.*

DEH notes that fishery dependent data acquired through catch and effort logbooks is not currently validated. Management of the fishery relies heavily on fishery dependent data for stock assessments and reviewing management performance. DEH considers the lack of validation of catch and effort data a major risk for the sustainable management of the LCF and recommends PIRSA develop and implement a system to validate commercial logbook data as a management priority.

Recommendation 3. *PIRSA, within 12 months, to review available options to validate catch and effort data on target and byproduct species in the LCF. Appropriate validation mechanisms for target and byproduct catch and effort data to be progressively developed and applied in the fishery within 18 months.*

Very little region-specific research has been carried out on species caught in the LCF. Some size and age information is available from various sources (Harris, 1968; Weng, 1971; Ferguson & Ward, 2003; Ye, 2004) but there is very little data on stocks, genetics, post-release survival, reproduction, recruitment, or any other aspect of fish biology or information relevant to fisheries management currently available.

A program to study gear interactions of non-target species in the commercial and recreational fisheries in the Lakes and Coorong area has been funded by FRDC for 2005-2007 (project 2005/061). The project aims to assess the composition and magnitude of retained and discarded catches as well as rates of capture of retained and discarded species for main gear types used by commercial and recreational fishers in the Coorong lagoons. It will also assess the survival of key species discarded after capture with large and small mesh gill nets, haul nets and lines. Mechanisms for reducing bycatch will be identified, and potential performance indicators and reference points related to bycatch will be developed.

The LCF is currently a data poor fishery, as it has had minimal effort and relatively low value in comparison with other South Australian fisheries. PIRSA have indicated recognition for the need for targeted research to determine basic biology parameters of target, byproduct and bycatch species and ecological interactions of these species to improve the fishery independent information available for management considerations. DEH strongly support the acquirement of fishery independent data however recognises that in the absence of such data, more robust, informative and validated fishery dependant data is required (see **Recommendations 2 and 3**).

Assessment

The submission states that estimates of the fishable biomass and the current proportion of that biomass being harvested are not known for any target species of the LCF. Goolwa cockles, black bream and golden perch are thought to be fully exploited, Greenback flounder stock status are unknown, while yellow-eye mullet appear to be within or positively outside fishery reference points. For 2002/03, the fishing practices and levels of harvest for mulloway were thought to be sustainable under those existing flow conditions, however, it was recognised that continued increases in the levels of extractions of water from the Murray River for agriculture could alter that

situation. Reduction in flow from the Murray River appears to negatively impact on stocks of mullet, greenback flounder and black bream and golden perch harvest rates have declined in recent years. Status of bony bream is unknown, but catch rates have declined over the past ten years.

The LCF is a data poor fishery and presently there is little baseline data on biological and ecological parameters of all harvested species. DEH considers this a major threat to sustainable management and a serious inadequacy for an established fishery such as the LCF.

A strategic research plan has been developed for the LCF which prioritises both fishery wide and species specific data gaps requiring research. In addition, PIRSA have detailed a five year schedule for the development of target species specific stock assessments, status reports and literature reviews. DEH commend PIRSA on this strategic approach to identifying research and reporting requirements. DEH expects that more refined stock assessment measures, including sustainable yield estimates, will be developed as a result of the acquisition of baseline biological data through catch sampling or other programs. DEH recommends immediate action in following the research plan to remedy the current data poor status of the fishery.

Recommendation 4. *PIRSA, within 2 years, to further refine stock assessments in a process to develop more robust sustainable yield estimates for key species. As a first step, PIRSA to implement ongoing programs, within 12 months, to obtain necessary biological and environmental data to inform stock assessment and performance criteria of key species.*

In the absence of adequate biological and ecological data on all target species, catch and effort data forms the basis of assessments of stock status currently. Catch records display considerable inter-annual variation for various species, which might reflect the influence of factors external to fishing activities such as environmental effects of flow rates of the Murray River. However, catch records suggest clear trends for some species. Catches of Goolwa cockles demonstrate increasing harvest levels, associated with increasing fishing effort. Bony bream are harvested in the Lakes sector and have been taken in large numbers historically. Catches have declined consistently since 1993/94 when 838 t were landed, to 2002/03 when harvests totalled 212 t, however bony bream remains the 3rd most harvested species by weight in the LCF. PIRSA have been advised that the cause of the declining catches is a result of decreased fishing effort and a shift in the preferred lobster bait market to carp. PIRSA do not currently have sustainability concerns for bony bream.

Bony bream contribute a substantial proportion of total harvests in the LCF and therefore DEH consider it prudent that precautionary harvest reference points be developed for bony bream to identify any substantial alterations in fishing effort or byproduct catch rates which may indicate changes in stock status. This is particularly important given that bony bream occupy an important trophic position in the Lakes system and are preyed upon by several fish and bird species.

Recommendation 5. *PIRSA to develop precautionary harvest reference points for bony bream in order to identify any substantial alterations in fishing effort or byproduct catch rates which may indicate changes in stock status.*

All species caught in the LCF are considered by PIRSA to be single stocks for the purposes of fisheries management. However, knowledge of stock structure for several target species is limited, and stocks of some species may in fact be shared with other jurisdictions. These species include mullet, yellow-eye mullet, Goolwa cockle, greenback flounder, golden perch and bony bream. Several byproduct species are also considered to be shared stocks with other jurisdictions. DEH

considers that the implementation of **Recommendation 4** will assist in identifying shared stocks for the purposes of fisheries management.

Potential removals from the species fished in the LCF include direct harvest by this fishery and harvest of particular species by other fisheries, recreational and indigenous harvest, illegal take and mortalities of discarded undersized, or out of season individual fish/cockles.

Commercial harvests within the LCF are monitored through the completion of catch and effort logbooks, however as noted, catch data is not currently validated (see **Recommendation 3**). The harvest of LCF stocks by other fisheries are also accounted for through their relevant catch and effort recording framework. There is currently no ongoing program to monitor the take by recreational and Indigenous fishing. The most comprehensive and recent survey of recreational and Indigenous fishing in South Australia was performed as part of a national survey undertaken in 2000/01 (Henry & Lyle, 2003). This survey indicated that the take of LCF species by the recreational sector was considerable. This data is now dated and the lack of current, robust estimates of recreational fisher landings poses a significant risk for fishery management purposes.

In the compliance risk assessment, illegal sales of LCF product by non-commercial entities was rated as high risk. Illegal harvest of Goolwa cockles is documented, however the extent of the activity has not been quantified. DEH considers developing a robust and regular method of estimating all removals of LCF stocks, including illegal, recreational and Indigenous catch, a priority for the sustainable management of the LCF.

Recommendation 6. *Within 18 months, PIRSA to develop a process to improve estimates of all removals of LCF species, including recreational and Indigenous harvests as well as an estimate of illegal take and factor these into the stock assessments and management controls to ensure overall catch levels are sustainable.*

The level and fate of bycatch in the fishery is discussed in more detail under Principle 2.

Management response

The LCF contains a mixture of input and output controls which contribute to controlling effort in the fishery. Controls include limited entry (37 licenses), gear restrictions, temporal and spatial closures and size limits for several species, however there is no limit to the potential total take of any species in the fishery. Management of the LCF has maintained flexibility for fishers to transfer effort between a diversity of species in the marine, estuarine and freshwater sectors of the fishery. Presently economic considerations have contributed to the level of effort targeted at particular species. That is, fishers are able to switch effort towards or from certain species depending on market demand and/or expenses of harvesting due to relative fish abundances. This flexible approach has facilitated reducing the risk of overexploitation of individual LCF species, however has not prevented the declining catch trends of several species in the fishery. Nor does it take into account the potential establishment of new, more profitable markets, which could drive more targeted fishing effort at specific species.

Goolwa cockles are currently the most important product harvested in the LCF by way of volume and value. It has been the subject of increasing targeted effort, largely due to an increased awareness of this product for human consumption. There are currently moves to develop export markets for Goolwa cockles, which may further drive fishing effort for this species in the LCF. Total catch of Goolwa cockles appears directly correlated with targeted effort expended in the LCF. Considerable latent effort issues exist for Goolwa cockles both within the LCF and from other fisheries (Marine Scalefish and Rock Lobster Fisheries), though DEH notes that moves have been

taken to address latent effort from other fisheries. The level of latent effort within the LCF remains a significant threat to the sustainable harvest of Goolwa cockles however.

DEH acknowledges that the LCF management plan has catch and effort reference points in place which will trigger management review if exceeded. Several species in the LCF are considered 'fully exploited', however no robust stock assessments for any species are available. It is possible, therefore, that any further increase in harvests may present a serious risk of overexploitation. DEH recommends PIRSA develop methods that manage catch and effort in the LCF at sustainable levels.

Recommendation 7. *PIRSA, within 2 years, to develop and implement management arrangements to control the extent of harvests of all target and key byproduct species at ecologically sustainable levels. Particular consideration should be directed at addressing the presently uncontrolled increases in catch of Goolwa cockles and risk of overexploitation of cockle stocks.*

Presently, size limits for key target species are a critical component of LCF management arrangements. DEH recognises that size limits can be an effective way of managing fish stocks, especially during particular life history stages. However the limits set by PIRSA in the LCF appear to be inconsistent with biological characteristics of some species they relate to. The legal size of Goolwa cockles is 35 mm, which is 1 mm less than the estimated size at sexual maturity. In addition, mulloway, yellow-eye mullet and golden perch (females), can all be caught under the size at which they mature. Size limits and spatial and temporal closures are currently the primary management measures to control the harvest of target species, and stock status for all species is uncertain. As such, DEH recommends that size limits for target species be reassessed to determine if they are appropriately precautionary and effective at protecting fishery stocks. In addition, the commercial size limit for greenback flounder does not apply for recreational fishers. Given the declines in catch of greenback flounder, and the possibility that un-natural outflow from the Murray River may be affecting spawning, DEH recommends that the lack of a size limit on recreational catches of greenback flounder be reappraised.

Recommendation 8. *PIRSA, within 18 months, to review known biology of harvested species and existing size limits to ensure size limits are sufficiently precautionary and take into account all removals from the fishery.*

A series of reference points have been developed from which fishery performance may be monitored and measured. These reference points relate to catch and effort trends for six key target species: Goolwa cockle; mulloway; yellow-eye mullet; golden perch; greenback flounder; and black bream. In the absence of adequate biological data for all species harvested in the LCF, an effort has been made to tailor catch and effort reference points for individual target species. Reference points include upper and lower catch and CPUE levels and trends in catch and CPUE rates. Catch and CPUE reference points were calculated from estimates from the three highest and three lowest years during the reference period of 1984/85 – 2001/02 for finfish and 1990/91 – 2000/01 for Goolwa cockles. Trends in catch and CPUE rates reference points were determined using the greatest rate of change during the reference period in total catch and targeted CPUE over a four year period for finfish and three year period for Goolwa cockles. DEH notes that reference points have not been developed for bony bream, which although not targeted in the fishery, is taken in substantial numbers. DEH recommends that the absence of reference points be rectified through implementation of **Recommendation 5**.

DEH has recommended the development of an improved process to estimate recreational, indigenous and illegal catch (**Recommendation 6**), a system to improve the accuracy of fishery dependent data and to validate catch and effort data (**Recommendation 2 and 3**) and the

development of more refined sustainable yield estimates (**Recommendation 4**) that will provide a more substantial basis to inform these reference points. A breach of one or more reference points triggers a response by the Inland FMC, which notifies the Minister for Agriculture, Food and Fisheries and the Director of Fisheries. Given the varying nature of the species involved (in terms of life history and population characteristics) assessments of the causes and appropriate management responses may vary considerably. The Inland FMC consults with industry and key stakeholders to determine the appropriate management actions. Once determined, a report with recommendations is provided to the Minister within three months of initial notification, whereupon appropriated management actions are implemented.

Byproduct caught in the LCF includes a variety of native and exotic scalefish, sharks and rays and crustaceans. Many of these are also caught in other fisheries. Bony bream, Australian salmon, redfin, yabbies, gummy sharks, whaler sharks, congolli and Murray cod are all taken as byproduct in the LCF. Byproduct catches are recorded in the compulsory catch and effort logbooks and factored into annual stock status reports produced by SARDI scientists.

Excluding bony bream which has been considered separately, byproduct comprises a minimal component of total landings in the LCF. Total commercial landings of all species in 2002/03 were estimated to be 1,979 t, of which only 9 t were taken as byproduct (not including bony bream). A number of management arrangements are in place to control the take of byproduct species. For gummy sharks, LCF fishers are limited to five carcasses per trip and a minimum legal size limit; recreational bag limits apply also. In addition, the submission advises that the commercial net fishing closure around the Murray River mouth will lessen the potential for over-fishing aggregations of sharks at the mouth during seasons of high river flow. Commercial harvests of Murray cod are minimal, however size limits and closed seasons for both commercial and recreational fishers are in place for this species. The harvest of Murray cod is considered in more detail under Principle 2, Objective 2.

Conclusion

DEH considers that the management regime in the LCF is appropriately precautionary in the short term however there is a need to strengthen the management regime to minimise significant risks that exist in the fishery. DEH considers that there is scope to refine some of the existing information collection, stock status assessment and catch and effort control measures and has provided a number of recommendations for improvements in the long term.

Promote recovery to ecologically viable stock levels

Objective 2: *‘Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes’*

The submission states that no fish stocks in the LCF are currently considered overfished, however DEH note that a number of key species stocks are classed as uncertain. PIRSA have proposed a strategic research and stock assessment process which should provide more robust analysis of the status of stocks in the LCF. The current management arrangements contain trigger points and management responses to avoid the risk of, and identify potential processes of, over-fishing key species in the LCF. DEH have made a number of recommendations to develop methods of controlling the level of total harvests for all sectors of the LCF, to improve data collection and validation processes, including taking into account all removals, which will refine stock assessments and facilitate minimising the risk of over-fishing of stocks in the LCF.

Conclusion

DEH considers that key target species stocks are not below defined reference points but should that occur in the future, the fishery is conducted such that there is a high degree of probability the stock would recover to ecologically viable stock levels within nominated timeframes.

Ecosystem impacts

Principle 2: *'Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem'*

Bycatch protection

Objective 1: *'The fishery is conducted in a manner that does not threaten bycatch species'*

Information requirements

There is no current or historical program for ongoing monitoring of bycatch in the LCF. Current catch and effort logbooks do not provide any provision for fishers to record bycatch. The predominant method of fishing in the LCF is mesh net fishing. Net fishing is a comparably non-selective method of harvesting and therefore substantial numbers of bycatch could be expected in the LCF. The principle harvest method for Goolwa cockle is using cockle nets/rakes and though species specific, may take substantial numbers of undersize cockles as bycatch.

A FRDC funded research program to monitor gear interaction of non-targeted species for both commercial and recreational fishers in the LCF has commenced (FRDC project 2005/061). This study should provide comprehensive data on the extent and composition of bycatch in the LCF, including threatened, endangered and protected species.

Assessment

There is currently no assessment of the effect of fishing activities on bycatch species in the LCF, due largely to the historic lack of bycatch data collection. However the commencement of FRDC project 2005/061 should contribute greatly to remedying the bycatch data poor status of the fishery. DEH considers the study to be invaluable for providing the means of conducting a risk analysis of bycatch vulnerable to excessive fishing mortality and for the development of a Bycatch Action Plan (BAP). DEH notes that PIRSA has committed to develop and implement a BAP during 2006. DEH supports the above commitment to develop a BAP and recommends that a program of recording bycatch by operators in the LCF be developed to allow the ongoing review of the BAP for minimising bycatch in the fishery. The extent of the program should be consistent with the level of risk for bycatch species identified by relevant research, including the FRDC project.

Recommendation 9. *PIRSA, within 2 years, to develop and implement an ongoing program to collect information on the composition and abundance of bycatch across the commercial sectors of the fishery.*

Management Response

There are no formal bycatch management responses currently in force in the LCF, however The Southern Fishermen's Association, through a Seanet Officer, have provided a number of recommended fishing measures to minimise bycatch of juvenile mulloway when targeting yellow-eye mullet in the small mesh net fishery of the Coorong lagoon. These measures include the use of

floating nets, reduction in net depth, ensuring nets are slung correctly and use of the optimal mesh size and ply rating, avoiding areas of high bycatch and timing of setting and hauling of nets. Similarly, the Association recommended the reduction of bycatch of Coorong crabs (*Paragrapsis gaimardii*) through the use of floating set mesh nets, and the avoidance of setting mesh nets in areas of high crab abundance. The submission provides no indication of the level of observance of the above measures by LCF fishers.

The development of a BAP, progress of the FRDC project and implementation of **Recommendation 9** should identify bycatch species at high risk and requiring management actions, categorise groups of bycatch species which could be monitored as indicator species and prioritise management arrangements in the short to long term to minimise the level of bycatch in the LCF.

Conclusion

DEH considers that while there is considerable uncertainty as to the current level of bycatch in the LCF, the current relevant research and the implementation of **Recommendation 9** provides a high likelihood the fishery will be conducted in a manner that identifies any potential threats to bycatch species and minimises those threats. DEH expects that PIRSA will undertake appropriate actions to ensure that bycatch species are not threatened by this fishery.

Protected species and threatened ecological community protection

Objective 2: *'The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities'*

Information requirements

A number of protected, endangered and threatened species listed either under the EPBC Act or State legislation have been considered in the submission, due to their being geographically distributed in waters of the LCF and therefore having the potential for interaction with the fishery. Species listed under the EPBC Act include marine mammals, sea birds, the great white shark, syngnathids and Murray cod. There is, however, currently no ongoing process to document interactions with protected, endangered or threatened species in the LCF. The recent commencement of FRDC project 2005/061 will document the composition and abundance of non-targeted species in the LCF, including interactions with protected, endangered and threatened species. The submission indicates that the catch and effort logbooks are currently under-review and compulsory provision for fishers to report any interactions with Murray cod, marine mammals, sea-birds and great white sharks will be included in the revised logbooks.

Assessment

The annual harvest of Murray cod, taken incidentally as byproduct in the Lakes sector of the fishery, is assessed annually via catch and effort logbook returns and will receive further assessment through the acquisition of more refined data once the revised logbooks are in place. Current harvests of Murray cod are minimal. DEH advise, however, that if levels of harvest of Murray cod increase above current levels, or new areas open to fishing, operators in the LCF refer their actions to DEH to determine whether approval is required under Part 9 of the EPBC Act.

The submission states that the vulnerability of protected, endangered and threatened species will be assessed following the acquisition of appropriate data through FRDC project 2005/061, which is currently underway. Potential interactions with protected species include direct effects of entanglement in fishing gear and indirect fishing effects such as vehicle disturbance of breeding populations of the hooded plover during fisher's access to the Goolwa cockle sector.

No threatened ecological communities occur in the range of the fishery, however the LCF operates in a Ramsar listed site, namely The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar site (site No 25). Under the EPBC Act, a person may not take an action that results or will result in a significant impact on the ecological character of a declared Ramsar wetland. Although DEH acknowledges that principle threats to the Ramsar site are related to the regulation of flows from the Murray River, several species taken by the LCF do fill key positions in the trophic structure of the Ramsar site. Goolwa cockles are an important food source for a number of shore birds, as are bony bream for several bird species in the Lakes sector of the fishery. Goolwa cockles are the subject of increasing harvesting pressure and harvests of bony bream have declined substantially over the last decade, suggesting a declining biomass. DEH considers it important therefore, that PIRSA evaluate the potential impact of operations in the LCF on the listed ecological character and values of the Ramsar site.

Recommendation 10. *Within 2 years, PIRSA to conduct an ecological risk assessment of the impacts of the LCF, including any impacts on the listed ecological character and values of The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar site (Site No. 25). PIRSA to develop and implement any mitigation measures considered necessary.*

Management response

Several management responses are in place to minimise interactions with protected, endangered and threatened species. Vehicle access to the Coorong Beach is restricted to commercial fishers during key hooded plover reproductive periods. The submission indicates that commercial cockle fishers operating during these periods typically employ balloon-type tyres on their vehicles to reduce depressions in soft sand and endeavour to drive on the wet sand at low water to avoid plovers.

For Murray cod, minimum and maximum size limits are in place for both commercial and recreational fishers and a closed season between 1 September and 31 December also applies. DEH notes that commercial catches of Murray cod in recent years were minimal and that this species is not targeted by the fishery.

The Southern Fishermen's Association have suggested a code of practice for all LCF operators to reduce interactions with seabirds through setting mesh nets during the night, avoiding fishing near bird rookeries or colonies and to attend nets regularly.

PIRSA has committed to the development and implementation of a BAP for the LCF by the end of 2006. DEH considers the BAP an extremely important tool for minimising interactions with all bycatch species, including protected, endangered and threatened species.

Conclusion

DEH notes that the level of interactions with protected species in this fishery is currently uncertain however arrangements are in place to improve data collection and analysis. DEH considers that the fishery is likely to be conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities. Should this situation change, or a risk assessment process indicate otherwise, DEH expects that appropriate actions will be undertaken to ensure the fishery avoids mortality or injury to these species and avoids or minimises impacts on threatened ecological communities.

A recommendation has been developed to ensure that the risk of unacceptable impact on protected species is minimised in the longer term.

Minimising ecological impacts of fishing operations

Objective 3: *'The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally'*

Information requirements

Information collected in the LCF has largely been restricted to catch and effort data for target and byproduct species. Limited, indirect information on fishery impacts on the wider environment are available through studies on biological and ecological characteristics of key target species.

DEH is concerned at the lack of information collection and research covering the fisheries impact on the ecosystem and environment generally. However, DEH understands that this lack of information is the case across a range of Australian and international fisheries and until appropriate research techniques and programs are developed and implemented this will continue to be the case. DEH strongly supports research in this area.

Assessment

The submission identifies a number of fishing activities that have the potential to impact on the wider ecosystem, including direct trophic impacts through removals of target and byproduct species, translocation of pests, bait collection, berleying and indirectly through anchor-scarring and vehicle use on Coorong Beach. No specific risk assessment for each of the above components has been performed however the submission suggests that for several components, impacts are expected to be minimal. Fishing activities in the Goolwa cockle sector occur in an environment of high wave energy and disturbance and on this basis the submission proposed that little habitat damage as a result of fishing activity is likely. Vehicular impacts on Goolwa cockle populations on surf beaches have not been quantitatively examined, however an extensive study performed in New South Wales did not identify vehicle activity as having a high impact on cockles in that area.

DEH considers that through the implementation of **Recommendation 10**, a more robust and complete analysis of the potential impacts of fishing activities in the LCF on the broader ecosystem will be conducted.

Management response

The LCF management plan has a specific goal of minimising impacts on the structure, productivity, function and biological diversity of the ecosystem. Management measures in place to minimise impacts on the broader ecosystem are largely based on input and output controls for target fishery species. Limits include restrictions on numbers of commercial licences, restrictions on gear specifications and application, seasonal and spatial closures and size limits.

The LCF is recognised as a fishery highly dependent on environmental factors such as flow rates from the Murray River. The submission states that breeding success of several species, including black bream and greenback flounder, are likely influenced by favourable flow regimes through the barrage system. Similarly, many species in the LCF might be impacted upon by closures of the Murray River mouth during periods of drought. The LCF management plan has in place reference points pertaining to the level of freshwater flow over the barrage network and periods of restricted flow through the Murray River mouth. Triggering of these reference points may initiate further management arrangements to minimise any negative impacts of current fishing practices on fish stocks under additional environmental pressures.

DEH has made a number of recommendations in this assessment that should have beneficial consequences for the broader marine ecosystem in the longer term, including the development of a process for more refined stock assessment (**Recommendation 4**), controls on levels of harvest

across the sectors of the LCF (**Recommendation 7**), quantification of bycatch (**Recommendation 9**) and assessing and mitigating the potential impacts of fishing activities on the listed ecological character and values of The Coorong, and Lakes Alexandrina and Albert Wetland Ramsar site (**Recommendation 10**).

Conclusion

DEH considers that the fishery is conducted in a sufficiently precautionary manner to minimise the impact of fishing operations on the ecosystem generally. Recommendations have been developed to ensure that the risk of significant impact by the fishery on the marine environment generally is minimised in the longer term.

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LIST OF ACRONYMS

BAP	Bycatch Action Plan
CFL	Caudal Fork Length
CPUE	Catch Per Unit Effort
DEH	Department of the Environment and Heritage
EPBC Act	Environmental Protection and Biodiversity Conservation Act, 1999
FRDC	Fisheries Research and Development Corporation
Inland FMC	Inland Fisheries Management Committee
LCF	Lakes and Coorong Fishery
PIRSA	Department of Primary Industries and Resources, South Australia
SARDI	South Australian Research and Development Institute
WTO	Wildlife Trade Operation