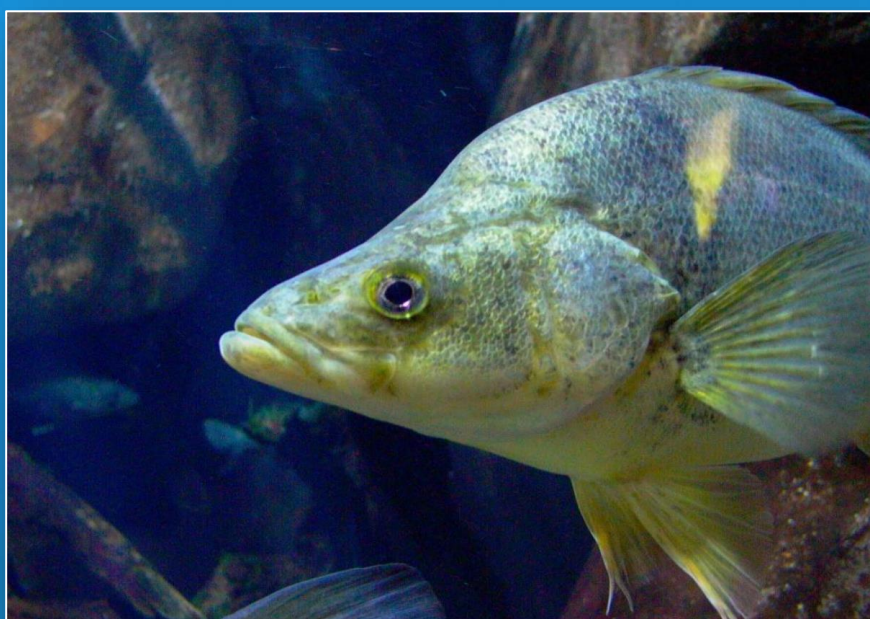


Fisheries

Assessment of the South Australian Lakes and Coorong Fishery in 2023/24



K.G. Sarakinis and J. Earl

**SARDI Publication No. F2020/000208-6
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**SARDI Aquatic and Livestock Sciences
PO Box 120 Henley Beach SA 5022**

October 2025

Report to PIRSA Fisheries and Aquaculture



**Government
of South Australia**

Department of Primary
Industries and Regions

SARDI



**SOUTH AUSTRALIAN
RESEARCH AND
DEVELOPMENT
INSTITUTE**

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EXECUTIVE SUMMARY

Overview

This report is the sixth in a series for South Australia's Lakes and Coorong Fishery (LCF). It provides a description of the fishing fleet, a stock assessment for Golden Perch, and assigns stock status to six other finfish species harvested by the three gillnet sectors of the fishery (estuarine large-mesh gillnet [ELMGN]; estuarine small-mesh gillnet [ESMGN]; and freshwater large-mesh gillnet [FLMGN]), and the Pipi sector. The report provides species-specific information relating to biology, fishing access, management, and trends in commercial fishery statistics from 1 July 1984 to 30 June 2024. Updated estimates of the performance indicators for finfish and Pipi are also provided, as prescribed in the fishery's Management Plan (PIRSA 2022) and Black Bream Recovery Strategy (PIRSA 2023).

Uncertainty in this assessment

Assessment of stock status for species in this report relied heavily on fishery-dependent data, including non-standardised CPUE used as a proxy for relative abundance, which currently does not account for any changes in the relative efficiency of the fleet over time. Additionally, information on the levels of incidental mortality in the LCF are limited to data collected during the Millennium Drought (Ferguson 2010), the presence of Long-nosed fur seals and their interactions and impacts on the LCF have not yet been quantified, recreational catch estimates for fishing in the Lower Lakes and Coorong Estuary are imprecise and infrequent, and the potential effects of the harmful algal bloom (HAB), which first occurred in the North Lagoon of the Coorong Estuary in May 2025, has not yet been quantified. These limitations reduce confidence in the stock status classification for most species.

Fleet dynamics

The dynamics of the LCF fleet have changed considerably over the last 40 years and have likely been driven by combined shifts in environmental conditions (i.e., freshwater inflows to the Coorong Estuary), market demands, and fishing practices. These changes are reflected in both the catch composition and targeted effort among the five primary species (Mulloway, Yelloweye Mullet, Golden Perch, Carp, and Pipi). In 2023/24, these species accounted for 90% of the fishery's targeted effort, an increase from the previous year (86%) that was associated with reduced targeting of the secondary species Greenback Flounder.

Golden Perch stock assessment

The LCF is the primary fishery for Golden Perch in South Australia, with commercial harvest of this species also occurring periodically in the Lake Eyre Basin Fishery (LEBF; single licence holder), and in the River Fishery prior to its closure in 2003. The assessment of the LCF for Golden Perch used a weight-of-evidence approach based on analyses of commercial catch, effort, and targeted catch per unit effort (CPUE) trends to 30 June 2024, and recent fishery size and age structures.

Golden Perch is a primary species in the FLMGN sector of the LCF, with all catches taken using large-mesh gillnets (LMGN; 115–150 mm mesh) in the Lower Lakes (Lake Alexandrina and Lake Albert). In 2023/24, targeted LMGN catches accounted for 48.2% of the total catch of this species with the remainder taken as by-product when other species were targeted. The total catch of 60.2 t in 2023/24 (52.4 t in 2022/23) was the highest catch since 2017/18 and was associated with low targeted LMGN effort. Targeted CPUE using LMGN ($CPUE_{LMGN}$) of 1.6 kg/net-day in 2023/24 was the second highest on record, reflecting high fishable biomass of Golden Perch in the Lower Lakes. The high catch rates may also reflect improved fishing efficiency associated with changes in fishing practices, some of which have been made to reduce interactions with Long-nosed Fur Seals.

The population age structure for 2024/25 was dominated by 7-year-old fish (2017 year class), and included moderate proportions of 2-year-olds (2022 year class) and 4-year-olds (2020 year class). The recent high catch rates and presence of several young age classes in 2024/25 age structure indicate that recruitment to the fishable biomass has occurred in recent years. The stock is classified as **sustainable**.

Stock status and performance indicators

Mulloway is the primary target species in the ELMGN sector. The total catch of 112.2 t in 2023/24 was around four times higher than that of the previous year, and the highest since 2019/20. The increased catch was associated with increased targeted effort using LMGN and swinger nets (SN; >150 mm mesh) in the Coorong Estuary and nearshore marine environment, respectively. In 2023/24, targeted $CPUE_{LMGN}$ increased to a record-high level and targeted $CPUE_{SN}$ increased to its second highest on record, reflecting high juvenile and adult biomass, respectively. This stock is classified as **sustainable**.

Black Bream is a secondary species in the ELMGN sector and was classified as depleted from 2016 to 2024. A Black Bream Recovery Strategy (PIRSA 2023) is in place. Temporary management arrangements, including annual seasonal fishery closures, have been in place since 2018 to recover the stock, and there is evidence of stock improvement. Targeted catch and effort for Black Bream remained low in 2023/24. The primary performance indicator (PI) in the Black Bream Recovery Strategy (PIRSA 2023) is smoothed incidental CPUE. The estimates of this PI have increased over the last five years from historically low levels. In 2023/24, smoothed incidental CPUE was 0.25 kg/net-day⁻¹, which was between the limit reference point (LRP; 0.20 kg/net-day⁻¹) and the trigger reference point (TrRP; 0.30 kg/net-day⁻¹) for the third consecutive year. The 2023/24 age structure (secondary PI) involved a single, strong (i.e., $\geq 25\%$) cohort of 6-year-old fish, which was below the target reference point (TRP) of two strong cohorts of fish aged ≤ 10 years. This stock is classified as **recovering**. It is noted this classification is different to that defined in PIRSA (2023).

Greenback Flounder is a secondary species in the ELMGN sector. As a 'marine estuarine-opportunist', Greenback Flounder enter the Coorong Estuary in substantial numbers during both juvenile and early adult life stages but use the marine waters as its primary habitat. In 2022/23, increased habitat availability in the Coorong Estuary after consecutive high freshwater flow years was associated with record high CPUE_{LMGN} and a reclassification of the stock from depleted to sustainable. In 2023/24, CPUE_{LMGN} remained high, reflecting high fishable biomass. This stock is classified as **sustainable**.

Yelloweye Mullet is the primary species in the ESMGN sector. Total catch was stable at around 210.3 t in 2023/24, with relatively low targeted effort resulting in record-high targeted CPUE_{SMGN}. This reflects high fishable biomass but could also relate to improved fishing efficiency associated with fishers adapting their operations to limit interactions with Long-nosed Fur Seals. This stock is classified as **sustainable**.

Bony Herring is a tertiary species in the FLMGN sector. Over the last 10 years, total catch and CPUE_{LMGN} have remained stable at moderate–high levels (366.7 t in 2023/24) compared to historical values. This stock is classified as **sustainable**.

The harvest strategy for finfish in the Management Plan uses PIs to guide recommendations on the total allowable commercial effort (TACE) for the three gillnet sectors. Estimates of the environmental and biological PIs are provided for the 2024/25 reporting year (1 February 2024 to 31 January 2025) and 2024 calendar year (1 January 2024 to 31 December 2024), respectively (Table E-2; Table E-3) to ensure up to date information was available for setting the TACEs for the 2024/25 financial year.

For the Pipi sector, annual catches have been constrained by total allowable commercial catches (TACCs) since 2009/10. The TACC for 2023/24 was 550 t. The estimate of fishery-independent relative biomass of legal-sized Pipi (primary PI) increased to 23.7 kg/4.5 m² in 2023/24, which was above the target RP of 12 kg/4.5 m² (Table E-4). The size structure from the 2023/24 Pipi survey (secondary PI) indicated the presence of pre-recruits (>30%). This stock is classified as **sustainable**.

Future directions

The most important research needs for the LCF fishery and its management are: (i) CPUE standardisation to improve the usefulness of CPUE as an index of relative abundance for key species; (ii) evaluating the extent of the effect of the HAB on stocks within the LCF; (iii) independent monitoring of discarding of sub-legal sized individuals of LCF species from commercial and recreational gillnets in the Coorong Estuary, Lower Lakes, and marine waters of the LCF; (iv) ongoing development of a time series of annual age structures, particularly for long-lived species Mulloway, Black Bream, and Golden Perch; (v) continuation of the fishery-independent surveys for Black Bream and Greenback Flounder to provide reliable information on relative abundance and recruitment that can be used to monitor stock recovery; and (vi) quantitative information on the extent of seal impacts on the fishery, with respect to catch losses and damaged discarded catch.

Table E-1. Annual catches and status classifications for key LCF finfish species from 2021/22 to 2023/24.

Species	Financial year	Catch (t)	Stock status
Mulloway	2021/22	55.6	Sustainable
	2022/23	28.9	Sustainable
	2023/24	112.2	Sustainable
Black Bream	2021/22	3.4	Depleted
	2022/23	3.9	Depleted
	2023/24	3.0	Recovering
Greenback Flounder	2021/22	4.6	Depleted
	2022/23	25.9	Sustainable
	2023/24	9.3	Sustainable
Yelloweye Mullet	2021/22	206.3	Sustainable
	2022/23	235.9	Sustainable
	2023/24	210.3	Sustainable
Golden Perch	2021/22	35.2	Sustainable
	2022/23	52.4	Sustainable
	2023/24	60.2	Sustainable
Bony Herring	2021/22	360.9	Sustainable
	2022/23	271.7	Sustainable
	2023/24	366.7	Sustainable

Table E-2. Results from annual assessments of the environmental performance indicators (PI) for the three gillnet sectors from 2022/23 to 2024/25 (reporting years) against their reference points (RP). The total allowable commercial effort (TACE in net units) for each sector for each financial year is also shown. Colour represents PI values above their respective target RP (green), trigger RP (orange), and limit RP (red).

Gillnet sector	Financial year	TACE	Environmental PI	Limit RP	Trigger RP	Target RP	Reporting year	PI value
Estuarine LMGN	2021/22	987	Habitat available to Mulloway	10%	24.9%	55%	2022/23	65.4%
	2022/23	1,175					2023/24	75.2%
	2023/24	1,175					2024/25	63.3%
Estuarine SMGN	2021/22	1,175	Habitat available to Yelloweye Mullet	10%	30.9%	50%	2022/23	87.1%
	2022/23	1,175					2023/24	100.0%
	2023/24	1,175					2024/25	68.8%
Freshwater LMGN	2021/22	1,175	Water level in the Lower Lakes (m)	-1.2 m	-0.71 m	0.4 m	2022/23	0.76 m
	2022/23	1,175					2023/24	0.74 m
	2023/24	1,175					2024/25	0.73 m

Table E-3. Results from annual assessments of the biological performance indicators (PI) for key species in the three gillnet sectors from 2022 to 2024 (calendar years) against their reference points (RP). Colour represents PI values above their respective target RP (green), trigger RP (orange), and limit RP (red).

Gillnet sector	Key species	Biological PI (kg/net-day)	Limit RP	Trigger RP	Target RP	Calendar year	PI value (kg/net-day)
Estuarine LMGN	Mulloway	Targeted CPUE _{LMGN}	0.80	1.39	2.68	2022	7.59
						2023	11.78
						2024	10.34
	Greenback Flounder	Targeted CPUE _{LMGN}	0.65	0.93	1.86	2022	2.79
						2023	3.73
						2024	2.27
	Black Bream	Targeted CPUE _{LMGN}	0.30	0.53	1.67	2022	1.02
						2023	2.48
						2024	2.92
Estuarine SMGN	Yelloweye Mullet	Targeted CPUE _{SMGN}	6.32	7.23	11.11	2022	32.34
						2023	25.43
						2024	21.42
Freshwater LMGN	Golden Perch	Targeted CPUE _{LMGN}	0.24	0.49	1.04	2022	0.59
						2023	2.00
						2024	1.62
	Bony Herring	CPUE _{LMGN}	2.32	3.54	5.42	2022	5.28
						2023	5.78
						2024	4.97

Table E-4. Key statistics and stock status for South Australia's Lakes and Coorong Fishery Pipi resource from 2020/21 to 2023/24 (financial years), including the results from the annual assessments of the primary performance indicator (PI, fishery-independent relative biomass of legal-sized Pipi) against the reference points (RP). Annual total allowable commercial catches (TACC) are also shown.

Pipi	Financial year	TACC (t)	LCF catch (t)	Primary performance indicator: relative biomass (kg/4.5 m ²)				Secondary performance indicator: Pre-recruits present?	Stock status
				Limit RP	Trigger RP	Target RP	PI value		
	2020/21	450	444	4	9	11	8.9	Yes	Sustainable
	2021/22	400	418*			12	15.2	Yes	Sustainable
	2022/23	450	453			18.0	Yes	Sustainable	
	2023/24	550	442			23.7	Yes	Sustainable	

* 2021/22 LCF catch of 418 t exceeded the TACC of 400 t due to carry-over of quota from 2020/21 (PIRSA pers.com.)

Keywords: stock status, Coorong Estuary, River Murray, fleet dynamics, weight-of-evidence, stock assessment, performance indicators, Golden Perch.

1 GENERAL INTRODUCTION

1.1 OVERVIEW

This is the sixth report in this series for the South Australian Commercial Lakes and Coorong Fishery (LCF) that provides a species-specific summary of information on fisheries biology, management arrangements, trends in commercial fishery statistics, and stock status at the biological stock or management unit scale. It includes a stock assessment for Golden Perch (*Macquaria ambigua*), updating the previous 2012 stock assessment (Ferguson and Ye 2012). It also assesses performance indicators against reference points for the gillnet (i.e., finfish) and Pipi (*Donax deltoides*) sectors of the fishery, as prescribed in the fishery's Management Plan (PIRSA 2022). As such, this report provides fundamental scientific information, extending over a 40-year time series from 1 July 1984 to 30 June 2024, to support the management of this multi-species, multi-gear fishery.

This report comprises five main sections. The first section, including this overview, provides a description of the LCF, its management arrangements, and the performance indicators used to inform management of the gillnet and Pipi sectors of the fishery. Section two describes the dynamics of the commercial fishing fleet, catch composition, and spatial and temporal trends in fishing effort.

Section three provides an assessment of the fishery for Golden Perch. This assessment is based on commercial catch and effort statistics, information on the size and age of Golden Perch harvested by the LCF, and an environmental performance indicator that relates to the mean annual water level (m) in the Lower Lakes.

Section four consists of a series of species-specific sub-sections that are arranged to align with the four sectors of the LCF, including the three gillnet sectors (estuarine large-mesh gillnet [ELMGN], estuarine small-mesh gillnet [ESMGN], and freshwater large-mesh gillnet [FLMGN]) and the Pipi sector, as defined in the Management Plan (PIRSA 2022). For key species in each sector, relevant biological information is provided along with a description of the fishery and its management arrangements, an interrogation of the fishery data, and a classification of stock status using the definitions of the National Fishery Status Reporting Framework (NFSRF; Roelofs et al., 2024). For each gillnet sector, environmental and biological performance indicators are also assessed against reference points prescribed in the Management Plan (PIRSA 2022) to inform setting of the 2025/26 total allowable commercial effort (TACE) for each sector. The final section, the General Discussion, discusses the overall performance of the fishery, highlights emerging trends within the fleet, current challenges and uncertainties with the assessments, and identifies research priorities to improve future assessments.

1.2 DESCRIPTION OF THE FISHERY

The LCF is a small-scale, multi-species, multi-gear fishery that operates in the estuary of the River Murray and Coorong lagoons (the Coorong Estuary), the freshwater lower lakes of the River Murray (Lake Alexandrina and Lake Albert) and the nearshore marine environment adjacent to the Coorong Estuary (Figure 1-1). Currently, there are 33 active licence holders in the fishery, who are permitted to take around 40 species/taxa that include fishes, molluscs, crustaceans, annelid worms, sharks, rays and skates (PIRSA 2022). Fishery production by weight of catch is mainly comprised of Pipi, Bony Herring (*Nematalosa erebi*), Carp (*Cyprinus carpio*), Yelloweye Mullet (*Aldrichetta forsteri*), Mulloway (*Argyrosomus japonicus*), and Golden Perch. Other species such as Greenback Flounder (*Rhombosolea tapirina*), Redfin Perch (*Perca fluviatilis*), and Black Bream (*Acanthopagrus butcheri*), have contributed significantly to the overall catch in some years.

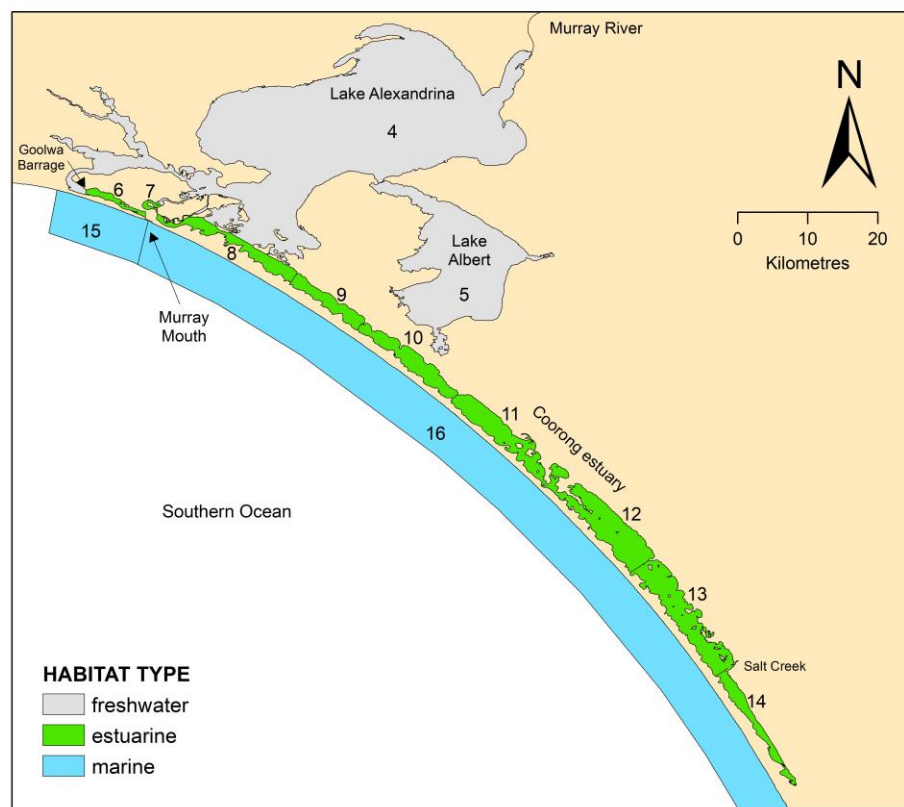


Figure 1-1. Commercial reporting blocks of the LCF showing the different habitat types.

There are approximately 15 types of fishing gear (or devices) endorsed in the LCF (PIRSA 2022). The use of these gears differs depending on the location of fishing and the species being targeted. Mesh gillnets are the main gear used by fishers targeting finfish species (Ferguson et al., 2013). In the Lower Lakes, LMGN are used to target Golden Perch, Redfin Perch, Bony Herring, and Carp. In the Coorong

Estuary, LMGN are used to target Mulloway, Greenback Flounder, and Black Bream, while SMGN are used to target Yelloweye Mullet. Mulloway are also targeted in the nearshore marine environment adjacent to the Murray Mouth using SN. Along the ocean beach on the Youngusband Peninsula, hand-held rakes are used to harvest Pipi. Other methods permitted for use include drum nets, hauling nets, set lines, and pyramid nets.

The broad mixture of target species, gear types, habitats, and regulations associated with the LCF make the task of assessing the status of the fish stocks challenging. This is compounded by the dynamic nature of fisher behavioural responses to markets, resource availability, environmental conditions, and in recent years, the presence of Long-nosed Fur Seals (*Arctocephalus forsteri*) (Earl et al., 2021), as fishers can adapt their fishing operations by readily switching their effort among species, gears and habitats.

The recreational fishing sector also has access to most species targeted by the LCF. Recreational fishing occurs in freshwater, estuarine, and marine waters in the region, with fishers permitted to use several gear types, including registered mesh nets no longer than 75 m in the Coorong Estuary. However, new recreational net registrations are no longer available for this region, Lake Alexandrina, or Lake Albert. Apart from Lake George, recreational net fishing is prohibited in all other coastal waters of South Australia (PIRSA 2022).

1.3 RIVER MURRAY FLOWS

Freshwater flow from the River Murray is a major driver of ecological processes and biological responses in the Lakes and Coorong region, including the population dynamics and abundance of fish species that support the LCF. Freshwater inflow affects fish through changes in: (i) availability of habitat, primarily through changes in salinity and water level, (ii) connectivity within and among marine, estuarine, and freshwater environments, and (iii) trophic productivity by transporting carbon, nutrients, and microbiota (i.e., food resources) from upstream (Ye et al., 2016; Bice et al., 2018).

Over the last 50 years, annual freshwater inflow to the Coorong Estuary has been highly variable (Figure 1-2). A major flood event in Murray-Darling Basin (MDB) in the mid-1970s led to inflows of 26,644 GL in 1974/75 – the highest inflows since the 1950s. From 1984/85 to 2000/01, inflow averaged around 5,166 GL (± 995 SE), with peaks of ~11,000 GL in 1989/90, 1990/91, 1992/93 and 1993/94. During the Millennium Drought (2001/02–2009/10) in the MDB, there were low or no annual freshwater flow releases through the barrages to the Coorong (DEW 2020). Since the drought, several years of moderate to high river flows (i.e., 2010/11–2012/13, 2016/17) and the delivery of water for the environment to the Lower Lakes have contributed to increased barrage releases. In 2022/23, flooding in the MDB after three consecutive years of La Niña (2021-2023) led to substantial increases in River Murray flows, which culminated in an annual barrage discharge of 16,657 GL—the highest annual

inflow since the 1970s. The annual barrage discharge of 5,174 GL in 2023/24 was associated with a climate shift reflecting more El Niño conditions (i.e., warmer and drier) (Bureau of Meteorology 2025). Daily discharge remained relatively high in 2022/23, averaging ~47,000 ML/day with several peaks >100,000 ML/day (Figure 1-2). Daily flows were considerably lower during 2023/24, averaging ~14,000 ML/day with a peak of 67,844 ML.

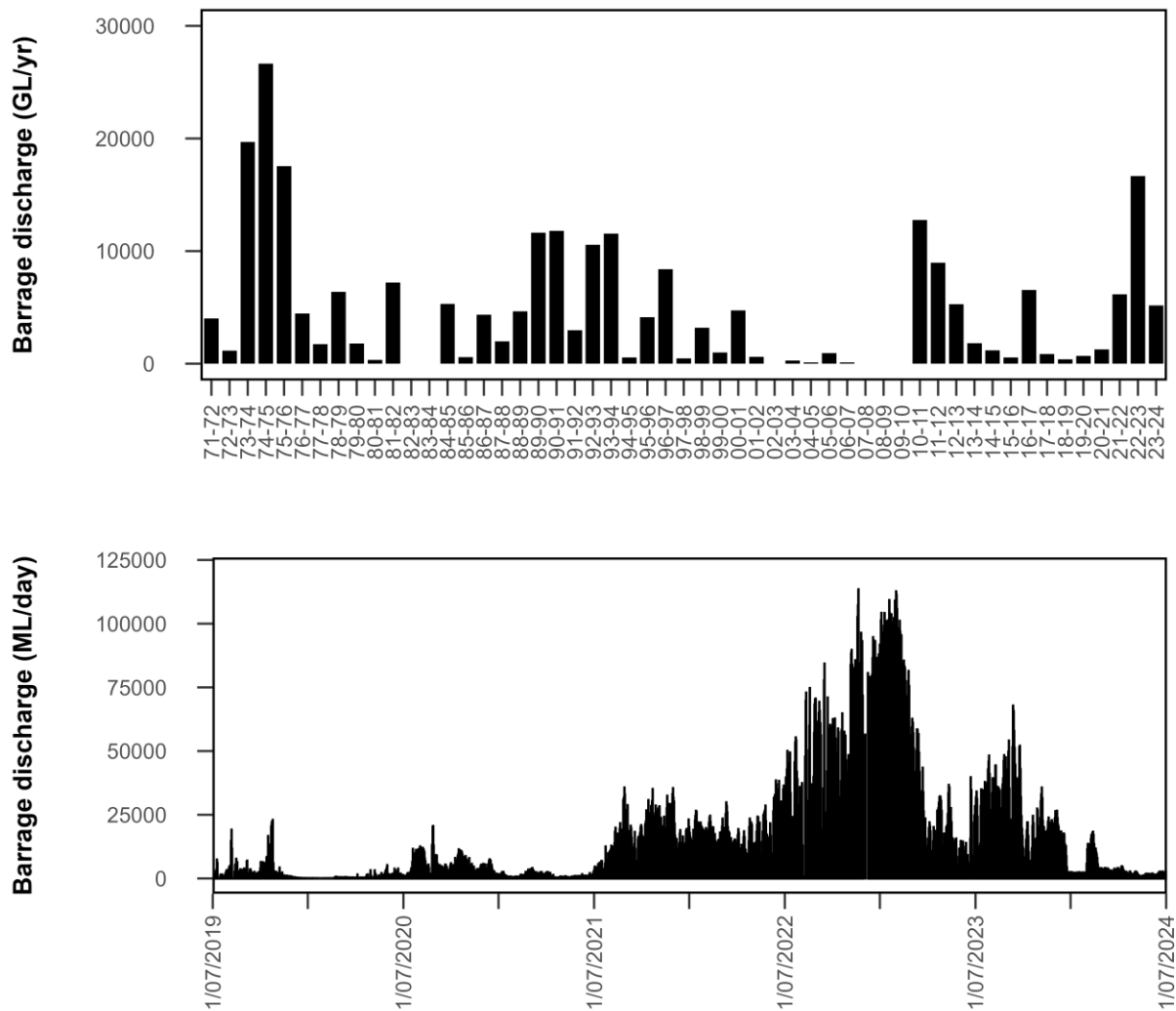


Figure 1-2. Freshwater flows across the barrages to the Coorong: (top) by financial year from July 1971 to June 2024, based on the estimates of the regression-based Murray hydrological model (MDM, BIGMOD, Murray-Darling Basin Authority); and (bottom) by day for the five-year period from 2019/20 to 2023/24, calculated by the Department for Environment and Water (DEW).

1.4 MANAGEMENT ARRANGEMENTS

The LCF is managed by the South Australian Government's Department of Primary Industries and Regions (PIRSA) Fisheries and Aquaculture in accordance with the legislative framework provided in the *Fisheries Management Act 2007*, and subordinate *Fisheries Management (General) Regulations 2017*, *Fisheries Management (Lakes and Coorong Fishery) Regulations 2024*, licence conditions and Management Plan. The LCF is managed as a limited entry fishery and has 36 licences (including non-active) with non-exclusive access within the Lakes and Coorong system and the adjacent to beaches along the Sir Richard Peninsula and Younghusband Peninsula. Fishing effort is limited through gear entitlements, with each licence endorsed for the type and number of devices that can be used, management arrangements implemented under associated legislation, and an annual TACE is applied to gillnet fishing for finfish in the Lower Lakes and Coorong. Owner-operator provisions and a range of output controls also apply, including a legal minimum length (LML) for most species and quota management for Pipi (total allowable commercial catch; TACC).

The Management Plan provides a strategic policy framework for sustainable management of the fishery and an overview of the management changes that have occurred over the last four decades (PIRSA 2022). In 1984, licence amalgamations were permitted under the Scheme of Management introduced to promote economic efficiency by allowing fishers to rationalise individual gear entitlements from within the existing pool of licences. In 1990, following an agreement between PIRSA and the commercial industry, a policy directive was introduced to formalise a set of guidelines on licence amalgamations and transfers. A key element of the policy was the limitation placed on the amount of gear that may be endorsed on an individual licence upon transfer or amalgamation. Specific arrangements apply to licence transfers between members of a family. All applications for licence transfer or amalgamation must be considered in accordance with the *Fisheries Management (Lakes and Coorong Fishery) Regulations 2024*. This 'amalgamation scheme' has allowed for limited structural adjustment of the commercial sector by reducing the number of licences and the amount of gear operating in the fishery.

The recreational fishery is managed with a range of regulations including size, boat, bag and possession limits, restrictions on the types of gear that may be used, temporal and spatial closures, and the complete protection of some species.

1.5 HARVEST STRATEGIES

The Management Plan includes harvest strategies for finfish and Pipi which provide strategic and transparent frameworks to guide annual management decisions on commercial harvesting (PIRSA 2022). The finfish harvest strategy defines the process for setting the annual TACE for each of three gillnet sectors of the fishery, which collectively account for around 98% of all finfish catches each year. The three gillnet sectors are: (i) estuarine large-mesh gillnet (ELMGN); (ii) estuarine small-mesh gill net (ESMGN); and (iii) freshwater large-mesh gill net (FLMGN).

Environmental conditions associated with river flows affect the distribution, abundance and availability of fish species targeted in the LCF (Ye et al., 2013, 2016, 2019). The finfish harvest strategy differs to traditional harvest strategies because it aims to manage the sustainable harvest of key species relative to the condition of environment within which the fishery operates, which is linked to the availability of the fished resources (Knuckey et al., 2015). It uses a combination of environmental (primary) and biological (secondary) performance indicators and decision rules to inform setting of the annual TACE for each sector. These performance indicators and associated reference points are not linked to classifications of stock status used in the NFSRF (Roelofs et al., 2024).

The primary environmental performance indicator for each gillnet sector is: (i) ELMGN - suitable habitat available (%) for Mulloway in the Coorong Estuary; (ii) ESMGN – suitable habitat available (%) for Yelloweye Mullet in the Coorong Estuary; and (iii) FLMGN - mean annual water level (m) in the Lower Lakes. For key species in each sector, a secondary biological performance indicator based on non-standardised annual (calendar year) targeted catch per unit effort (CPUE) is used to monitor fishery performance. In this report, estimates of the environmental and biological performance indicators are provided for the 2024/25 reporting year (1 February 2024 to 31 January 2025) and 2024 calendar year, respectively, to ensure that the most up-to-date information is available to inform the setting of the TACE for each gillnet sector for the 2025/26 financial year.

The harvest strategy for Pipi describes performance indicators, reference points, and decision rules to inform setting of the annual TACC (PIRSA 2022). The biological performance indicators used in the harvest strategy are: (i) fishery-independent mean annual relative biomass (primary performance indicator), and (ii) presence/absence of pre-recruits in size-frequency distributions (secondary performance indicator) (Ferguson and Ward 2014; Ferguson et al., 2015; Ferguson and Hooper 2025). The harvest strategy also utilises fishery economic performance indicators and market price estimates to provide direct input of external factors on expected future prices over a range of potential TACC values (PIRSA 2022).

1.6 BLACK BREAM RECOVERY STRATEGY

In 2023, the Black Bream Recovery Strategy was developed in response to ongoing concerns about the Black Bream stock in the LCF, which has been classified as 'depleted' since 2016 (PIRSA 2023). The recovery strategy was developed by PIRSA Fisheries and Aquaculture, in conjunction with industry and SARDI. It defines the management intervention to recover the stock, performance indicators and reference points to monitor stock recovery, and the target levels required to achieve a 'sustainable' stock classification. The primary performance indicator is 3-year mean (i.e., smoothed) incidental (i.e., non-targeted) catch per unit effort (CPUE, kg/net-day) for LMGN in the Coorong Estuary, which is used as a proxy for relative abundance of Black Bream. The secondary performance indicator uses annual fishery age structure data to determine the presence/absence of strong cohorts (i.e., >25% of the overall age structure for each year class) in the first ten years of the age structure.

1.7 STOCK STATUS CLASSIFICATION

A national stock status classification system has been developed for the consistent assessment of key Australian fish stocks (Roelofs et al., 2024). It considers whether the current level of fishing pressure is adequately controlled to ensure that spawning stock abundance is not reduced to a point where the production of juveniles and subsequent recruitment to the fishable biomass is impaired. The system combines information on both the current stock size and the level of catch into a single classification for each stock against defined biological reference points. Each stock is then classified as either: 'sustainable', 'depleting', 'recovering', 'depleted' or 'undefined' (Table 1-1). PIRSA has adopted this classification system to define the status of South Australian fish stocks.

Table 1-1. Classification scheme used to assign fishery stock status. The description of each stock status and its potential implications for fishery management are also shown (Roelofs et al., 2024).

	Stock Status	Description	Potential implications for management of the stock
	Sustainable	Biomass (or proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (recruitment is not impaired) and for which fishing mortality (or proxy) is adequately controlled to avoid the stock becoming recruitment impaired (overfishing is not occurring)	Appropriate management is in place
	Depleting	Biomass (or proxy) is not yet depleted and recruitment is not yet impaired, but fishing mortality (or proxy) is too high (overfishing is occurring) and moving the stock in the direction of becoming recruitment impaired.	Management is needed to reduce fishing mortality and ensure that the biomass does not become depleted.
	Recovering	Biomass (or proxy) is depleted and recruitment is impaired, but management measures are in place to promote stock recovery, and recovery is occurring.	Management is in place, and there is evidence that the biomass is recovering.
	Depleted	Biomass (or proxy) has been reduced through catch and/or non-fishing effects, such that recruitment is impaired. Current management is not adequate to recover the stock, or adequate management measures have been put in place but have not yet resulted in measurable improvements.	Management is needed to recover this stock; if adequate management measures are already in place, more time may be required for them to take effect.
	Undefined	Not enough information exists to determine stock status	Data required to assess stock status are needed

2 FISHING FLEET DYNAMICS

2.1 INTRODUCTION

The dynamics of a fishing fleet are the product of decisions made by the fishers that relate to when and where to fish, what gear to use and what species to target. These decisions can be influenced by factors such as the abundance of target species, environmental conditions, management arrangements, markets, and other socio-economic considerations. For multi-species, multi-gear fisheries such as the LCF, understanding the dynamics of the fleet is an important first step toward assessing the status of the fish stocks they exploit. Understanding how fishing effort is directed among species and areas over time is important for interpreting trends in the fishery data (Hilborn and Walters 1992). This section of the report provides an overview of the fishery by examining trends in catches, effort, gear use, fishing areas, and season from 1 July 1984 to 30 June 2024. This summary explains the dynamic and complex nature of this fishery over different spatial and temporal scales and provides context for the assessments of stock status for individual species in subsequent sections of this report.

2.2 METHODS

The LCF is divided into 13 blocks for the purposes of data reporting and monitoring of commercial fishing activity (Figure 1-1). All fishers are required to log their daily fishing activities by recording details such as the reporting block fished, species targeted, species caught, weight of each species caught, gear type used, and for gillnet fishing, the number of gillnets used. These daily catch and effort data have been collected by LCF fishers since 1 July 1984 and are submitted monthly to PIRSA Fisheries and Aquaculture where they are entered into the PIRSA Information System. This database is routinely reviewed and cross-checked in accordance with quality assurance protocols (Vainickis 2010). The current database provides the primary source of data used for the assessments of status in this report.

Daily catch and effort data were extracted from the LCF Information System for period from 1 July 1984 to 30 June 2024. These data were aggregated to provide annual totals of catch by species, and targeted effort by species, gear, month, and location, for each financial year from 1984/85 to 2023/24. These aggregations of data enable analysis of the trends in fisher behaviour and fleet dynamics.

2.3 RESULTS

2.3.1 Trends in the number of active licences

There has been a 28.6% decline in the number of active fishers operating in the LCF over the past 39 years, declining from 42 licences in 1984/85 to a low of 30 licences in 2022/23 (Figure 2-1). In 2023/24, 33 fishers were active in the LCF.

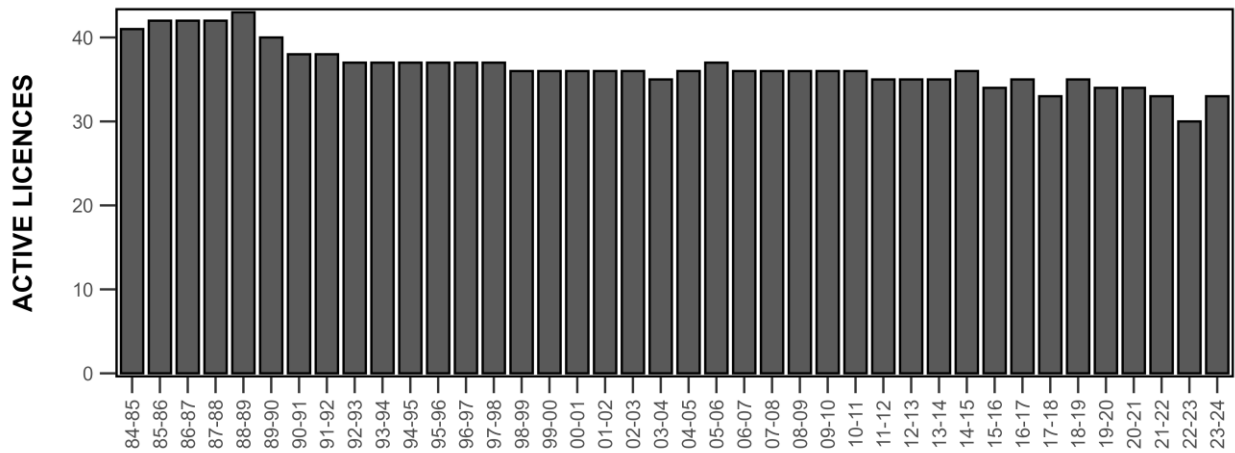


Figure 2-1. Long-term trend in the number of active licence holders in the LCF (financial years).

2.3.2 Trends in commercial catch

Since 1984/85, there have been considerable changes in the composition of the catches, which have contributed to high interannual variability in total catch (Figure 2-2). This variation is mainly attributable to variability in catches of the primary species, which have made up 65–85% of total annual production since the early 1990s. Most of the remaining catch in each year has comprised secondary species, with their contribution declining from >50% in the 1980s to 10% in the early 2000s. In 2023/24, the total fishery catch of 1,486 t was dominated by the five primary species (72.13%), with secondary (25.50%), tertiary (0.04%), and other species (2.34%) making up the remainder.

Total catch of the primary species has varied cyclically over time, with three notable peaks since 1984/85. The highest peak of 2,101 t was recorded in 2005/06, with two smaller secondary peaks of 1,771 t and 1,561 t recorded in 1993/94 and 2019/20, respectively (Figure 2-2). In 2023/24, total catch of the primary species increased to 1,072 t. Among the primary species, catches of Pipi (38.1%) and Carp (37.3%) have consistently accounted for most of the annual catches since 1984/85, followed closely by Yelloweye Mullet (14.5%) with smaller contributions from Golden Perch (5.6%) and Mulloway (4.5%).

Total annual catches of the secondary and tertiary species peaked at 1,177 t in 1989/90, with 98.3% of that attributed to Bony Herring, and smaller contributions from the secondary species consisting of Black Bream (0.9%) and Greenback Flounder (0.3%, Figure 2-2). Since then, total catches have been considerably lower, reflecting lower catches of Bony Herring. In 2023/24, the total catch of 380 t comprised Bony Herring (96.6%), Greenback Flounder (2.4%), Black Bream (0.8%) and the tertiary species Western Australian Salmon (*Arripis truttaceus*, 0.1%). No catches of the other tertiary species Snapper and Australian Herring were reported in 2023/24.

Annual catches of all other permitted species peaked at 103 t in 1988/89, with a smaller secondary peak of 72 t in 2011/12 (Figure 2-2). Among the 'other' species that have contributed to the commercial harvest since 1984/85, Redfin Perch have dominated catches, accounting for 79–98% of annual catches of species/taxa in this group (92.2% in 2023/24). A summary of total annual catches for twelve LCF species from 1984/85 to 2023/24 is shown in Appendix 1.

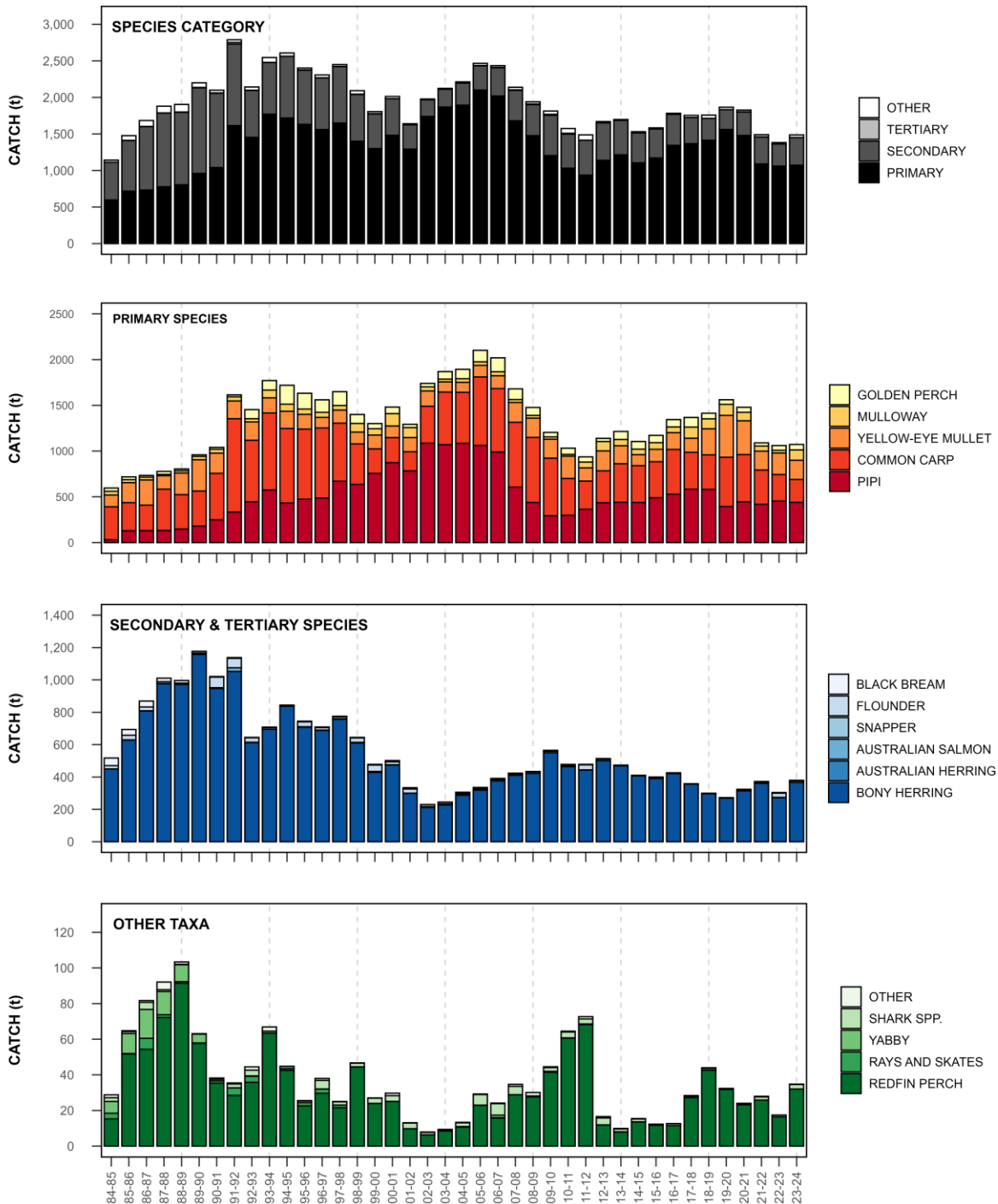


Figure 2-2. Long-term trends in total catch (t) in the commercial LCF from 1984/85 to 2023/24 (financial years), presented by species category, primary species, secondary and tertiary species, and all other permitted taxa/species.

2.3.3 Trends in commercial fishing effort

Species

Annual estimates of total fishing effort in the LCF peaked at 10,081 fishing days in 1988/89 (Figure 2-3). A substantial annual reduction in effort occurred in early 2000s, which coincided with onset of the Millennium Drought, when large areas of the Coorong Estuary became uninhabitable for fish due to persistent hypersaline environmental conditions associated with a lack of freshwater inflows from the River Murray (Webster 2010). In the last decade, annual effort increased to 7,573 fishing days in 2014/15 and then steadily declined to the lowest recorded effort of 4,545 fishing days in 2022/23. In 2023/24, total effort was 5,402 fishing days, with 75.6% (4,083 fishing days) being targeted effort (i.e., targeted to a particular species).

Of all targeted effort since 1984/85, the primary species have consistently accounted for the highest proportion (mean: 90%, range: 75–99%), of which Yelloweye Mullet and Golden Perch have historically dominated (Figure 2-3). During the 1980s, Yelloweye Mullet and Carp accounted for the largest proportions of the targeted effort among the primary species. There was a shift in fleet dynamics during the early 1990s, as fishers directed some of their effort from Yelloweye Mullet and Carp towards Golden Perch and Mulloway. The relative proportion of effort targeted towards Pipi also increased during the 1990s and was highest during the mid-2000s. In 2023/24, targeted effort increased for all primary species, including Yelloweye Mullet (by 2.8%), Mulloway (177%), Golden Perch (65.7%), and Carp (17.8%), with the exception of Pipi (-4.2%).

Prior to 1992/93, the up to 21% of the total fishing effort was targeted at secondary and tertiary species in some years, with most of this directed toward Bony Herring, Black Bream and Greenback Flounder (Figure 2-3). Of these species, Bony Herring and Black Bream accounted for most of the targeted effort during the 1980s, prior to a shift to targeting Greenback Flounder in the 1990s. Since then, targeted fishing for secondary species has been highly variable and accounted for <5% of total effort in most years. The increase to 13.7% of the overall effort in 2022/23, the highest in over a decade, was due to increased targeting of Greenback Flounder. In 2023/24, effort targeted towards secondary and tertiary species remained relatively high, accounting for 8.7% of total targeted effort, with a decline for Black Bream (-24.1%) and Greenback Flounder (-60.7%), and a considerable increase for Bony Herring (1,169%). Over the last 40 years, most of the remaining targeted effort in the fishery has been directed toward Redfin Perch (28 fishing days in 2023/24).

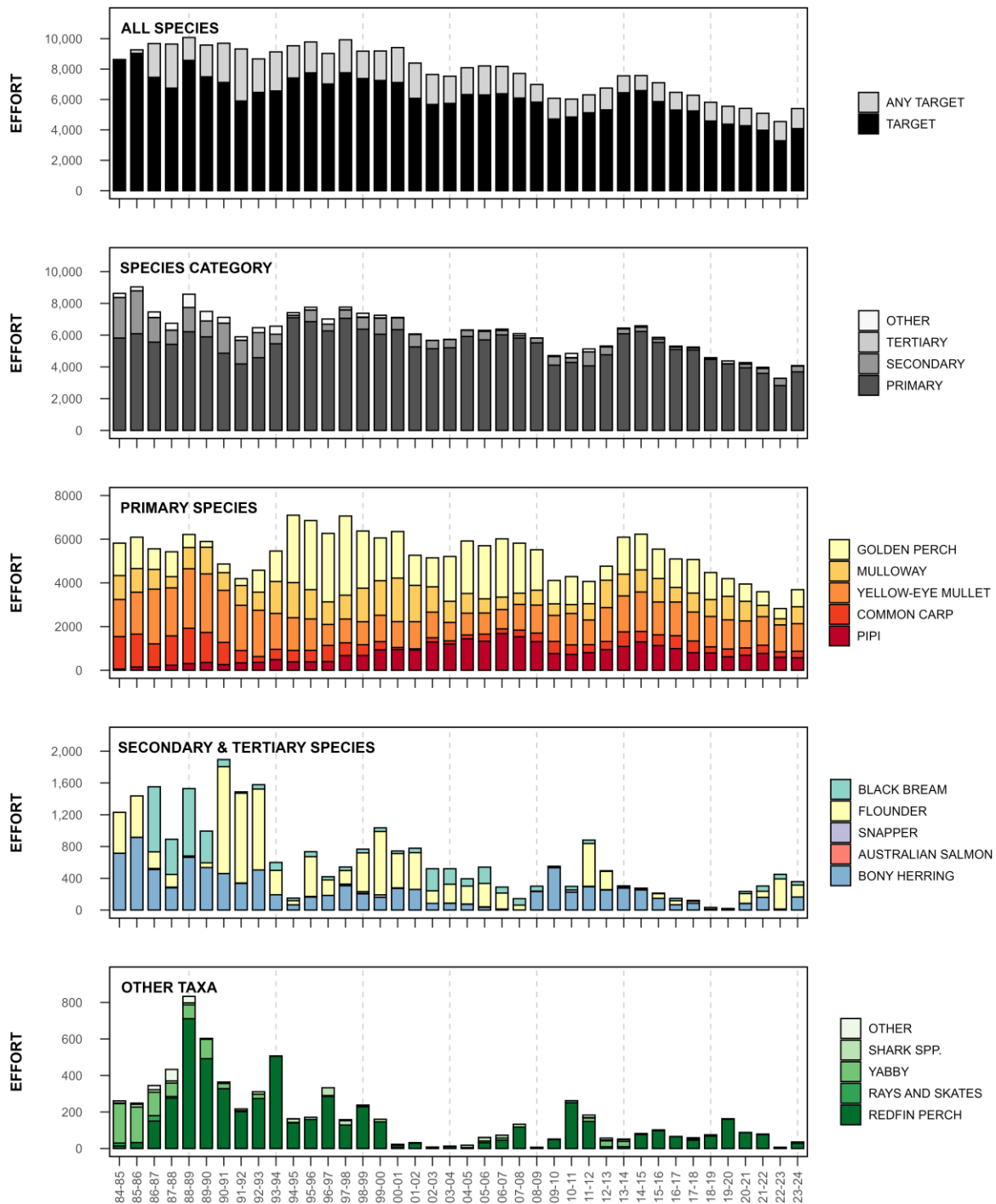


Figure 2-3. Long-term trends in total effort (fishing days) in the LCF from 1984/85 to 2023/24 (financial years) presented by targeted and non-targeted ('any target') effort (top graph), and targeted effort by species category, primary species, secondary and tertiary species, and all other permitted species.

Gear

Large-mesh gillnets have consistently been the dominant gear type used in the LCF, accounting for 56–82% of the total fishing effort each year since 1984/85 (57.5% in 2023/24) (Figure 2-4). Small-mesh gillnets have been the second most used gear type (25.9% in 2023/24). The relative use of cockle rakes steadily increased from <3% during the 1980s to 20% in 2006/07 before stabilising at 12–15% during 2013/14–2022/23 and declining to 10.5% in 2023/24. Swinger nets have accounted for most of the remaining fishing effort in the fishery (5.1% in 2023/24), with negligible contributions from hauling nets, drum nets, and yabbie pots (combined contribution of 1.0% in 2023/24).

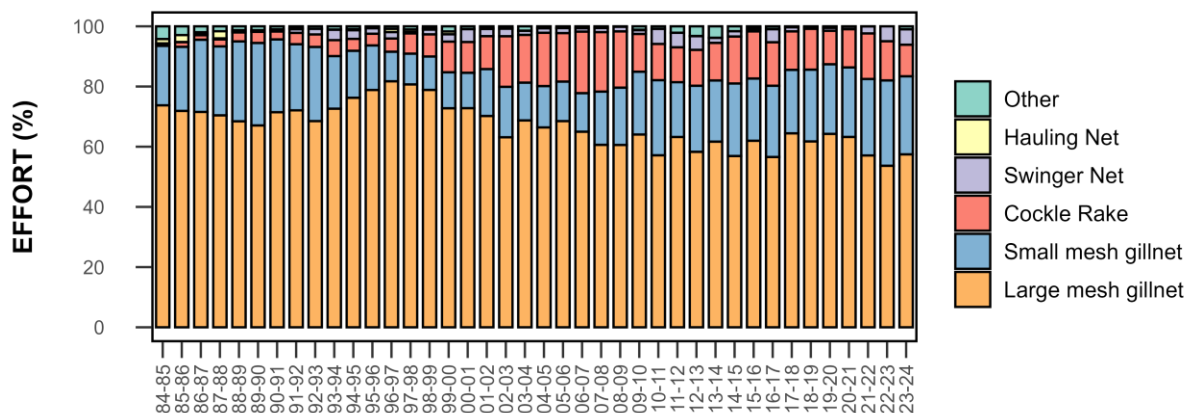


Figure 2-4. Gear usage (% of total fishing effort in fishing days) within the LCF (financial years).

Season

Among the five primary species over the last five years, Yelloweye Mullet were targeted consistently throughout the year, although average monthly targeted effort was highest during the cooler months from May–September, peaking in July at 119 fishing days (± 8 SE) (Figure 2-5). Mean targeted effort for Mulloway was highest in late spring, peaking at 99 fishing days (± 24 SE) in November. Targeted effort on Golden Perch was consistent from July (46 fishing days ± 13 SE) to April (61 fishing days ± 4 SE), before increasing to 84 fishing days (± 11 SE) in May and 85 fishing days (± 15 SE) in June. Over the last five years, targeted effort on Pipi was highest during January–March. Carp were consistently targeted throughout the year, ranging from 24 fishing days (± 4 SE) in December and 30 fishing days (± 9 SE) in March.

For the secondary species, fishing effort on Greenback Flounder was highest during the warmer months from November to April (Figure 2-5), while targeted fishing for Bony Herring was generally limited to the months from August to January. Targeted effort on Black Bream was highest in January and June, with lower levels of targeting from September to December aligning with the Black Bream fishery closure during these months in recent years.

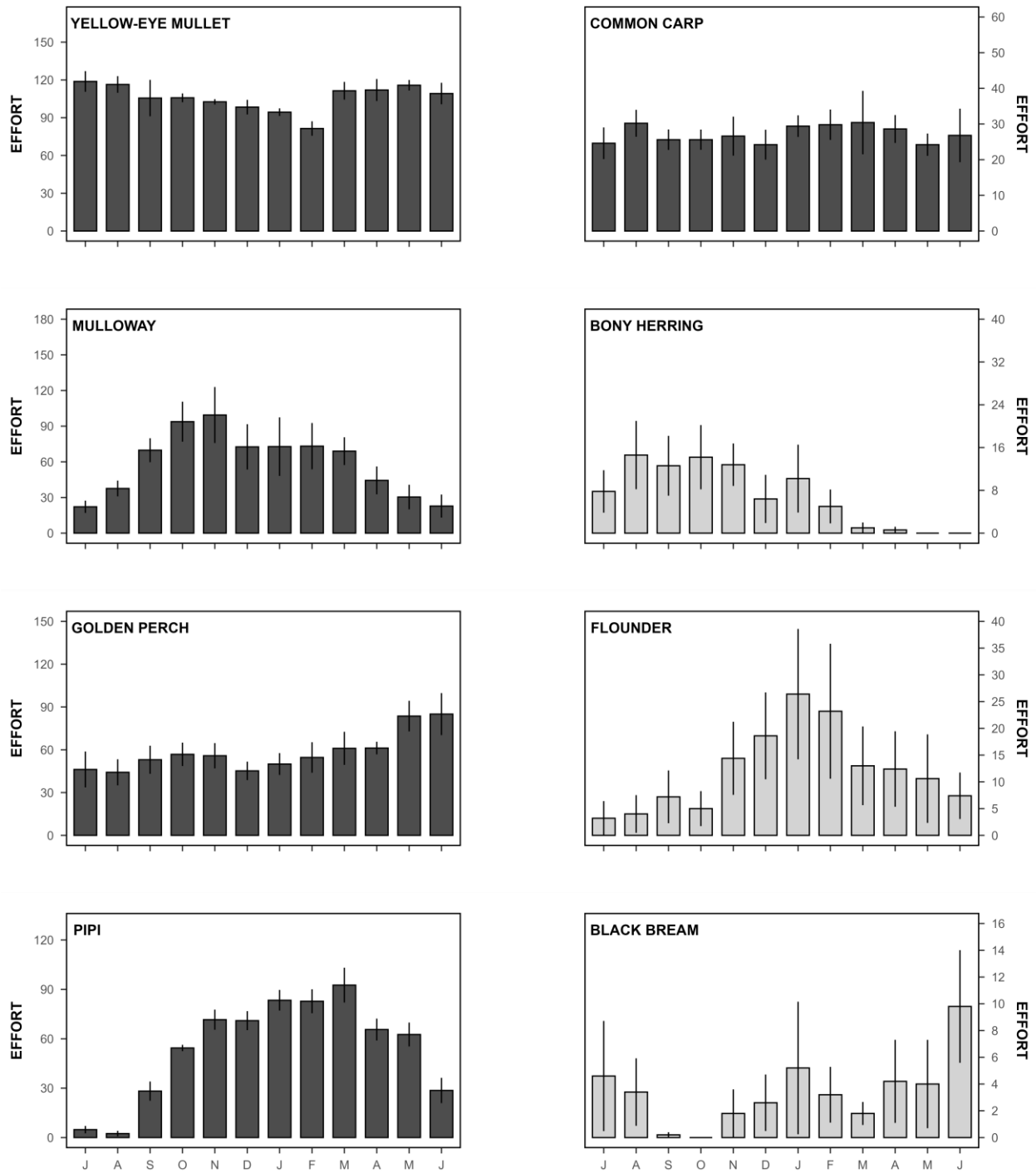


Figure 2-5. Monthly pattern of targeted fishing effort (fishing days averaged, \pm SE) averaged over the five-year period from 2019/20 to 2023/24 (financial years) for each species assessed in this report. The different shades denote species category; primary (dark grey) and secondary (light grey).

Location

During the mid-1980s, the spatial distribution of fishing effort in the LCF was largely limited to the Lower Lakes (reporting blocks 4, 5) and Coorong Estuary (blocks 6–12), with low levels of fishing along the adjacent ocean beaches (blocks 15, 16) (Figure 2-6). During this time, effort was highest in Lake Alexandrina (block 4) with moderate levels of targeting in the upper estuary (blocks 8–10). During the 1990s and 2000s, there was a progressive increase in fishing activity along the ocean beach of the Youngusband Peninsula (block 16) associated with increased targeting of Pipi, while Lake Alexandrina (block 4) continued to account for most of the effort. During 2004/05–2008/09, there was a contraction of the fishing ground in the Coorong Estuary associated with the Millennium Drought, with lower effort in the south lagoon (blocks 12–14). Increased river inflows in 2010/11 led to improved environmental conditions in the estuary and a subsequent expansion of the fishing ground into southern areas of the south lagoon. The low levels of fishing effort across the fishery during 2019/20–2023/24 (Figure 2-6) reflected lower effort in Lake Alexandrina and the coastal waters adjacent to the Coorong, compared to the preceding five-year period.

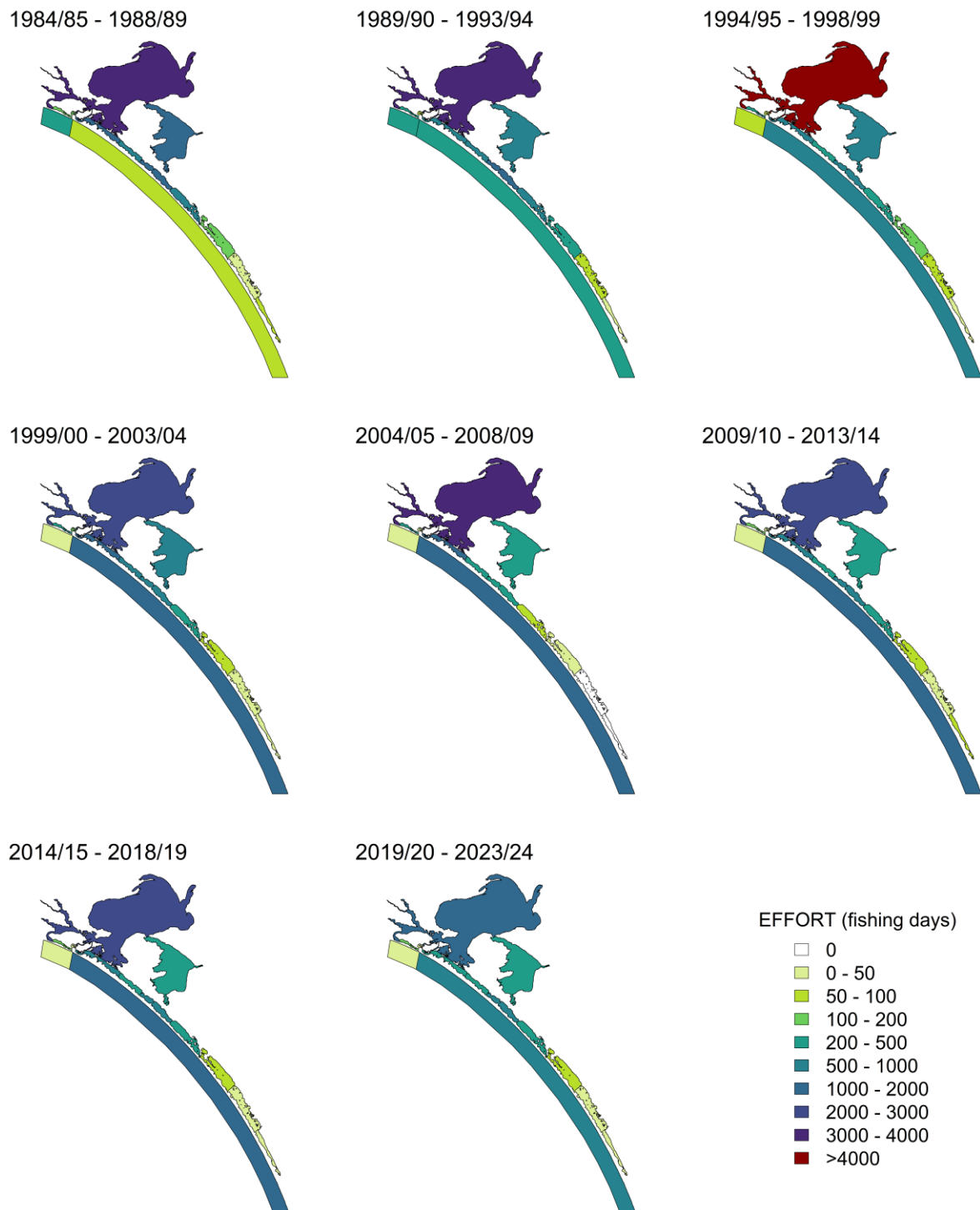


Figure 2-6. Spatial and temporal distribution of annual fishing effort (fishing days) in the LCF averaged over five-year periods from 1984/85 to 2018/19, and for the four-year period from 2019/20 to 2023/24 (financial years).

2.4 DISCUSSION

The dynamics of the LCF fleet have changed considerably over the last 40 years and have likely been driven by combined shifts in environmental conditions, market demands, and fishing practices. While the primary species have consistently accounted for most of the targeted effort in the fishery over that time, the most obvious changes in fisher behaviour have related to shifts in targeting among the primary species.

In the late 1980s, a large proportion of the fleet's targeted effort was directed at Yelloweye Mullet, Mulloway, and Carp. These species continue to be key targets for the fishery, with Yelloweye Mullet and Mulloway sold for human consumption, and Carp primarily supplied as bait to the Southern Rock Lobster Fishery, with small volumes sold for human consumption. During the 1990s, there was an increase in targeting of Golden Perch, and this species is now a key target for the fishery due to its high wholesale value compared to other species targeted by the fishery (EconSearch 2024). There was also a substantial increase in targeting of Pipi during the 1990s and 2000s, when most of the catch was supplied as relatively low-value bait product. The introduction of a TACC under a quota management system for Pipi in 2007/08 has effectively constrained commercial harvest from 2009/10 (Ferguson and Hooper 2021), and since then, the fishery has increased the proportion of Pipi sold for human consumption which has increased its wholesale market value.

Environmental conditions associated with freshwater inflow from the River Murray have a major influence on the productivity of the Lakes and Coorong ecosystem, including the abundance and distribution of fishes that support the LCF. Since 1984/85, there have been several key environmental events that have resulted in fishers modifying their activities to optimise production. For example, during the Millennium Drought (2002–2010), a lack of freshwater inflows resulted in the intensification of a longitudinal salinity gradient in the Coorong Estuary where extremely high salinities (>140 ppt) in the south lagoon made it uninhabitable for fish. Consequently, the fishable area in the estuary contracted considerably, with fishing effort becoming confined to areas adjacent to the Murray Mouth and the upper north lagoon. This contraction of the fishery likely reduced the area of suitable estuarine habitat for Mulloway, Flounder, Yelloweye Mullet and Black Bream. In contrast, a flood event in 2010/11 led to reduced salinities in the lower north lagoon and upper south lagoon, re-opening fish habitat and resuming fishing activity in these areas. A similar event occurred during 2022 and 2023 after heavy rainfall across the MDB resulted in the largest flooding event in South Australia since 1956, lowering water salinity across the Coorong Estuary and increasing the amount of suitable estuarine habitat for fish. These environmentally driven changes in fisher behaviour, along with the day-to-day behavioural responses of fishers to markets, management changes, weather, and the presence of Long-nosed Fur Seals since 2010 (EconSearch 2024; Earl et al., 2021), highlight the dynamic and adaptive nature of the LCF fleet.

3 STOCK ASSESSMENT – GOLDEN PERCH

3.1 INTRODUCTION

3.1.1 Overview

This section of the report provides an assessment of the LCF for Golden Perch, which builds on previous stocks assessments completed in 2004 and 2012 (Ye 2004; Ferguson and Ye 2012) and the 2024 assessment of stock status (Sarakinis and Earl 2024). It provides a synopsis of information available for this species and an assessment of the current status of the LCF for Golden Perch based on (i) commercial fishery catch and effort statistics from 1 July 1984 to 30 June 2024; (ii) results from State-wide recreational fishing surveys conducted in 2000/01, 2007/08, 2013/14, and 2021/22 (Henry and Lyle 2003; Jones 2009; Giri and Hall 2015, Beckmann et al., 2023); (iii) information on the size and age characteristics of Golden Perch from commercial catches to inform on population structure and recent recruitment; and (iv) information on the recent condition of the environment in which the Golden Perch fishery operates against reference points prescribed in the Management Plan (PIRSA 2022).

3.1.2 Biology

Golden Perch (*Macquaria ambigua*), also known locally as 'Callop' and 'Yellowbelly', is a medium-bodied, long-lived freshwater species and a member of the Percichthyidae family (Classon and Booth 2002). Golden Perch occurs throughout the MDB, except at high altitudes, as well as in the Lake Eyre and Bulloo drainage systems of Queensland, NSW, and South Australia, and the Dawson-Fitzroy river system in Queensland (Lintermans 2007). Translocated fish occur in numerous other waterways and impoundments throughout south-eastern Australia. Golden Perch can grow to 760 mm TL and live to 28 years of age (Zampatti et al., 2015; Mallen-Cooper and Stuart 2003). It is a potamodromous species, migrating and completing its lifecycle entirely within freshwater habitats. Spawning occurs in the water column mainly during spring and summer (Battaglione and Prokop 1987), where eggs and larvae drift downstream into nursery habitats, with adults able to move back upstream and return to their natal source (Zampatti et al., 2022; Stuart and Sharpe 2020). This native Australian species exhibits highly migratory behaviour across its distribution range, with individuals migrating over large distances (100s-1000s km) during both early- and adult-life history stages (Koehn and Nicol 2016; Zampatti et al., 2018), a behaviour often linked to elevated freshwater flows (Crook et al., 2024; Koster et al., 2017). In the lower River Murray, individuals usually mature at 2–4 years of age. The size-at-maturity for the Lower Lakes population is not known, although Golden Perch growth is similar across the species' MDB distribution (Wright et al., 2020). Golden Perch growth is environmentally influenced, with recent studies indicating increased [fish otolith] growth in response to elevated flows and migratory behaviour (Barrow et al., 2024, 2021; Izzo et al., 2016). Similarly, recruitment and

subsequent population abundance has also been linked to increased flow (Stocks et al., 2021; Zampatti et al., 2021; Bice et al., 2014).

Understanding of stock structure for Golden Perch is based on results of several genetic studies and demographic information from across the species' range. Golden Perch in the MDB are genetically distinct from those in the Lake Eyre, Bulloo, and Fitzroy systems (Faulks et al., 2010a, b; Beheregaray et al., 2017). Murray-Darling Golden Perch form a well-connected metapopulation with low-level basin-wide population structure, reflecting their ability to migrate and disperse long distances (Attard et al., 2022, 2018; Zampatti et al., 2018). However, subtle genetic differences and regional differences in population structures driven by discrete recruitment sources suggest sub-structuring across some regions. Examples include the Lower Lakes (Earl et al., 2015) and Paroo River (Attard et al., 2018), and potentially the physically disconnected and hydrologically impacted Victorian tributaries of the River Murray and some NSW tributaries of the Barwon-Darling, e.g., Lachlan River (Shams et al., 2020). The assessment of stock status in this report is undertaken at the management unit level – the LCF.

3.1.3 Fishery

Golden Perch is an important species for commercial and recreational fisheries in South Australia. Historically, the commercial fishery had three main sectors: the LCF; the River (or Reach) Fishery; and the Lake Eyre Basin Fishery (LEBF). The LCF is the main commercial fishery for Golden Perch in the State. The LCF uses LMGN to target the species in the Lower Lakes and the River Murray between Lake Alexandrina and Wellington. The commercial River Fishery was established in 1923 and operated along the main channel of the River Murray, before it was closed in 2003 (Earl et al., 2015). The LEBF was established 1992 and has one licensed fisher that operates on the pastoral holding of Mulka Station. The LEBF is a unique fishery due to the harsh environment in which it operates and its dependence on the dispersion of Golden Perch to the region during large scale flood events within the Cooper Creek system. Catch and effort data for the River Fishery and LEBF are not considered in this report.

Currently, Golden Perch is the only large-bodied native fish species that is permitted to be taken by recreational fishers along the River Murray in South Australia. Most recreational fishers target Golden Perch using rod and line. In 2021/22, the estimated State-wide retained recreational catch of Golden Perch was 11.2 t (\pm 3.5 SE based on confidence interval of retained fish numbers for comparison among surveys) (Beckmann et al., 2023). There are no catch and effort data for Aboriginal and traditional fishing.

3.1.4 Harvest strategy

The Management Plan includes a harvest strategy for finfish (PIRSA 2022). The harvest strategy uses environmental (primary) and biological (secondary) performance indicators, reference points and decision rules to inform setting of the annual TACE for the three gillnet sectors, as defined in Section 1.4. Golden Perch is the primary target species in the FLMGN sector. The environmental performance indicator for the FLMGN sector, mean annual water level (m) in the Lower Lakes, was developed as a surrogate metric for fishable biomass of Golden Perch in the Lower Lakes and is a measure of the available area for fish to occupy (PIRSA 2022; Knuckey et al., 2015). The biological (secondary) performance indicator for Golden Perch, non-standardised annual targeted catch per unit effort (CPUE) using LMGN, is used to monitor fishery performance. These performance indicators and associated reference points are not linked to classifications of stock status used in the NFSRF (Roelofs et al., 2024).

3.1.5 Management Arrangements

Golden Perch is a primary species of the LCF, making a relatively high contribution to the total production value (PIRSA 2022). For the commercial sector, management arrangements are in place to manage targeted fishing effort and limit the take of Golden Perch. These include temporal and spatial netting closures, restrictions to net lengths and mesh sizes, and a LML of 330 mm TL.

There are multiple management arrangements in place for Golden Perch in the recreational sector including input and output controls. These include gear restrictions and a daily bag limit of five fish and boat limit of 15 fish. The LML of 330 mm TL also applies.

3.2 METHODS

The data sources considered in this stock assessment were (i) commercial fishery statistics, (ii) recreational fishery catch estimates, (iii) contemporary annual fishery size and age structures from commercial catch sampling, and (iv) estimates of the environmental performance indicator for the FLMGN sector. These data were considered at the management unit scale for the LCF.

3.2.1 Fishery statistics

The commercial fishery data for Golden Perch were extracted from the commercial PIRSA Fishery Information System for the 40-year period of 1984/85 to 2023/24. These data were aggregated to provide annual totals of total catch across all gear types, and targeted catch, targeted effort and targeted CPUE for LMGN ($CPUE_{LMGN}$) in financial years. Targeted $CPUE_{LMGN}$ was estimated by dividing annual targeted catch by annual targeted effort based on the number of LMGNs that were deployed (net-days). Effort in fisher-days is not considered, because it does not account for any variation in the number of nets deployed on each day. Estimates of total catch, by month and block

(Figure 1-1), for the past 40 years is also presented to describe the fine-scale spatial and temporal trends in fishery production. Estimates of total State-wide recreational catches of Golden Perch obtained from telephone/diary surveys done in 2000/01, 2007/08, 2013/14 and 2021/22 (Henry and Lyle 2003, Jones 2009, Giri and Hall 2015, Beckmann et al., 2023) are also presented.

3.2.2 Size and age structures

Biological samples of Golden Perch were collected from commercial catches taken using LMGN in the Lower Lakes in 2014/15, 2015/16, 2022/23, 2023/24, and 2024/25. Commercial catches were accessed at the SAFCOL Fish Market in Adelaide and opportunistically by onboard SARDI observers during regular fishing activities.

On each sampling occasion, fish were randomly sub-sampled from the catch, and each sampled fish was measured to the nearest mm and then dissected for the removal of its otoliths that were later used to determine fish age. Golden Perch otolith increments have been validated as occurring on an annual basis (Anderson et al., 1992; Stuart 2006). Therefore, fish were aged by counting these annual increments (i.e., opaque bands) from sectioned otoliths using an established ageing protocol (Zampatti et al., 2015). Estimates of annual size and age structures were generated.

3.2.3 Performance indicators

The environmental performance indicator for the FLMGN sector is the mean annual water level in the Lower Lakes. Annual estimates of this performance indicator provide an indication of the amount of habitat available for Golden Perch in the Lower Lakes. Estimates are derived from daily recorded water level data from twelve fixed water monitoring stations located throughout the Lower Lakes (Figure 1-1), which are maintained by the Department of Environment and Water. For this assessment, a time series of annual performance indicator values was calculated from 1984/85 to 2024/25. The value for the 2024/25 reporting year (1 February 2024–31 January 2025), was compared to the TRP, TrRP, and LRP from the reference period of 1984/85–2012/13 (PIRSA 2022).

The biological performance indicator is based on non-standardised annual targeted CPUE for Golden Perch using LMGN. For this assessment, a time series of annual CPUE in calendar years from 1985–2024 was calculated. Then, the value for the 2024 calendar year was compared against TRP, TrRP, and LRP prescribed in the Management Plan (PIRSA 2022).

3.3 RESULTS

3.3.1 Fishery statistics

Lakes and Coorong Fishery

Trends in total catch, effort and CPUE

Total annual catches of Golden Perch have fluctuated cyclically over the past 40 years (Figure 3-1A). They ranged from 17.8 to 36.3 t during the late 1980s, then increased to a peak of 206 t in 1994/95, before declining to 36.3 t in 2001/02. Catch increased to a secondary, smaller peak of 151.9 t in 2006/07 and then fell to 33.9 t in 2012/13. Between 2013/14 and 2016/17, annual catches ranged between 79.5 and 88.2 t, then increased to 105.9 t in 2017/18, before progressively declining to 35.2 t in 2021/22. Since then, catches have increased to 52.4 t and 60.2 t in 2022/23 and 2023/24, respectively.

Targeted catches taken using LMGN have accounted for >75% of the total Golden Perch catch in most years since 1984/85. In 2023/24, targeted LMGN catches accounted for 48.2% of the total catch, with the remainder taken as by-product when other species were targeted using LMGN. Trends in targeted effort using LMGN have been similar to total catch with peaks of 128,896 and 94,006 net-days in 1997/98 and 2006/07, respectively (Figure 3-1B). Effort has been considerably lower over the past 14 years, declining to its second lowest level of 10,758 net-days in 2022/23. In 2023/24, targeted LMGN effort increased to 18,708 net-days.

Estimates of targeted $CPUE_{LMGN}$ have followed the same cyclical pattern as catch and targeted LMGN effort, with peaks in the early 1990s and mid-2000s (Figure 3-1C). Since 2009/10, $CPUE_{LMGN}$ increased from 0.6 kg/net-day to 1.6 kg/net-day in 2017/18, before progressively declining to 0.8 kg/net-day in 2021/22. In 2022/23, $CPUE_{LMGN}$ spiked to 2.0 kg/net-day, the highest recorded the fishery, and remained high at 1.6 kg/net-day in 2023/24.

Spatial and temporal trends in catch

Catches taken in reporting block 4 (Lake Alexandrina) have consistently accounted for >90% of annual total catches since 1984/85 and accounted for 99.3% in 2023/24, with block 5 (Lake Albert) contributing most of the remaining catches (Figure 3-2A; 3-2B). There has been no clear seasonality in catches during the past decade, although catch was highest in 2023/24 in January and May and lowest in August (Figure 3-2C).

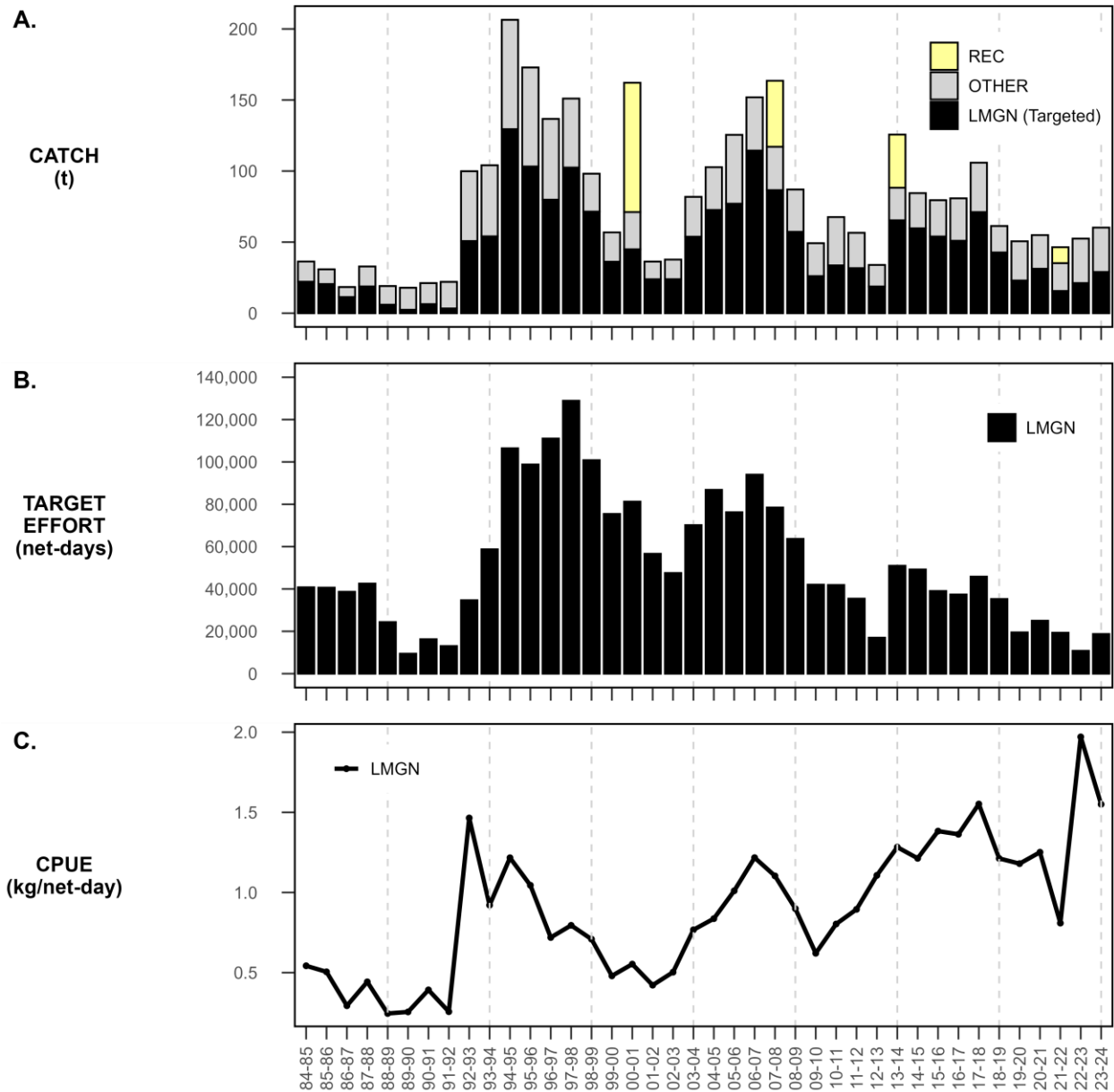


Figure 3-1. Fishery statistics for Golden Perch presented by financial year. Long term trends in: (A) total catch for large-mesh gillnets (LMGN), the recreational sector (REC; from all State waters for 2000/01, 2007/08, 2013/14 and 2021/22); and by all other means (OTHER); (B) targeted effort for LMGN; and (C) targeted CPUE for LMGN.

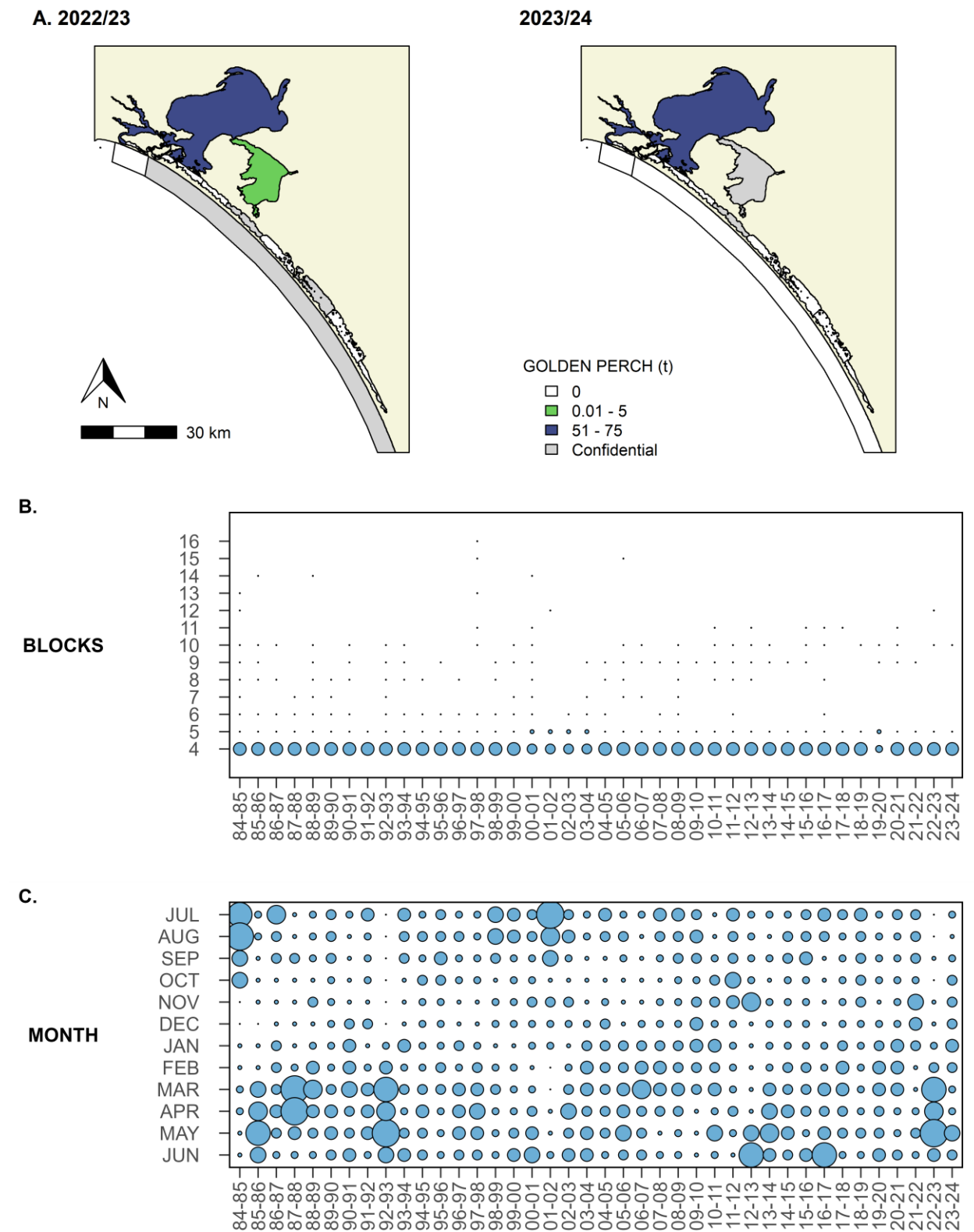


Figure 3-2. Fishery statistics for Golden Perch presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

3.3.2 Size and age structures

The size structures for Golden Perch from LMGN catches taken in the Lower Lakes varied considerably from 2014/15 to 2024/25 (Figure 3-3); In 2014/15 and 2015/16, fish length ranged from the LML of 330 mm TL to 384 mm TL, with a high proportion of 340-350 mm TL in 2014/15, and 330, 350, and 370 mm TL fish in 2015/16. Size structures in recent years indicate an increasing proportion of larger individuals caught, with the size range extending beyond 380 mm TL to ~575 mm from 2022/23-2023/24 and a high proportion of 390-400 mm TL in 2022/23 and 350 mm TL in 2023/24 (Figure 3-3). The size structure in 2024/25, which contained the most Golden Perch sampled in a financial year, comprised an even contribution of fish relative to previous years, ranging from 330 to 380 mm TL with the size range further extending to 558 mm TL.

With higher proportions of smaller fish in the catch samples from 2014/15 and 2015/16, the age structure comprised high proportions of young fish compared to subsequent years and were dominated by three- and four-year-olds, ranging from 3–14 years and 3–12 years, respectively. In 2022/23, fish ages ranged from 3–26 years, with almost 60% of the age structure comprising six-year-olds (i.e., 2017 year class). In 2023/24, a high proportion of two-year-olds (i.e., 2022 year class) and seven-year-olds (i.e., 2017 year class) were present, with ages ranging from 2–25 years. In 2024/25, age ranges remained similar to recent years (i.e., 2–23 years), with a high proportion of the 2017 year class, followed by four- and two-year-old fish. The presence of strong year classes in 2023/24 and 2024/25 reflects new recruits entering the fishable biomass.

Across all age structures, the dominant cohorts were associated with years of high freshwater flow. For example, strong 2011 and 2012 year classes in both 2014/15 and 2015/16 originated from spawning during high flow periods in 2010/11 and 2011/12, respectively (Figure 1-2). Similarly, the strong 2017 and 2022 year classes shown in recent years are associated with spawning during periods of high freshwater flow in 2016/17 and 2022/23 (i.e., the 2022/23 Murray River Flooding event), respectively (Figure 1-2).

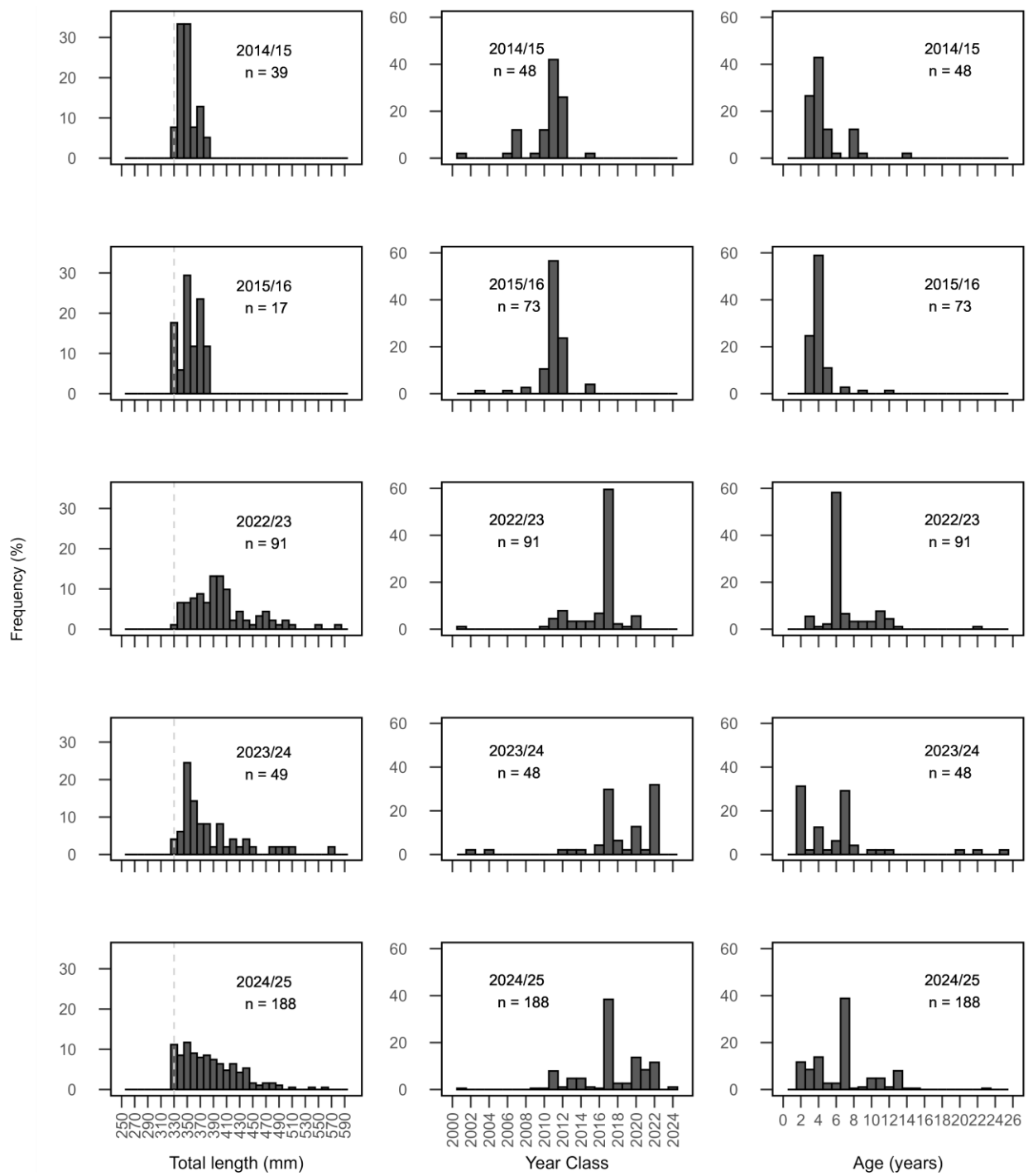


Figure 3-3. Size (left), year class (middle), and age (right) structures for Golden Perch from catches taken by the LCF using large-mesh gillnets in the Lower Lakes in 2014/15, 2015/16, 2022/23, 2023/24, and 2024/25 (financial years). The numbers (n) of fish processed are shown. Note the different y-axis scales. Grey dashed vertical line represents the LML of 330 mm TL.

3.3.3 Environmental performance indicator

The FLMGN performance indicator for mean water level in the Lower Lakes for the 2024/25 reporting year was 0.73 m (± 0.004 SE), which was above the TRP of 0.40 m (Figure 3-4). Since 1984/85, this performance indicator has dropped below the TRP four times, while the TrRP has only been breached once. These breaches all occurred during the Millennium Drought (2007/08–2010/11), following several years of exceptionally low or no river flows.

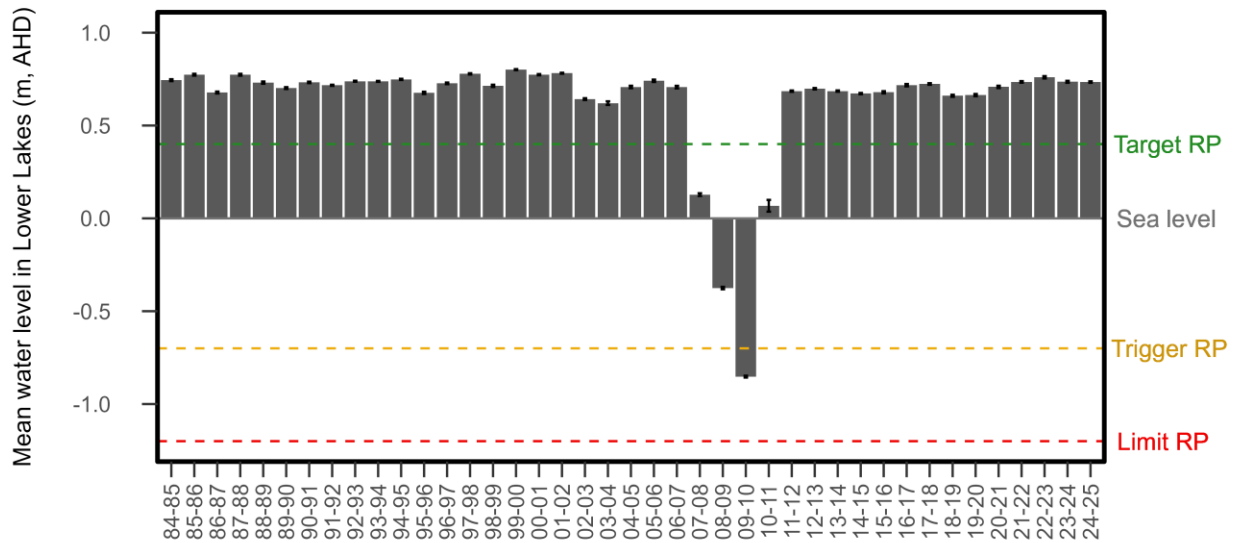


Figure 3-4. Time series of annual estimates of the FLMGN environmental performance indicator for mean water level in the Lower Lakes (\pm SE) from 1984/85 to 2024/25 (reporting years), showing target, trigger and limit reference points (RP).

3.3.4 Biological performance indicator

For the 2024 calendar year, the biological performance indicator for targeted Golden Perch CPUE_{LMGN} was 1.62 kg/net-day, which was above the TRP of 1.04 kg/net-day, and the second highest recorded in the LCF (Figure 3-5). The biological performance indicator for the Golden Perch stock is used in the harvest strategy and not to determine stock status.

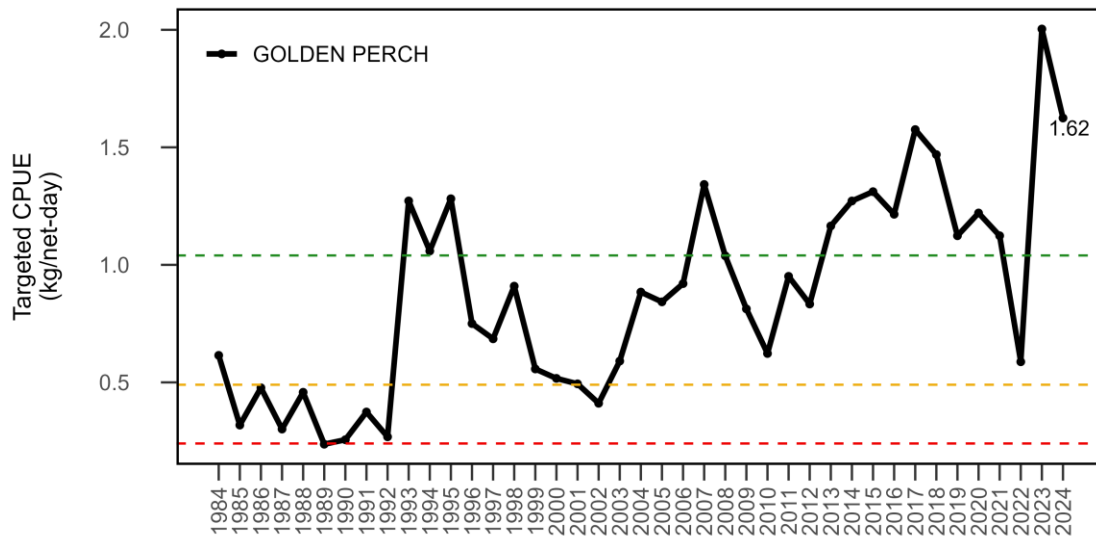


Figure 3-5. Time series of annual estimates of the ESMGN biological (secondary) performance indicator (targeted CPUE_{SMGN}) for Yelloweye Mullet from 1985 to 2024 (calendar years), showing target (green dashed line), trigger (orange dashed line) and limit (red dashed line) reference points.

3.4 DISCUSSION

3.4.1 Context of this assessment

The previous Golden Perch stock assessment, which was primarily based on analyses of commercial catch and effort data and fishery size and age structures up to June 2011, classified the stock as 'sustainably exploited' (Ferguson and Ye 2012). Recent assessments of stock status (e.g., Earl 2023; Sarakinis and Earl 2024), which were based solely on analyses of commercial catch and effort data, classified the stock as 'sustainable'.

3.4.2 Determination of stock status

The status of the LCF for Golden Perch was assigned using the NFSRF (Table 1-1; Stewardson et al., 2018). The current harvest strategy for finfish (PIRSA 2022) does not provide a pre-defined LRP that determines when the Golden Perch stock is depleted (i.e., when recruitment is impaired because the adult biomass no longer has the reproductive capacity to replenish itself) and lacks an index that

explicitly defines stock status. Consequently, the assignment of stock status for Golden Perch used a weight-of-evidence approach that placed considerable emphasis on trends in commercial catch and effort data from 1984/85 to 2023/24, and the size and age structures from commercial fishery catches from 2014/15, 2015/16, 2022/23, 2023/24, and 2024/25. This weight-of-evidence approach is consistent with the approach used in the Status of Key Australian Fish Stocks Reports (Roelofs et al., 2024) and previous LCF stock assessments (e.g., Earl and Bailleul 2021; Earl 2023; Sarakinis and Earl 2024).

3.4.3 Stock status

The LCF is the primary commercial fishery for Golden Perch in South Australia. The most obvious long-term trends in the fishery data for Golden Perch is the cyclical nature of the interannual variation in total catch, which has been closely linked with variations in targeted effort and $CPUE_{LMGN}$, and likely reflects trends in fishable biomass in the Lower Lakes. Since 1984/85, catch peaks in the mid-1990s, mid-2000s, and mid-2010s were indicative of periods of high biomass which were followed by gradual declines in catch and CPUE that were consistent with a declining biomass. Since 2021/22, total catch has increased and was 60.2 t in 2023/24, while $CPUE_{LMGN}$ has been at near-record high levels. The State-wide recreational catch of Golden Perch was estimated at 11.2 t in 2021/22, although the proportion of the State-wide catch taken in areas of the LCF is not known (Beckmann et al., 2023).

The age structure for Golden Perch from the Lower Lakes in 2024/25 was similar to those from 2022/23 and 2023/24 – it was dominated by fish from the 2017 year class (seven-year-old fish), and included moderate proportions of two-year-old fish (2022 year class) and four-year-old fish (2020 year class), with small proportions of fish up to 25 years old. The predominance of young age classes (i.e., 2–7 years of age) in the recent age structures, is consistent with the historical age structures from 2013/14 and 2014/15 and indicates that fishery performance over the past decade has been dependent on the abundance of these young age classes in the Lower Lakes. The larger age classes in the population appear to be linked to Murray River flow events in (2010/11, 2011/12, 2016/17, 2020/21, and 2022/23), highlighting that environmental conditions associated with elevated river flows are important for recruitment of Golden Perch to the Lower Lakes. The lack of older fish in the historical and contemporary age structures could relate to a combination of factors, including the removal of older fish by fishing, selectivity of the gillnets used by the fishery, impacts of environmental conditions (e.g., low recruitment during periods of low Murray River flows), and/or demographic processes such as the emigration of larger/older individuals upstream into the Murray River – currently poorly understood. Nonetheless, the presence of multiple year classes of young fish in the recent fishery age structures indicates that recruitment to the fishable biomass has occurred in recent years.

The environmental performance indicator for the FLMGN of the LCF was developed as a surrogate metric for fishable biomass of Golden Perch in the Lower Lakes (Knuckey et al., 2015; PIRSA 2022). The FLMGN performance indicator of mean water level in the Lower Lakes for the 2024/25 reporting year was 0.73 m, which was above the TRP of 0.40 m.

The recruitment of Golden Perch to the fishable biomass in the Lower Lakes in recent years and high targeted catch rates indicate that the biomass of this stock is unlikely to be depleted, recruitment is unlikely to be impaired, and the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On this basis, and using the definitions from the NFSRF, the LCF for Golden Perch is classified as a **sustainable** stock.

3.4.4 Uncertainty in the assessment

The main uncertainty in this assessment for Golden Perch relates to the correlation between fishable biomass and targeted CPUE_{FLMGN}. It is assumed that the patterns in commercial catch and targeted CPUE_{FLMGN} reflect the biomass of Golden Perch in the Lower Lakes. However, there are other factors relating to fisher behaviour that may also influence these relationships. Fishers can switch their fishing effort between different target species and move between different areas to optimise their fishing efficiency and profitability. For example, gillnet fishers can operate in the narrow main channel of the Murray River below the Wellington ferry at times of the year when Golden Perch are more abundant in this area (possibly when the fish are attempting to move between the Lower Lakes and main river channel), and this is likely to improve catch rates. Furthermore, in recent years some fishers have adapted their fishing practices to try and avoid interactions with Long-nosed Fur Seals (e.g., reduced gillnet soak times, displacement of targeted effort, altered fishing locations/times), and so the measure of a unit of fishing effort (i.e., net-day) has changed over time (Earl et al., 2021). These changes in fisher behaviour, over time complicate interpreting fishing effort and CPUE in terms of fishable biomass.

Environmental variability contributes additional uncertainty around the relationships between fishable biomass and the commercial fishery data. Freshwater flow is strongly linked to the life history of Golden Perch, with migratory behaviour, spawning, egg and larval transport downstream, and recruitment linked to increased freshwater flow in the MDB (Crook et al., 2024; Koster et al., 2017). Variation in the timing and magnitude of freshwater flow could be influencing the Golden Perch biological stock across the River Murray and Lower Lakes, including the level of recruitment to the fishable biomass and overall population abundance in the LCF, subsequently influencing their catchability. This has been partially addressed by aligning age structures with annual barrage discharges (as an indicator of Murray River flows to the Lower Lakes) to identify the recruitment of Golden Perch associated with elevated freshwater flows. However, the age structures for Golden Perch in the Lower Lakes and River Murray can differ, with strong year classes in the Lower Lakes (i.e., 2017 year class) often being

absent in the lower River Murray (Bice et al., 2023), suggesting localised recruitment in the Lower Lakes and/or limited upstream movement of juveniles or adult Golden Perch. Understanding of how patterns in abundance and population structure compare between the Lower Lakes and River Murray, and the processes underlining these patterns (e.g., passive and/or active movement, spawning, and recruitment) is limited. Such influences may confound interpretation of $CPUE_{LMGN}$ as an indicator of fishable biomass, stressing the importance of future research aimed at understanding population structure and potential connectivity of Golden Perch across the Lower Lakes and River Murray.

A further uncertainty relates to the lack of information on spatial trends in Golden Perch catch by the recreational sector in South Australia. State-wide telephone/diary surveys in 2000/01, 2007/08, 2013/14, and 2021/22 estimated that recreational Golden Perch catches in South Australia accounted for 20–28% of the State's combined commercial and recreational catch of the species (Jones and Doonan 2005; Jones 2009; Giri and Hall 2015; Beckman et al., 2023). However, the proportion of the total State-wide recreational catch taken in the Lower Lakes is not known. Understanding the spatial and temporal trends in Golden Perch catch by the recreational sector would improve future stock assessments for this species.

Finally, a further source of uncertainty in this stock assessment relates to the levels of fishing mortality that are not accounted for in the fishery data. Estimates of incidental mortality of sub-legal sized Golden Perch discarded by commercial and recreational fishers in the Lower Lakes are not available. Estimates of discarding in the LCF are only available from limited sampling undertaken in the Coorong Estuary during the Millennium Drought, not in the areas that support Golden Perch (Ferguson 2010). For the commercial sector, this could be addressed through a by-catch monitoring program that extends across all three gillnet sectors of the LCF, including the FLMGN sector. Another potential source of fishing-related mortality that is not accounted for in the fishery data relates to Golden Perch that were caught in gillnets and subsequently removed by Long-nosed Fur Seals before they could be landed (Goldsworthy and Boyle 2019; Earl et al., 2021). As such, if seal depredation of fish caught in gillnets is occurring, fishing mortality (and targeted catch rates) of Golden Perch in the Lower Lakes is likely to be higher than the levels reported in this assessment. Reliable, quantitative information on the impacts of seals on the fishery in terms of catch losses, as well as the possible changes to fisher behaviour in response to the presence of seals is not currently available, although will be addressed by the Fisheries Research and Development Corporation (FRDC) project 'Seal-fisher-ecosystem interactions in the Lower Lakes and Coorong: understanding causes and impacts to develop longer-term solutions' (FRDC 2018-036).

3.4.5 Research priorities

The most important research needs for the Golden Perch stock in the LCF and its management include: (i) CPUE standardisation to improve the usefulness of CPUE as an index of relative abundance for Golden Perch; (ii) ongoing development of a time series of annual age structures from the Lower Lakes, based on fishery and research survey catches; (iii) investigating population structure and potential connectivity of Golden Perch populations across the Murray River and Lower Lakes and its influences on population structure in the Lower Lakes; (iv) improved understanding of discard rates and incidental mortality of sub-legal sized Golden Perch by commercial and recreational fishers; (v) information on the proportion of the Golden Perch catch that is caught in commercial gillnets and subsequently lost to seal depredation (vi) regular surveys to estimate recreational harvest of Golden Perch in the Lower Lakes; and (vii) collecting more refined data on fishing effort from the commercial sector (e.g., soak time of gillnets) which is expected to be addressed with the introduction of the e-catch reporting platform in 2025/26.

4 STOCK STATUS OF OTHER KEY SPECIES

4.1 INTRODUCTION

Assessing the status of fish stocks can be challenging, especially for stocks that have limited data. In these situations, a weight-of-evidence approach is often required to support stock status determination. This approach involves the systematic consideration of a range of biological and fisheries information to estimate trends in fishable biomass and levels of fishing mortality to support a status determination. Information about the species' stock structure, biology and management arrangements also contribute to the decision-making process. This weight-of-evidence approach is the standard approach used in the Status of Australian Fish Stocks Reports (Roelofs et al., 2024) for data-poor stocks (i.e., stocks for which sophisticated stock assessment models are not available) and stocks that lack performance indicators and reference points that are linked to definitions of stock status.

This section of the report uses a weight-of-evidence approach to assign stock status for five key LCF species that are distributed across the 'primary' and 'secondary' species categories defined in the Management Plan (PIRSA 2022). It consists of species-specific sections, which are arranged to align with the ELMGN and FLMGN sectors of the fishery. For the key species in each sector, the relevant biological information is provided, along with a description of the fishery, associated management regulations, an interrogation of the fishery data from 1984/85 to 2023/24, and a classification of stock status using the definitions from the NFSRF (Table 1-1; Roelofs et al., 2024). For Black Bream, the report uses two biological performance indicators and reference points to assign stock status, as prescribed in the Black Bream Recovery Strategy (PIRSA 2023).

This section of the report also provides information to inform the harvest strategy for finfish, as required by the Management Plan (PIRSA 2022). While catch and effort data for each species are provided by financial year to match the fishing season (i.e., when the annual finfish total allowable commercial effort [TACE] and Pipi total allowable commercial catch [TACC] are applied), the primary and secondary performance indicators are provided at different time scales to ensure that the processes for setting the finfish TACEs and Pipi TACC are based on the most up-to-date information available. For the ELMGN and ESMGN sectors, estimates of the environmental (primary) performance indicators are provided for the 2024/25 reporting year (1 February 2024–31 January 2025) and estimates of the secondary (biological) performance indicators for key species are provided for the 2024 calendar year (1 January–31 December 2024), and these are compared to TRP, TrRP, and LRP. This information will inform setting of the 2025/26 TACE for each gillnet sector.

This section also summarises relevant biological information, fishery data and assessment of stock status for Pipi, including an assessment of biological performance indicators against reference points defined in the Management Plan.

4.2 METHODS

4.2.1 Fishery statistics

Daily commercial catch and effort data are the primary data considered in this section. These data have been collected by LCF fishers since 1 July 1984, which are submitted monthly to PIRSA Fisheries and Aquaculture and archived in the Lakes and Coorong Fishery Information System. Data include catch (kg), effort (fishing days and net-days) for targeted and non-targeted species, and location of the fishing activity by reporting block (see Figure 1-1). The appropriate data for each species were extracted from the Lakes and Coorong Fishery Information System. For Pipi, data on catches by the MSF are also included. The data span a 40-year time series from 1984/85 to 2023/24 and were aggregated to provide annual estimates of catch and effort for the main gear types.

The fishery data are presented by financial year from 1984/85 to 2023/24. For each species, annual estimates are provided for: (i) total catch; and for the dominant gear type(s); (ii) targeted catch; (iii) targeted effort; and (iv) catch per unit effort (CPUE; targeted catch divided by targeted effort). For species that are not typically targeted, CPUE was determined based on total catch and the amount of effort that produced catches of that particular species. Maps are presented that show total catch by reporting block for the 2022/23 and 2023/24 financial years (for comparison), as well as plots showing annual trends in catch across months and reporting blocks since 1984/85. The presentation of data was limited by constraints of confidentiality, i.e., data are only presented when aggregation for five or more fishers is possible. Where available, estimates of recreational catch obtained from four recreational fishing surveys (Jones and Doonan 2005; Jones 2009; Giri and Hall 2015; Beckmann et al., 2023) are also presented.

4.2.2 Performance indicators

Finfish harvest strategy

Two sets of performance indicators were considered for each of the ESMGN, ELMGN, and FLMGN sectors of the fishery, including the environmental (primary) performance indicators and the biological (secondary) performance indicators. The environmental performance indicator used in the finfish harvest strategy for each sector is: (i) ESMGN – suitable habitat available (%) for Yelloweye Mullet in the Coorong Estuary and (ii) ELMGN – suitable habitat available (%) for Mulloway in the Coorong Estuary (Table 4-1). The time series of data in reporting years (1 February–31 January) from 1984/85–2024/25 for each of the three indicators were compared against their respective TRP, TrRP, and LRP

(Table 4-1), as prescribed in the Management Plan (PIRSA 2022). An assessment of the environmental performance indicator for the FLMGN sector is provided in Section 3 of this report.

The biological (secondary) performance indicators are based on annual non-standardised CPUE (kg/net-day) for the primary and secondary species in each sector (Table 4-2; PIRSA 2022). The time series of data in calendar years (1 January–31 December) from 1985–2024 for each indicator was calculated. Then, the value for the 2024 calendar year was compared against TRP, TrRP, and LRP (Table 4-2). Detailed descriptions of the environmental and biological performance indicators and how their respective annual estimates are calculated are provided in the Management Plan.

Table 4-1. Environmental (primary) performance indicators and associated target, trigger, and limit reference points used in the harvest strategy for finfish, as specified in the Management Plan (PIRSA 2022).

Gillnet sector	Primary performance indicator	Limit RP	Trigger RP	Target RP
Estuarine LMGN	Habitat available to Mulloway (%)	10	24.9	55
Estuarine SMGN	Habitat available to Yelloweye Mullet (%)	10	30.9	50
Freshwater LMGN	Water level in the Lower Lakes (m, AHD)	-1.2	-0.71	0.4

Table 4-2. Biological (secondary) performance indicators and associated target, trigger, and limit reference points used in the harvest strategy for finfish, as specified in the Management Plan (PIRSA 2022). The biological performance indicators are prescribed for the primary^(P) and secondary^(S) species in each sector.

Gillnet sector	Key species	Secondary performance indicator	Limit RP	Trigger RP	Target RP
				(kg/net-day)	
Estuarine LMGN	Mulloway ^P	Targeted CPUE _{LMGN}	0.80	1.39	2.68
	Greenback Flounder ^S	Targeted CPUE _{LMGN}	0.65	0.93	1.86
	Black Bream ^S	Targeted CPUE _{LMGN}	0.30	0.53	1.67
Estuarine SMGN	Yelloweye Mullet ^P	Targeted CPUE _{SMGN}	6.32	7.23	11.11
Freshwater LMGN	Golden Perch ^P	Targeted CPUE _{LMGN}	0.24	0.49	1.04
	Bony Herring ^S	CPUE _{LMGN}	2.32	3.54	5.42

Black Bream Recovery Strategy

The Black Bream Recovery Strategy (PIRSA 2023) uses two biological performance indicators (primary and secondary) and associated reference points to monitor the recovery of the Black Bream stock in the Coorong Estuary. Unlike performance indicators used for other key species in LCF to set TACEs, the Black Bream Recovery Strategy uses performance indicators to directly assign status using a stock status determination framework (Table 4-3).

The primary performance indicator uses a three-year mean (i.e., smoothed) incidental CPUE (kg/net-day) as a proxy for relative abundance of Black Bream. Reference points for this performance indicator were determined based on historical performance indicator values and include a trigger of 0.30 kg/net-

day, which represents a satisfactory fishery performance, and a limit of 0.20 kg/net-day, which represents a level of relative abundance at which recruitment is likely to be impaired.

The secondary performance indicator is based on fishery age structures. Reference points based on the number of strong year classes (i.e., accounts for >25% of the overall age structure) in the first ten years of the fishery age structure is a benchmark against which recent recruitment to the fishable biomass is assessed (Table 4-3). A prolonged period of poor recruitment (i.e., when strong age classes of fish ≤ 10 years of age are absent) coupled with low relative abundance (e.g., when smoothed incidental CPUE is below the TrRP of 0.3 kg/net-day) is not expected to support stock recovery.

Table 4-3. Black Bream stock status determination framework, as prescribed in the Black Bream Recovery Strategy (PIRSA 2023). It considers the results of the assessment of two biological performance indicators (primary and secondary) against trigger and limit reference points to assign status. PI = performance indicator, TrRP = trigger reference point, LRP = limit reference point.

Secondary PI - number of strong (>25%) cohorts in first 10 years	Primary PI – smoothed incidental CPUE		
	Above TrRP ≥ 0.30 kg/net-day for three consecutive years	Between TrRP ↔ LRP 0.20–0.30 kg/net-day for three consecutive years	Below LRP <0.20 kg/net-day or not above TrRP for three consecutive years
≥ 2	Sustainable	Sustainable	Recovering
1	Sustainable	Depleting	Depleted
0	Sustainable	Depleting	Depleted

Pipi harvest strategy

The harvest strategy for Pipi uses biological performance indicators and decision rules to inform setting of the TACC (PIRSA 2022). The biological performance indicators used in the Pipi harvest strategy are: (i) fishery-independent mean annual relative biomass (primary performance indicator), and (ii) presence/absence of pre-recruits in size frequency distributions (>30%; secondary performance indicator; Table 4-4; Ferguson and Ward 2014; Ferguson et al., 2015; Ferguson and Hooper 2025). Estimates of these performance indicators relative to TRP, TrRP, and LRP for the 2023/24 financial year are presented to support status determination for Pipi. Contemporary information to inform the TACC setting process for the 2025/26 financial year are provided in Advice Notes, separate to this report. Detailed descriptions of the biological performance indicators and associated reference points are provided in the Management Plan (PIRSA 2022).

Table 4-4. Pipi harvest strategy performance indicators (primary and secondary) and associated target, trigger, and limit reference points, as specified in the Management Plan (PIRSA 2022). PI = performance indicator.

Primary PI	Relative biomass of legal sizes Pipi – harvestable biomass (kg/4.5m ²)	Target RP	12
		Trigger RP	9
		Limit RP	4
Secondary PI	Presence/absence of pre-recruits in size frequency distribution	Present	>30%

4.3 RESULTS

4.3.1 Estuarine large-mesh gillnet sector

Environmental performance indicator

Modelled daily salinity concentrations for 109 locations in the Coorong Estuary were used to estimate the amount of suitable habitat available for Mulloway during the 2023/24 and 2024/25 reporting years (1 February–31 January; Figure 4-1). During these years, freshwater inflows to the Coorong fluctuated over time, with the modal proportion of suitable habitat for Mulloway (i.e., salinity was <51 ppt) throughout the system being 64%. The sustained high freshwater inflows during the 2022/23 reporting year increased the suitable habitat for Mulloway to 100% from July 2023 to late November 2023. During the 2024/25 reporting year, reduced freshwater flow resulted in higher salinity south of Parnka Point, with available habitat decreasing to 45% of the Coorong Estuary in November 2024. The ELMGN performance indicator for habitat available to Mulloway in the Coorong Estuary for the 2024/25 reporting year was 63.3%, which was above the TRP of 55% (Figure 4-2).

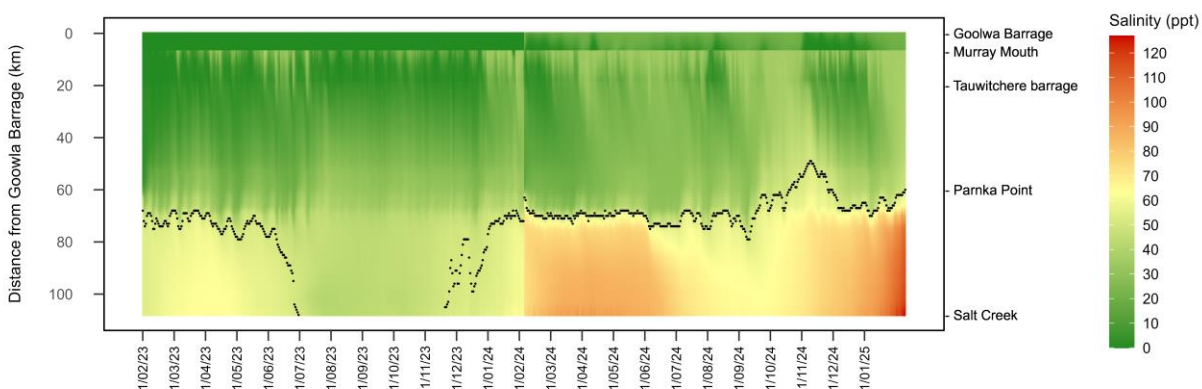


Figure 4-1. Modelled salinity concentration for the Coorong Estuary, with distance from the Goolwa Barrage to Salt Creek for the 2023/24 and 2024/25 reporting years, with the approximate salinity threshold for Mulloway (51 ppt) shown as a dotted line. Salinity threshold represents the level of salinity that was lethal for 10% of test fish, as determined by Ye et al., (2013). The dark green contours (i.e., <10 ppt) indicate periods of freshwater inflow. Refer to Figure 1-1 for map of Coorong Estuary.

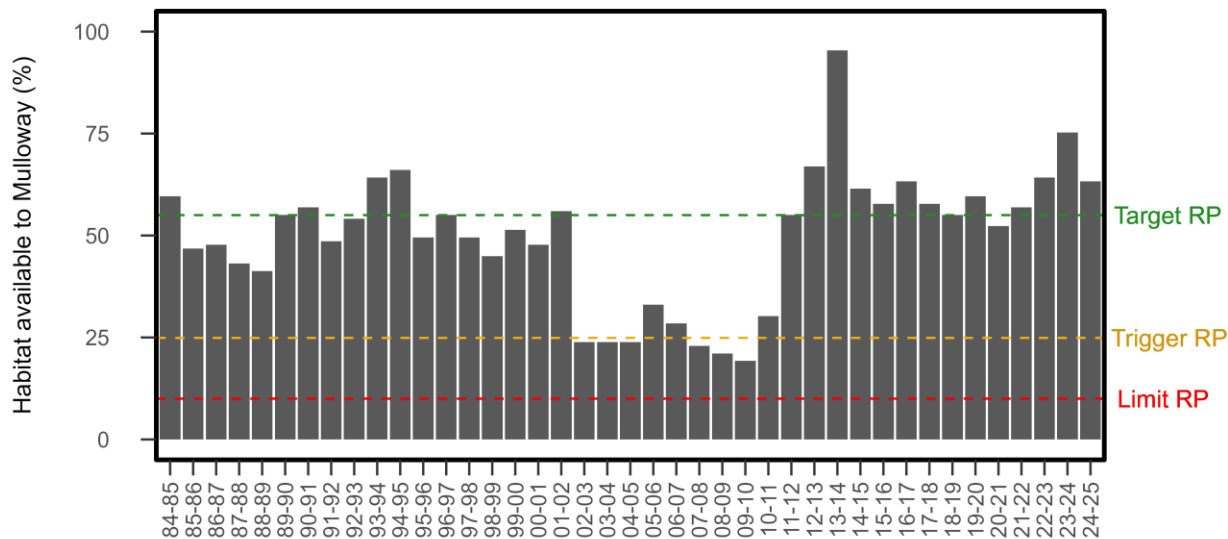


Figure 4-2. Estimates of the ELMGN performance indicator for habitat available to Mulloway in the Coorong Estuary from 1984/85 to 2024/25 (reporting years), showing target, trigger, and limit reference points (RP).

Mulloway

Biology

Mulloway (*Argyrosomus japonicus*) is a member of the Sciaenidae family (Gomon et al., 2008). It is broadly distributed throughout the Indo-Pacific region, including Australia where it occurs from the Gascoyne region on the west coast of Western Australia, around the southern coasts of the continental mainland, and up to the Wide Bay–Burnett region on the east coast of Queensland (SAFS 2020; Kailola et al., 1993). Within this distribution, Mulloway occur in bays, tidal creeks, estuaries, and marine waters to depths of at least 100 m. In South Australia, juveniles are abundant in the Coorong Estuary, while larger Mulloway are common in exposed marine habitats, such as surf beaches.

Mulloway have a complex life-history that involves ontogenetic changes in habitats linked by movement at different life history stages (Ferguson et al., 2014). In South Australia's southeast, temporal analysis of gonadosomatic indices indicated that Mulloway have a prolonged spawning season that extends from October to January. Previous studies have suggested that spawning occurs in aggregations that form during spring/summer in the marine waters near the Murray Mouth (Hall 1986; Ferguson et al., 2008, 2014). Young juveniles then enter the Coorong Estuary when environmental conditions are favourable and utilise the estuarine habitat as juveniles, before returning to the marine environment as four- to six-year-olds. Such movement results in a significant ontogenetic shift from protected estuarine habitat to more exposed marine habitats. As a result, population size and age structures vary among habitats. The Coorong Estuary generally supports a population with only a few young age classes, whereas the population in the adjacent marine environment generally

comprises multiple age classes of larger, older fish and has included individuals up to 41 years old (Ferguson et al., 2014; Earl 2020). The estimated length-at-50%-maturity (L_{50}) for Mulloway in South Australia is 850 mm total length (TL) for females and 778 mm TL for males, which is equivalent to the mean age of approximately six years and five years, respectively (Ferguson et al., 2014).

Biological stock structure for Mulloway in Australia is uncertain. It has been suggested that a single panmictic population occurs in Australia (Archangi 2008), but this is not supported by more recent studies that suggested sub-structuring between populations in New South Wales, South Australia and Western Australia (Ferguson et al., 2011; Barnes et al., 2016). These studies suggested that two stocks occur in South Australia. The eastern stock occupies marine and estuarine waters of 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., 2016). While there is evidence that fish in Gulf St Vincent may be part of the eastern stock and fish in Spencer Gulf may be part of the western stock, further research is required to confirm biological stock delineation for the species in South Australia. This assessment of stock status is undertaken at the management unit level—the LCF.

Fishery

Mulloway is a significant inshore species for multiple Australian fisheries across Western Australia, South Australia, New South Wales, and Queensland (SAFS 2020; Kailola et al., 1993). Historically, the national commercial catch for this species has been dominated by that from South Australia, with moderate contributions from New South Wales and small contributions from Western Australia and Queensland (Earl et al., 2021b). Mulloway is also a popular target species amongst recreational fishers in all States where it occurs including Victoria (Henry and Lyle 2003).

In South Australia, Mulloway is targeted by commercial and recreational fishery sectors (PIRSA 2022; Beckmann et al., 2023). Several life history stages are targeted: juveniles in the Coorong Estuary and mature adults in nearshore marine waters across the State; including near the Murray Mouth, the south-east, and on the far west coast (Earl and Ward 2014; Rogers et al., 2014). As such, during their ontogenetic development the fish run the gauntlet of fishing lines and mesh nets that are used by both sectors to target them in different habitats. Because of this, South Australia's fishery for Mulloway can currently be described as a 'gauntlet' fishery (Smith 2013).

In the commercial LCF, fishers target juvenile Mulloway using LMGN in the Coorong Estuary, while adults are targeted using SN in the adjacent marine environment. Three other South Australian commercial fisheries have limited access to Mulloway – MSF, NZRLF and SZRLF – although catches from these fisheries are relatively low and not considered in this report. For the recreational sector, Mulloway is an iconic species that is targeted using rod and line mainly from shore (Beckmann et al., 2023).

Management arrangements

The commercial LCF for Mulloway has undergone a number of management changes over the past 40 years that have seen the introduction of general gear restrictions, spatial and temporal restrictions and size limits. The most significant recent change occurred in 2016, when the LML for Mulloway taken in all State waters outside of the Coorong Estuary was increased from 750 to 820 mm TL. This increase was made to enable at least 50% of the Mulloway in marine waters to reach sexual maturity and have opportunity to spawn at least once before capture (Ferguson et al., 2014). The LML for Mulloway in the Coorong Estuary was kept at 460 mm TL, which is 54% and 59% of the size-at-maturity for females and males, respectively (Ferguson et al., 2014).

The recreational sector of the LCF is managed through a combination of input and output controls, aimed at ensuring the total catch is maintained within sustainable limits and to ensure that recreational access to the fishery is equitably distributed between recreational fishers (PIRSA 2022). Bag and boat limits apply, which vary geographically and with fish size. In the Coorong Estuary, the daily bag limit is 10 fish for the size range of 460–820 mm TL, and two for fish more than 820 mm TL. Boat limits also apply; when three or more people are onboard, the boat limit is 30 fish sized 460–820 mm TL, and six fish above 820 mm. In all waters outside the Coorong, a daily bag limit of two fish, and a boat limit of six fish applies. Management arrangements also comprise general gear restrictions. A small number of registered recreational mesh net owners can also use gillnets to target finfish in the Coorong. The mesh nets must be less than 75 m long with 50–64 mm mesh, and the registered net owner must be within 50 m of the net when fishing. Temporal and spatial closures apply to the use of recreational nets in the region.

Commercial Fishery statistics

Trends in total catch, effort and CPUE

Total annual catches for Mulloway in the LCF increased from 13.8 t in 1987/88 to a peak of 135.7 t in 2000/01 (Figure 4-3A). Annual catches then fell to 45.4 t in 2002/03 and continued to decline, although at a lower rate, to 19.4 t in 2010/11. This decadal decline in catch was associated with a decline in targeted effort for the dominant gear types – LMGN and SN. Since 2010/11, catches have been considerably higher in most years, including from 2018/19 to 2020/21 when they ranged from 92.3 t to 120.5 t. Total catch declined to 28.9 t in 2022/23, its lowest in over a decade, before increasing to 112.2 t in 2023/24.

The main gear type used to target Mulloway has historically been the LMGN (Figure 4-3A). On average, targeted catches taken using LMGN have accounted for around 64% of the annual catch, while those taken using SN along the ocean beaches adjacent to the Murray Mouth have accounted for around 13%. The remaining catches have been by-product when other species were targeted. In

2022/23, there was a temporary displacement of targeted effort between gear types resulting from high freshwater inflows to the Coorong making that area largely unfishable for most the year, with targeted catches using LMGN only accounting for 30.9% (8.3 t) of all catches, while those taken using SN accounted for 68.9% (18.6 t). In 2023/24, LMGN was the dominant gear type, with targeted catches accounting for ~55% (61.5 t) of the annual catch, followed by targeted SN effort (34%; 38.0 t), and the miscellaneous category “other gear type” (11%; 12.8 t).

Estimates of mean annual targeted $CPUE_{LMGN}$ have generally increased since 1984/85 (Figure 4-3C). The initial increase to 2010/11 was slow, followed by a rapid increase to 5.4 kg/net-day in 2011/12 whereafter $CPUE_{LMGN}$ increased to record high levels >9.0 kg/net-day during 2016/17–2018/19 before falling to around 8.0 kg/net-day from 2019/20 to 2022/23. In 2023/24, $CPUE_{LMGN}$ spiked to a record high of 11.9 kg/net-day. Estimates of mean annual CPUE for SN ($CPUE_{SN}$) have been variable and have increased to unprecedented high levels in recent years (Figure 4-3D). Since falling to a low of 7.7 kg/net-day in 1988/89, it has fluctuated periodically at much higher levels with peaks of between 71.0–82.0 kg/net-day in the 1990/91, 1998/99, 2007/08 and 2016/17. In 2021/22, $CPUE_{SN}$ increased to its highest peak of 160.3 kg/net-day, declined to 87.8 kg/net-day in 2022/23, and then increased to its second highest level of 143.0 kg/net-day in 2023/24.

Spatial and temporal trends in catch

Since 1984/85, reporting block 8 (i.e., upper Coorong Estuary) has consistently made the greatest contribution to the fishery’s annual catches of Mulloway (Figure 4-4A; 4-4B). An exception was in 2010/11 and 2021/22, when majority of the catch was taken in reporting block 16 (i.e., along the ocean beach, south-east of the Murray Mouth). The spatial distribution of catches in recent years have also differed to previous years, with reporting block 9 in 2019/20 and reporting block 10 in 2017/18, 2018/19, and 2022/23 (both in the North Lagoon of the Coorong Estuary) making the greatest contribution to annual catches. This shift to catches originating from further south of the upper Coorong Estuary continued in 2023/24, with most commercial catches from reporting block 9 (28.4%), followed by block 16 (24.8%), and block 8 (14.0%). The LCF for Mulloway has been seasonal with the highest catches taken in the warmer months from October to March (Figure 4-4C). In 2023/24, catches from January to March accounted for 50% of the annual commercial Mulloway catch.

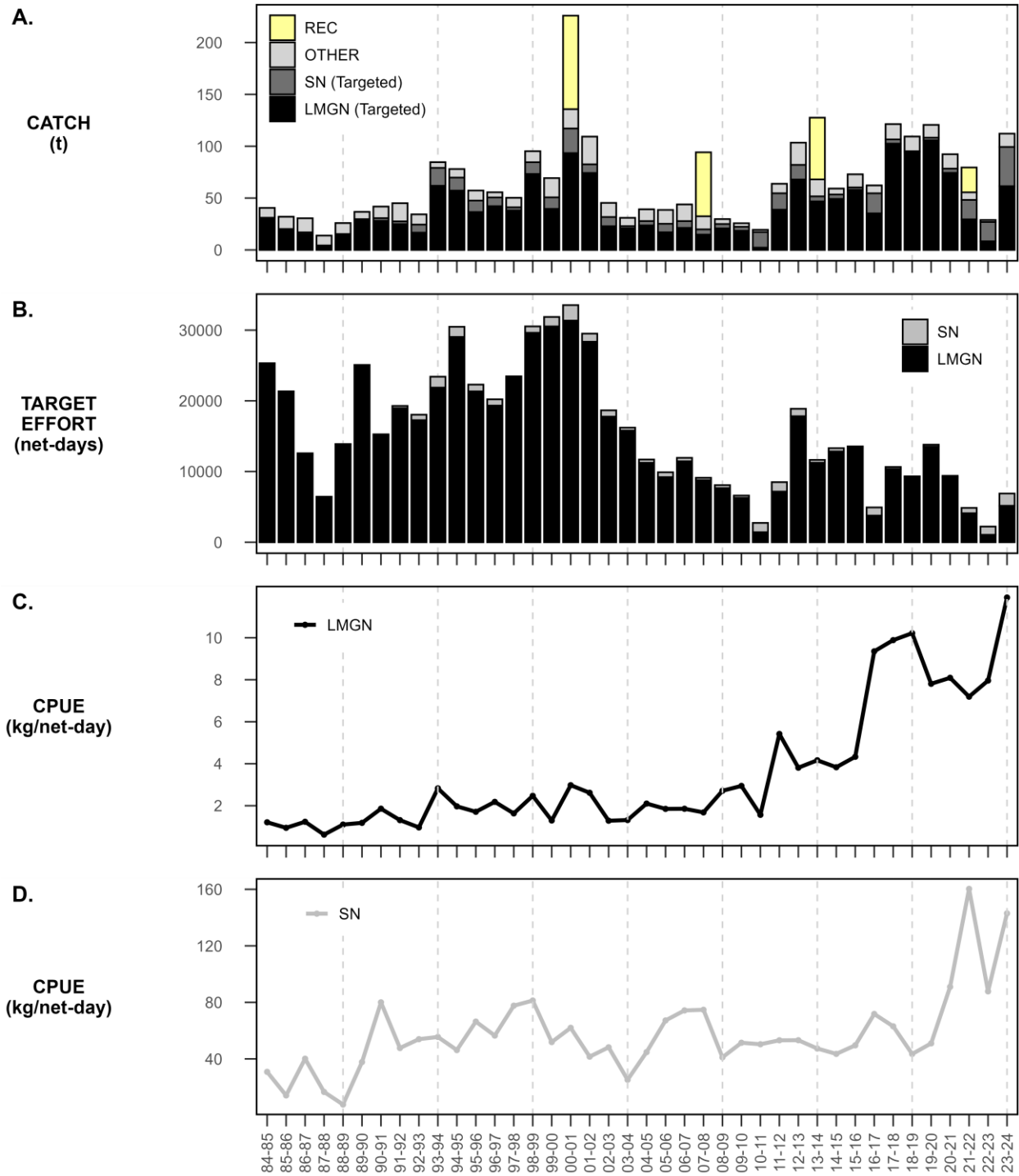
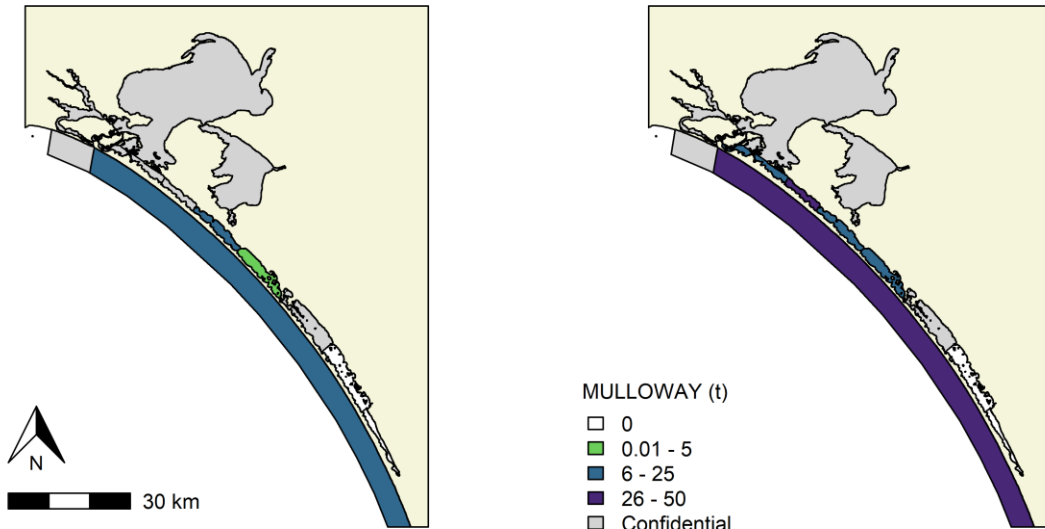


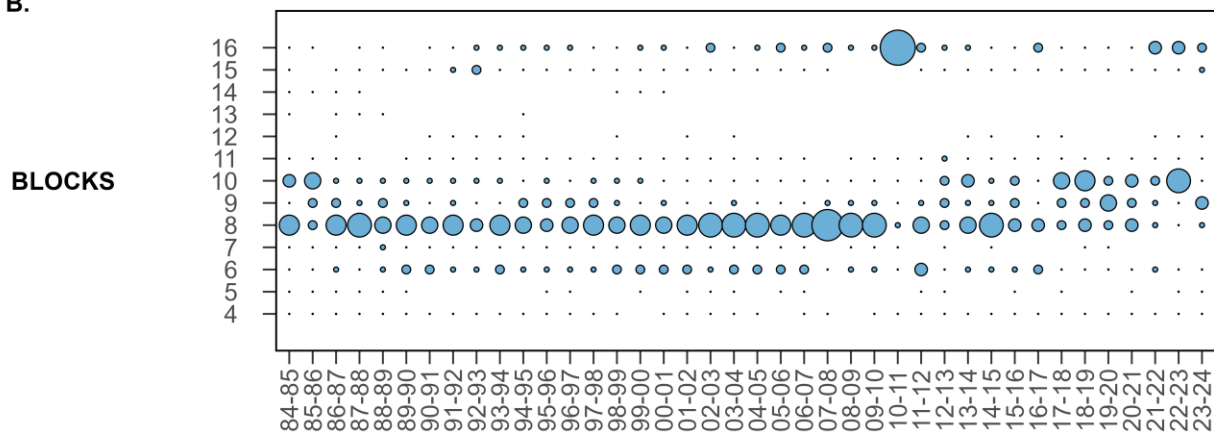
Figure 4-3. Fishery statistics for Mulloway presented by financial year. Long term trends in (A) total catch, including targeted catch for large-mesh gillnets (LMGN), swinger nets (SN), the recreational sector (REC) (from all State waters for 2007/08, 2013/14 and 2021/22); and by all other commercial means (OTHER); (B) targeted effort for LMGN and SN; and targeted CPUE for (C) LMGN and (D) SN.

A. 2022/23

2023/24



B.



C.

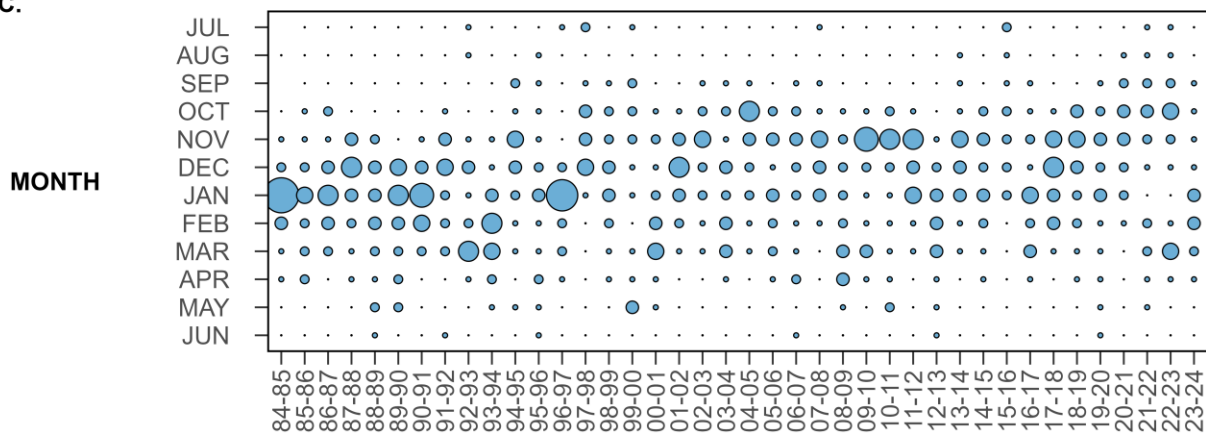


Figure 4-4. Fishery statistics for Mullet presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

Stock status

Mulloway is a primary species for the commercial LCF (PIRSA 2016). This reflects its history of relatively high catches and high wholesale value compared to most other species available to the fishery (EconSearch 2024). The most recent stock assessment for Mulloway was completed in 2023 and used a weight-of-evidence approach that considered commercial catch and effort data to the end of June 2022 and fishery size and age structures to the end of June 2023 (Earl 2023).

The highest total annual catch of Mulloway for the LCF was 135.7 t in 2000/01. From then, catch declined to a historic low of 19.4 t in 2010/11. This decline in catch was associated with a decrease in targeted fishing effort and low CPUE_{LMGN} during the Millennium Drought (2002/03–2010/11) and reflected a decline in fishable biomass in the Coorong Estuary. Since 2010/11, catches have been considerably higher. Annual catches between 2017/18 and 2020/21 ranged from 92.3–121.3 t, which represents the highest sustained catch of Mulloway on record. In 2022/23, catch declined to 28.9 t, its lowest level since 2010/11, reflecting a reduction in targeted LMGN effort in the Coorong Estuary due to the high freshwater flows making large parts of the upper Coorong unfishable using gillnets. This led to an increase in targeted effort using SN along the ocean beaches adjacent to the Murray Mouth, which is where the majority of the annual catch was taken. In 2023/24, environmental conditions in the Coorong Estuary stabilised and regular gillnet fishing activities in the traditional fishing areas in the estuary resumed. Consequently, annual catch increased to 112.2 t in 2023/24 – its third highest level since 2000/01. Recent catches taken using both LMGN and SN have been associated with historically high CPUE_{LMGN} and CPUE_{SN} and reflect high abundance of Mulloway in the Coorong Estuary (i.e., juveniles) and adjacent marine environment (i.e., adults), respectively (Earl 2023). The State-wide recreational catch of Mulloway was estimated at 24.0 t in 2021/22, although the proportion of the State-wide recreational catch taken in the Coorong region is not known (Beckmann et al., 2023).

The increase in catch and high targeted CPUE for LMGN and SN in 2023/24 are indicative of high fishable biomass of juvenile and adult Mulloway, respectively. These results suggest that recruitment is unlikely to be impaired, and that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On this basis, the LCF for Mulloway is classified as a **sustainable** stock.

Biological performance indicator

The performance indicator for Mulloway has remained above the TRP since 2010. For the 2024 calendar year, targeted CPUE_{LMGN} was 10.34 kg/net-day, the third highest on record. (Figure 4-5). This biological performance indicator is used in the finfish harvest strategy and is not considered in the weight-of-evidence assessment of stock status for Mulloway in 2023/24.

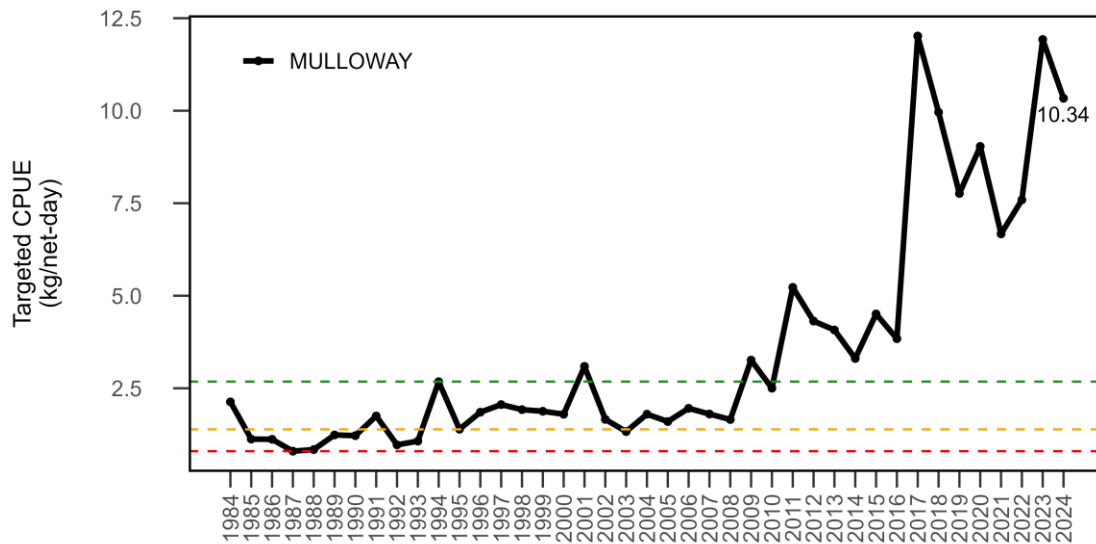


Figure 4-5. Time series of annual estimates of the ELMGN biological (secondary) performance indicator (targeted CPUE) for Mulloway from 1984 to 2024 (calendar years), showing target (green dashed line), trigger (orange dashed line) and limit (red dashed line) reference points.

Black Bream

Biology

Black Bream (*Acanthopagrus butcheri*) is a member of the Sparidae family of fishes (Gomon et al., 2008). It has a wide distribution in estuaries and coastal waters of southern Australia from central New South Wales (NSW) to central west coast Western Australia, including Tasmania, where it is a popular target for commercial and recreational fishers (SAFS 2020; Kailola et al., 1993).

Black Bream is an estuarine-dependent species, inhabiting coastal waters and lower sections of rivers but completing much of its life cycle within a single estuary (Sarakinis et al., 2024; Chaplin et al., 1998). Movement out of estuaries can vary among populations, with the coexistence of both migratory and resident life cycles known to occur within the same location (i.e., partial migration; Gillanders et al., 2015). It is a slow-growing and long-lived fish, able to grow to 600 mm TL and live for 32 years. In the Coorong Estuary, males and females mature (L_{95}) at around 334 mm TL and 309 mm TL, respectively (Cheesman 2022). Timing and location of spawning can vary across the species distribution, although typically is confined to estuaries and occurs between August and January. Growth and recruitment of Black Bream within estuaries are strongly influenced by environmental conditions associated with freshwater inflows and subsequent changes to water salinity (Jenkins et al., 2018; Williams et al., 2013; Patridge and Jenkins 2002). Thus, it is likely that at the local scale at least, annual recruitment strength is dependent on environmental conditions, with substantial inter-annual variation in

recruitment affecting local stock demographics and biomass. Here, the assessment of status is undertaken at the biological stock level—the Coorong Stock.

Fishery

Black Bream supports recreational and commercial fisheries in South Australia. Historically, the LCF has been South Australia's main commercial fishery for Black Bream. Since 2019/20, over 90% of the State's annual catches have been taken by LCF fishers, who target the species in the Coorong Estuary using LMGN. Black Bream has historically had a high market value and is a premium product of the LCF (EconSearch 2024). The MSF, NZRLF and SZRLF also have access to this species, although catches from these sectors are negligible and are not considered in this assessment.

South Australian recreational fishers target Black Bream in coastal waters using rod and line, particularly in estuaries (Beckmann et al., 2023). The State-wide recreational survey in 2021/22 estimated that 30,878 (\pm 7,853 SE) Black Bream were captured, of which ~76% were released (Beckmann et al., 2023). The retained fish contributed to an estimated state-wide harvest weight of 5.6 t (\pm 2.7 SE based on confidence interval of retained fish numbers for comparison among surveys). The proportion of the state-wide catch that was taken in the Coorong Estuary is not known. There are no catch and effort data for Aboriginal and traditional fishing.

Management arrangements

Black Bream is a secondary species in the LCF, making a relatively low contribution to the total production value over the last 32 years (PIRSA 2022). For the commercial sector, management arrangements are in place to limit the take of Black Bream. These include temporal and spatial netting closures under the Black Bream Recovery Strategy (PIRSA 2023), restrictions to net lengths and mesh sizes, and a LML of 300 mm TL.

There are multiple management arrangements in place for Black Bream in the recreational sector including input and output controls. Such controls include gear restrictions, spatial closures, and a daily bag limit of 10 fish and boat limit of 30 fish. The LML of 300 mm TL also applies.

Temporary management arrangements were implemented in 2018, 2019 and 2021 to recover the Black Bream stock in the Coorong, after it was classified as 'overfished' in 2016 (Earl et al., 2016) and 'depleted' in 2017 (Conron et al., 2018). The 'depleted' status classification was retained in 2023, based on commercial fishery data from 1984/85 to 30 June 2022 (SAFS 2020; Earl et al., 2022). The temporary arrangements applied to Black Bream in the Lower Lakes and Coorong Estuary from 1 September–30 November in 2018; 21 September–30 November in 2019; and 1 August–31 December 2021; and 1 August–31 January in 2022/23 and 2023/24. Under the arrangements, commercial and recreational fishing nets could not be used within 300 metres of barrages located in the Coorong Estuary, including Goolwa, Mundoo, Boundary Creek, Ewe Island, and Tauwitthere barrages; and

Black Bream could not be targeted, and all incidental catch of Black Bream had to be released by both sectors.

The Black Bream Recovery Strategy describes management arrangements to recover the Black Bream stock in the Coorong Estuary (PIRSA 2023). Under the Recovery Strategy, until such time as a sustainable stock status classification is reached, the following management arrangements will continue to apply: (1) a seasonal closure from 1 August to 31 January that applies to both the recreational and commercial fishing sectors within the area defining the Lakes and Coorong Fishery to prohibit fishing for both sectors; and (2) a 300 m spatial closure around the Lakes and Coorong barrages to prohibit fishing for both the recreational and commercial sectors. Should high flow levels occur, defined as >30,000 ML/day into the Coorong, the 300 m spatial closure will be removed and the 150 m spatial closure as outlined in the Fisheries Management (General) Regulations 2017 will apply. Once high-water flows have dissipated the 300 m spatial closure around barrages will be reinstated.

Commercial Fishery statistics

Trends in total catch, effort and CPUE

Over the past 40 years, the highest total annual commercial catch of Black Bream in the LCF was 46.8 t in 1984/85 (Figure 4-6A). Annual catches were around 35 t in 1985/86 and 1986/87 and then declined to 3.7 t in 1990/91. They remained low during the 1990s, averaging 3.7 t/yr before increasing to 11.6 t in 2002/03. Catches then gradually declined to 1.7 t in 2008/09 and have been <2 t in most years since. The total catch of 3.4 t in 2021/22 and 3.9 t in 2022/23 were the highest catches since 2007/08, recognising the fishery was closed during 1 August–31 December 2021 and 1 August 2022–31 January 2023. This closure continued from 1 August 2023–31 January 2024, with the total annual commercial catch of Black Bream declining to 3.0 t.

The main gear type used to target Black Bream has been the LMGN (Figure 4-6B). The low catches since the early 1990s have been associated with low targeted effort using LMGN, with most of the catches taken as by-product when other species were targeted. In 2023/24, targeted effort accounted for 35.8% of the total annual catch, with the remaining 64.2% taken as by-product. In recent years, targeted LMGN effort has declined from 1,219 net-days in 2021/22 to 486 net-days in 2023/24.

Estimates of annual targeted effort and targeted $CPUE_{LMGN}$ were confidential for most of the past 15 years (Figure 4-6C). While estimates of targeted $CPUE_{LMGN}$ were stable at historically moderate levels in 2021/22 and 2022/23, and reached a near-record high in 2023/24, they should be interpreted with caution due to considerable uncertainty around $CPUE_{LMGN}$ as a measure of relative abundance (Earl et al., 2016b). This is because spatial contraction of the habitat for this species, particularly during low inflow years, may increase their catchability and thus confound interpretation of $CPUE_{LMGN}$ as an

indicator of relative abundance (Earl et al., 2016b; Ye et al., 2022). Given the high wholesale value of Black Bream (EconSearch 2024), catch is currently considered a more appropriate indicator of abundance for this species in the Coorong.

Spatial and temporal trends in catch

Between 1984/85 and 1998/99, reporting blocks 9 and 10 contributed the most to annual catches of Black Bream (Figure 4-7A; 4-7B). The spatial distribution of catches gradually shifted northward during the late 1990s and 2000s with most of the catches taken from reporting blocks 6 and 8, adjacent to the Murray Mouth. This included the highest proportion of commercially caught Black Bream from a single reporting block (block 6) over four consecutive years, contributing between 66–81% p.a. This contraction of the fishing ground occurred when low freshwater inflows reduced the amount of suitable habitat available for Black Bream in the Coorong Estuary. The floods in 2010/11 freshened the estuary and increased in the size of the fishable area with higher proportions of the annual catches coming from reporting blocks 6–11 during recent years. During the Murray River flooding event in 2022/23, more than 60% of the commercially caught black bream came from reporting block 10, a record high contribution excluding block 6. In recent years, reporting block 10 has contributed the most to annual catches of Black Bream, with these remaining above 35% since 2020/21 and contributing 36.4% in 2023/24, followed by reporting block 9 (23.2%).

Historically the fishery for Black Bream in the Coorong Estuary was seasonal with catches generally concentrated between July and December, with peaks in September and October (Figure 4-7C). In 2022/23, catches were greater between February and April and this extended to June in 2023/24.

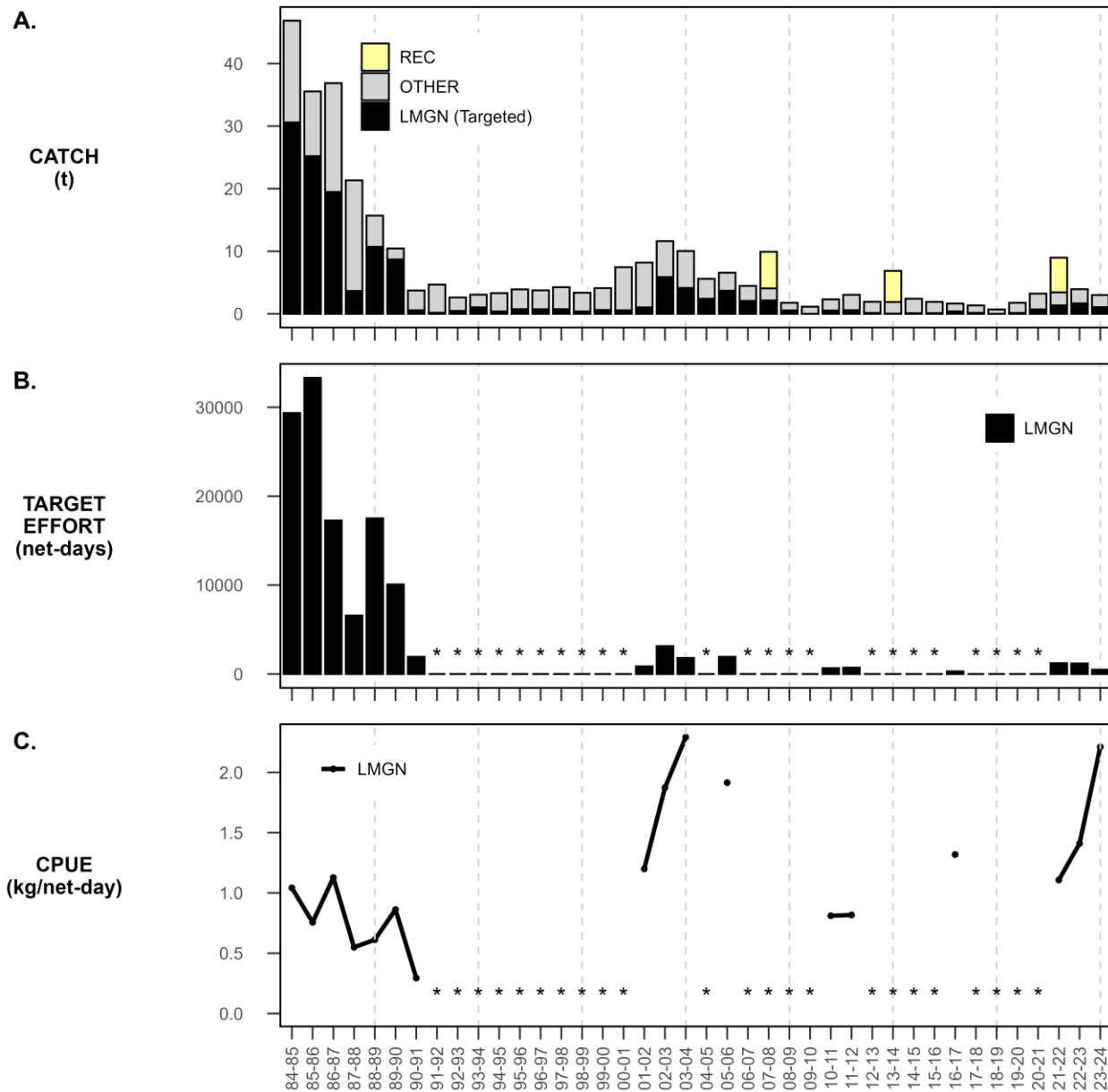
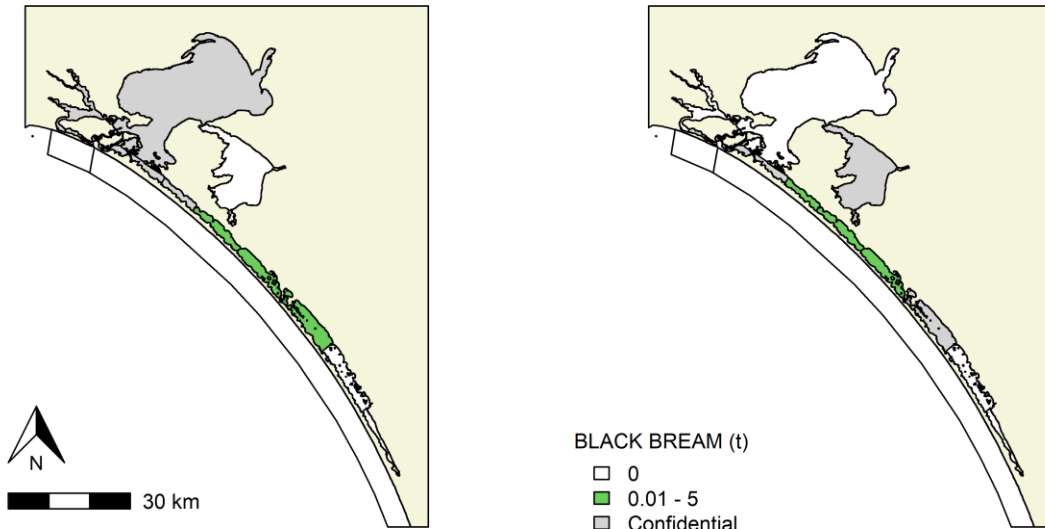


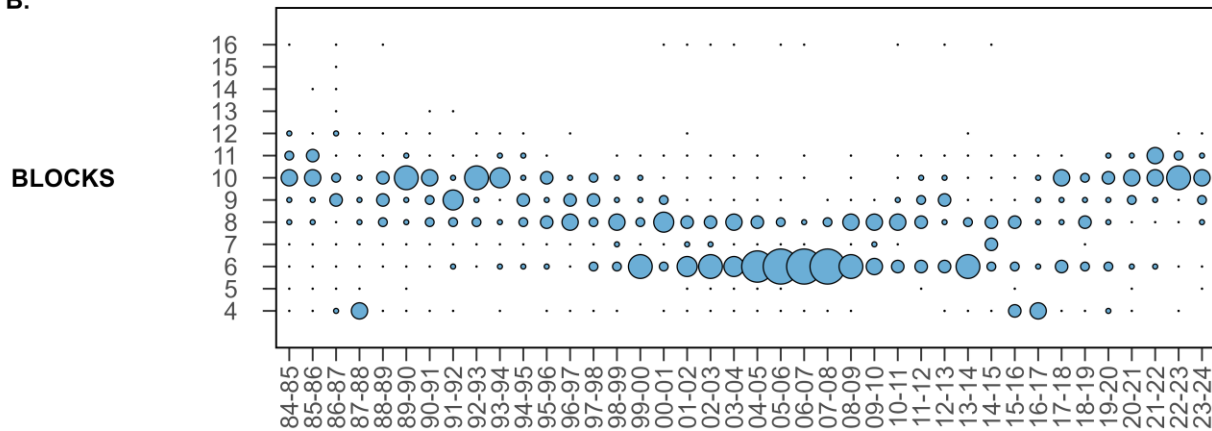
Figure 4-6. Fishery statistics for Black Bream presented by financial year. Long term trends in: (A) total catch, including targeted catch for the main gear type - large-mesh gillnets (LMGN), targeted and non-targeted catch for all gear types (OTHER), and for the recreational sector (REC) (from all State waters for 2007/08, 2013/14 and 2021/22); (B) targeted effort for LMGN; and (C) targeted CPUE for LMGN. Asterisks (*) indicate confidential data (i.e., from <5 fishers). Seasonal fishery closures have been in place since 2018/19, with the exception of 2020/21.

A. 2022/23

2023/24



B.



C.

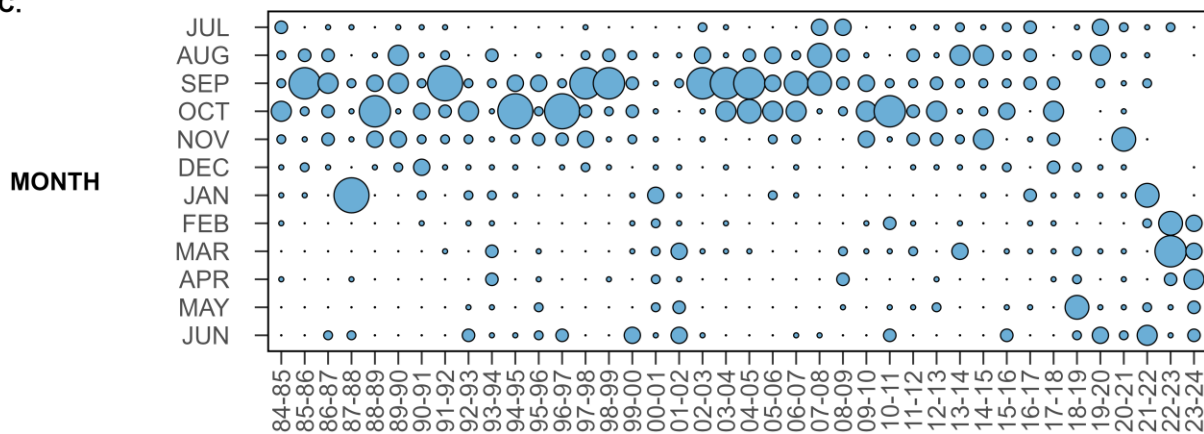


Figure 4-7. Fishery statistics for Black Bream presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

Black Bream recovery strategy performance indicators

Primary performance indicator – Smoothed incidental CPUE

Estimates of smoothed incidental CPUE (primary performance indicator) for Black Bream have fluctuated over time with a major peak in 1986/87 (0.56 kg/net-day) and a smaller peak in 2001/02 (0.26 kg/net-day) (Figure 4-8). Over the past decade, smoothed incidental CPUE was initially historically low, reaching the lowest recorded value in 2018/19 (0.02 kg/net-day), which aligned with the commencement of the seasonal fishery closures for Black Bream. Since then, smoothed incidental CPUE has gradually increased with every financial year, reaching the fifth highest value on record in 2023/24 (0.25 kg/net-day), which lies above the limit of 0.20 kg/net-day and below the trigger of 0.30 kg/net-day for the third consecutive year.

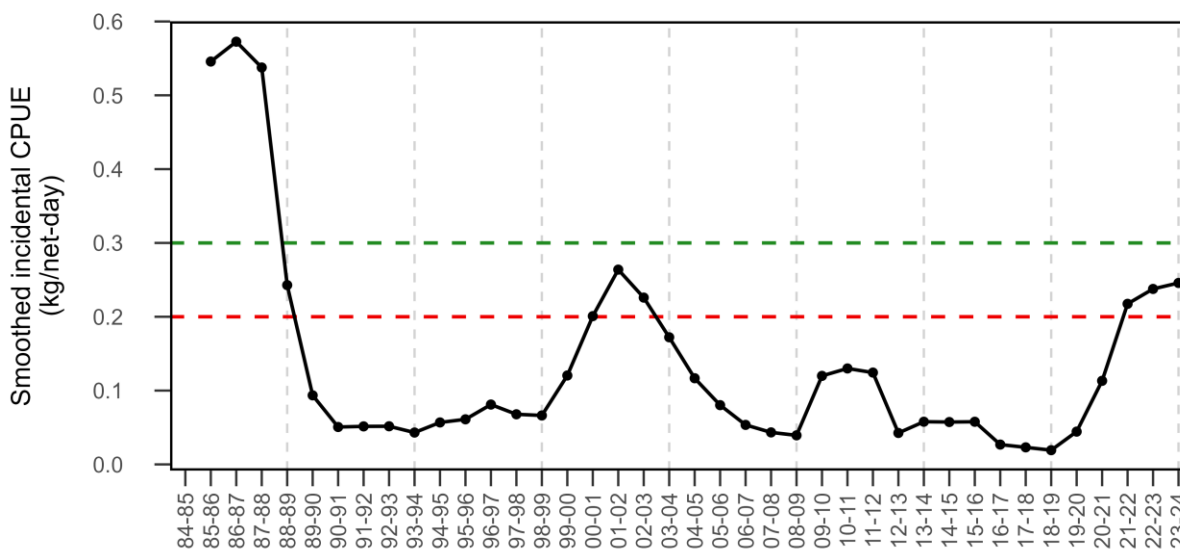


Figure 4-8. Estimates of the primary performance indicator for Black Bream from 1984/85 to 2023/24 (financial years), showing smoothed incidental CPUE for LMGN (black solid line), trigger reference point (0.30 kg/net-day) (green dashed line) and limit reference point (0.20 kg/net-day) (red dashed line).

Secondary performance indicator – Fishery age structures

Biological samples of Black Bream have been collected annually from commercial catches taken using LMGN in the Coorong Estuary since 2008/09 (Figure 4-9). Age classes have primarily ranged between three and eight, with the oldest individual, a 32-year-old, caught in 2011/12. For age structures from financial years there has been only a single strong cohort (i.e., >25% of the age structure) below the age of 10 years, except in 2015/16 and 2018/19 when no strong cohorts were present, and in 2019/20 where two strong cohorts were present (three- and four-year-old fish). In 2022/23, a single strong cohort was present (five-year-old fish that originated from spawning in 2017/18), with a moderate cohort of 13-year-old fish. The 2023/24 age structure had a narrower age range than those in previous

years, comprising of primarily five- to seven-year-old fish, and 15-year-old fish. The 2017/18 year class dominated the age structure in 2023/24 as six-year-old fish, accounting for 74.7% of all fish sampled.

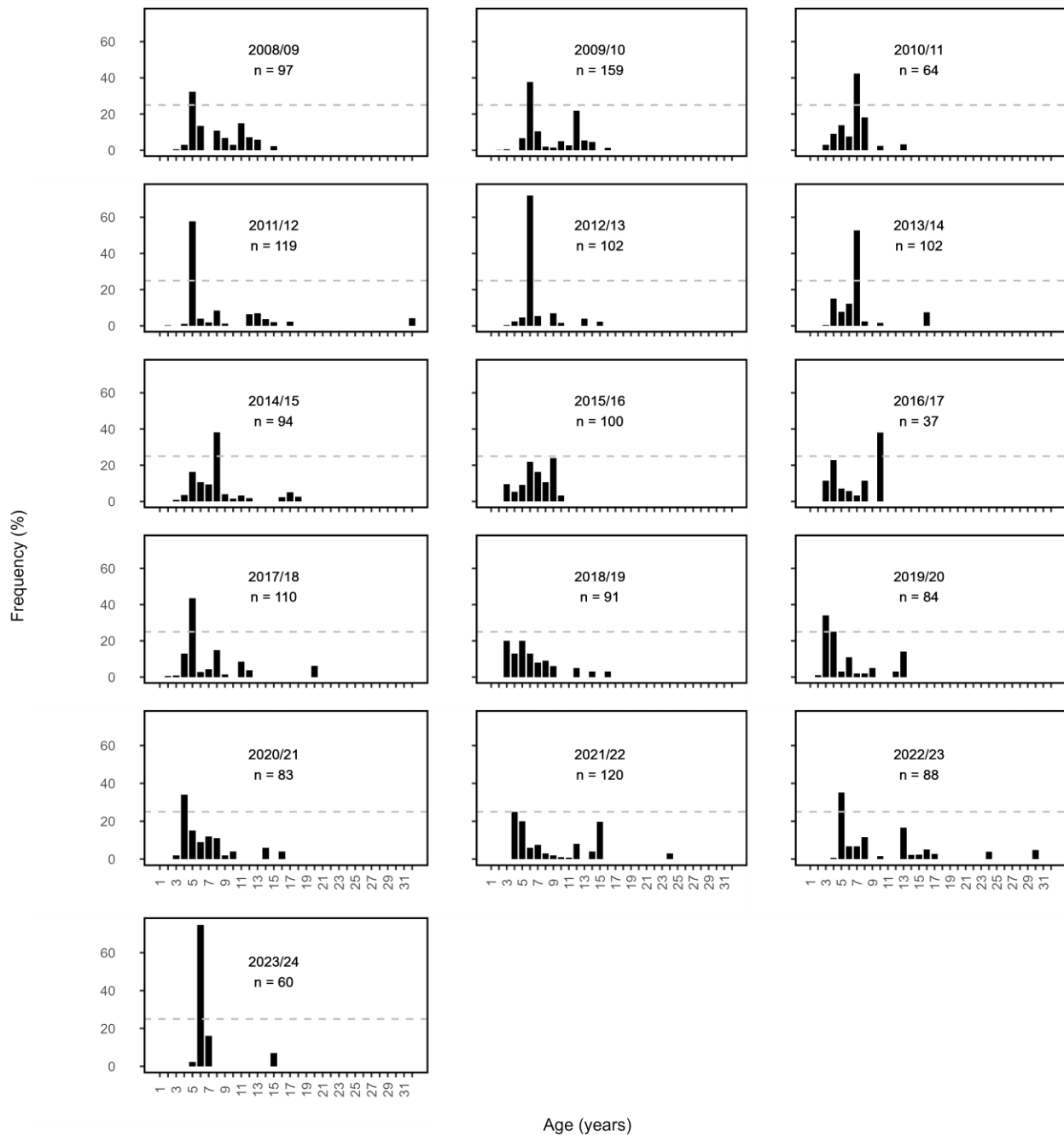


Figure 4-9. Estimates of the secondary performance indicator for Black Breem, showing annual fishery age structures from the Coorong Estuary from 2008/09 to 2023/24 (financial years), based on commercial fishery samples. Values above the grey dashed line represent a strong cohort (i.e., frequency >25%).

Stock status

Black Bream is a secondary target species for the LCF (PIRSA 2022). The most recent stock assessment for Black Bream in the Coorong Estuary was completed in 2016 and used a weight-of-evidence approach that considered fishery data and fishery age structures up to 30 June 2015 (Earl et al., 2016b). Since then, catch sampling has been done to continue the time series of annual age structures for Black Bream as part of the Coorong Fish Condition Monitoring program (Ye et al., 2024).

Analysis of the long-term chronology of fishery production for Black Bream in the Coorong Estuary indicates high variability in fishable biomass. In the early 1990s, catches dropped to historically low levels and have remained low. Recent annual catches gradually increased to a 15-year high of 3.9 t in 2022/23, before declining to 3.0 t in 2023/24. The recent low catches have been associated with low targeted effort. Given the high wholesale value of Black Bream (EconSearch 2024), the lack of targeting likely indicates low fishable biomass. The recent lack of targeting may also relate to: (1) the implementation of seasonal fishery closures since 2018, during what has historically been the most productive period for Black Bream fishers (among other management measures in place to recover the stock since 2018); and (2) the presence of Long-nosed Fur Seals in the region, which has reportedly resulted in fishers: (i) avoiding the long gillnet soak times required to effectively target Black Bream; and (ii) using heavier ply gillnet mesh than is optimal for targeting this species (Earl et al., 2021).

In 2022, recruitment of Black Bream in the Coorong Estuary was evidenced by the detection of higher-than-average abundances of young-of-year that originated from spawning in 2020/21 (Ye et al., 2022). Recruitment of these juveniles to the fishable biomass has not yet occurred and is expected to occur over the next 2-4 years. Young-of-year were not detected in 2023 (Ye et al., 2024). The 2023/24 fishery age structure (secondary PI; a proxy for recruitment) involved a single, strong (i.e., $\geq 25\%$) cohort of six-year-old fish, which was below the target RP of two strong cohorts of fish aged ≤ 10 years.

Based on the weight-of-evidence approach, the biomass of this stock is likely to be depleted and recruitment is likely to be impaired.

There is, however, evidence of stock recovery. In 2023, the Black Bream Recovery Strategy was formally adopted to address the 'depleted' status that has been applied to this stock since 2016 (PIRSA 2023). Management measures in the form of seasonal fishery closures have been in place since 2018 to promote stock recovery. The primary PI is smoothed incidental CPUE (a proxy for abundance) of Black Bream, which has continued to increase over the last five financial years from historically low levels. The estimates of this PI were between the limit and trigger RPs from 2021/22 to 2023/24. Based on both the primary and secondary PI estimates, there is evidence that the biomass is recovering.

On the basis of the evidence above, the status of the Black Bream stock in the LCF is classified as **recovering**. It is noted this classification is different to that defined in PIRSA (2023).

Greenback Flounder

Biology

Greenback Flounder (*Rhombosolea tapirina*) is a member of the family Rhombosoleidae (Gomon et al., 2008). Its Australian distribution extends from southern Western Australia, around the southern parts of the continent and Tasmania, and up to southern NSW (SAFS 2020; Kailola et al., 1993). They are common over unvegetated substrates in coastal waters and are often abundant in bays and estuaries.

Greenback Flounder can grow to 450 mm TL and live to 10 years of age (Sutton et al., 2010). It is a fast-growing species, reaching around 220 mm TL in its first year (Earl et al., 2014a). The estimated size at maturity for females and males in the Coorong Estuary is 198 and 211 mm TL, respectively (Earl 2014). Spawning occurs from March to October (Kurth 1957; Crawford 1984; Earl 2014). In South Australia, Greenback Flounder is considered a 'marine estuarine-opportunist' – a marine species that enters estuaries in substantial numbers, particularly during the juvenile and early adult life stages, but use marine waters as alternative habitat (Earl 2014). This is supported by an acoustic telemetry study that showed that the population in the Coorong Estuary is likely part of a broader population that includes the adjacent marine environment (Earl et al., 2017). Nevertheless, the extent of the portion of the population in the marine environment adjacent to the Coorong Estuary is not known. Here, the assessment of stock status is undertaken at the management unit level – the LCF.

Fishery

Greenback Flounder is an important species for commercial and recreational fisheries across southern Australia. Commercial catches of this species are taken in NSW, Victoria, Tasmania, South Australia, and Western Australia (SAFS 2020; Kailola et al., 1993). In South Australia, the LCF accounts for most of the commercial catch of this species, which is targeted and taken as a by-product using LMGN in the Coorong Estuary. The MSF, NZRLF and SZRLF also have limited access to the species, although catches from these fisheries are negligible. Recreational fishers target Greenback Flounder using hand-held spears in estuaries and protected coastal waters across South Australia. The estimated State-wide harvest of flounder (all species) by the recreational sector in 2021/22 was 0.5 t (\pm 0.3 SE based on confidence interval of retained fish numbers) (Beckmann et al., 2023). There are no catch and effort data for Aboriginal and traditional fishing.

Management arrangements

Greenback Flounder is a secondary species of the commercial LCF, making a relatively low contribution to the total production value (PIRSA 2022). For this sector, management arrangements are in place to manage fishing effort and limit fishing mortality. These include temporal and spatial netting closures, restrictions to net lengths and mesh sizes, and a LML of 250 mm TL (PIRSA 2022).

The recreational sector is managed through a combination of input and output controls. Management restrictions apply to all flounder species collectively, including Greenback Flounder. A daily bag limit of 20 flounder per person, and a daily boat limit of 60 flounder, applies to this fishery. Management arrangements also comprise general gear restrictions (PIRSA 2022). No LML applies for this sector.

Commercial Fishery statistics

Trends in total catch, effort and CPUE

Total annual catches of Greenback Flounder have been highly variable since 1984/85. Catch peaked at 65.3 t in 1990/91 and subsequently declined to 3.0 t in 1994/95 (Figure 4-10A). Catch was higher in the following seven years, increasing to a smaller peak of approximately 39.9 t in 1999/00 and averaging around 24.0 t/yr, before progressively declining to <1.0 t/yr during the 2000s (i.e., the Millennium Drought). In 2011/12, catch increased to 31.1 t following the commencement of drought-breaking freshwater inflows to the Coorong Estuary in September 2010. This flow event led to an increase in the amount of suitable estuarine habitat for flounder in the Coorong. From 2013/14 to 2019/20, annual catches were again considerably lower, ranging from 0.3 to 4.5 t and averaging 1.5 t. These low catches corresponded to a period of relatively low freshwater inflows (Figure 1-2). Catch increased to 4.5 t in 2020/21 and was stable at 4.6 t in 2021/22. A spike in annual catch in 2022/23 to 25.8 t reflects the recent La Niña years (2021-2023) and subsequent increase in freshwater discharge during 2021/22 and 2022/23, including the 2022/23 River Murray flood event. With a reduction in freshwater flow in 2023/24, the commercial Flounder catch decreased to 9.3 t, the second highest annual catch since 2012-13.

The trends in total catch reflect the trends in targeted fishing effort using LMGN (Figure 4-10B). In recent years, annual targeted effort declined from a peak of 9,773 net-days in 2011/12 to 194 net-days in 2018/19 and then remained low until 2020/21 and 2021/22, when it increased to 2,093 and 1,853 net-days, respectively. In 2022/23, targeted effort using LMGN increased to 6,394 net-days, its highest level since 2010/11, before declining to 2,903 net-days in 2023/24.

Estimates of targeted $CPUE_{LMGN}$ for Greenback Flounder should be interpreted with caution due to uncertainty around $CPUE_{LMGN}$ as a measure of relative abundance resulting from likely environmental influences on catchability (Earl and Ye 2016) (Figure 4-10C). In 2022/23 and 2023/24, targeted $CPUE_{LMGN}$ increased to its highest levels on record of ~4 kg/net-day and ~3 kg/net-day, respectively, which reflects high relative abundance in the Coorong Estuary. Given the high wholesale value of Greenback Flounder compared to other species available to the LCF (EconSearch 2024), catch is considered a more appropriate indicator of abundance for this species.

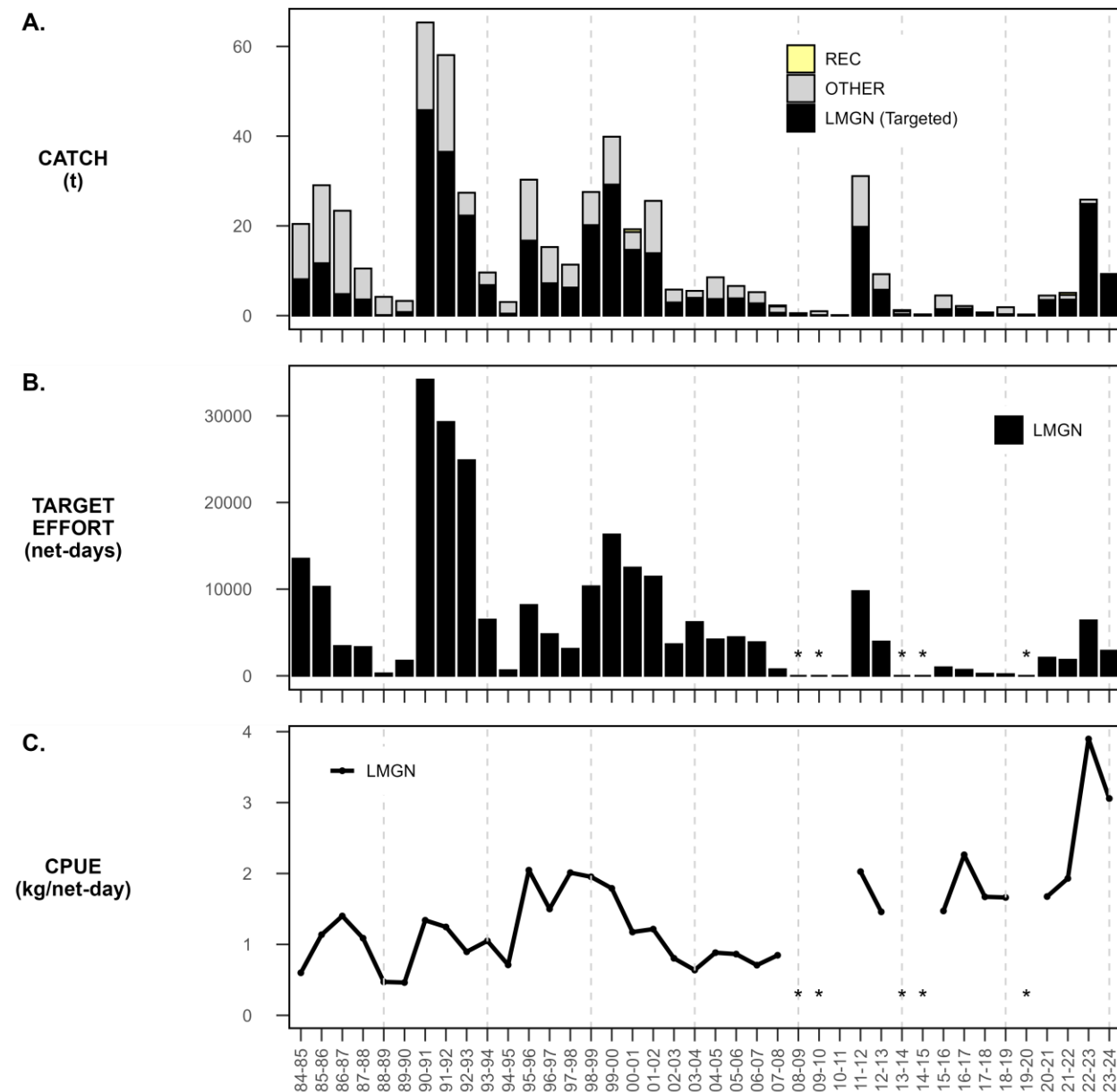


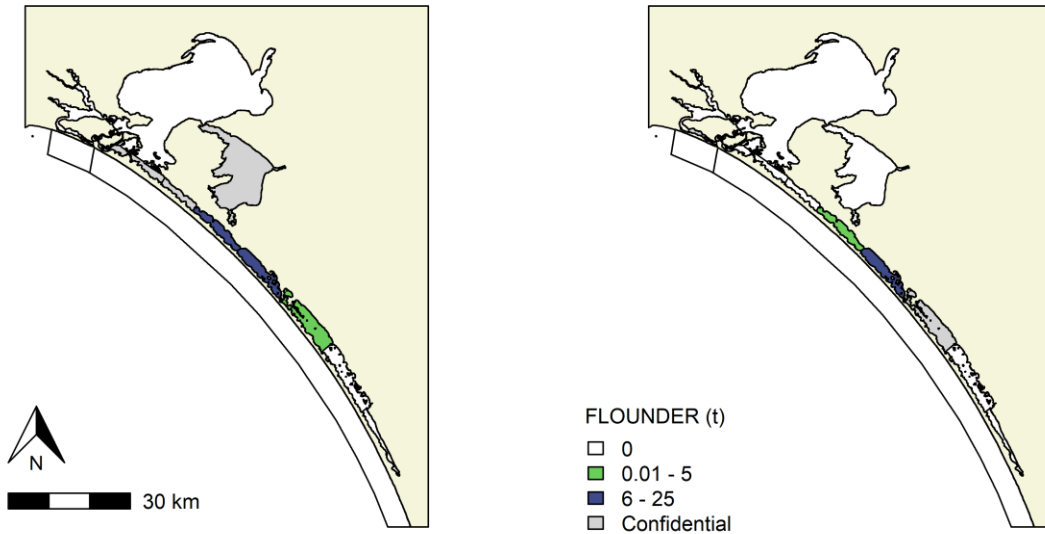
Figure 4-10. Fishery statistics for Greenback Flounder presented by financial year. Long term trends in: (A) total catch, including targeted catch for the main gear type - large-mesh gillnets (LMGN), targeted and non-targeted catch for all gear types (OTHER), and for the recreational sector (REC) (from all State waters for 2000/01, 2007/08, 2013/14 and 2021/22); (B) targeted effort for LMGN; and (C) targeted CPUE for LMGN. Asterisks (*) indicate confidential data (i.e., from <5 fishers).

Spatial and temporal trends in catch

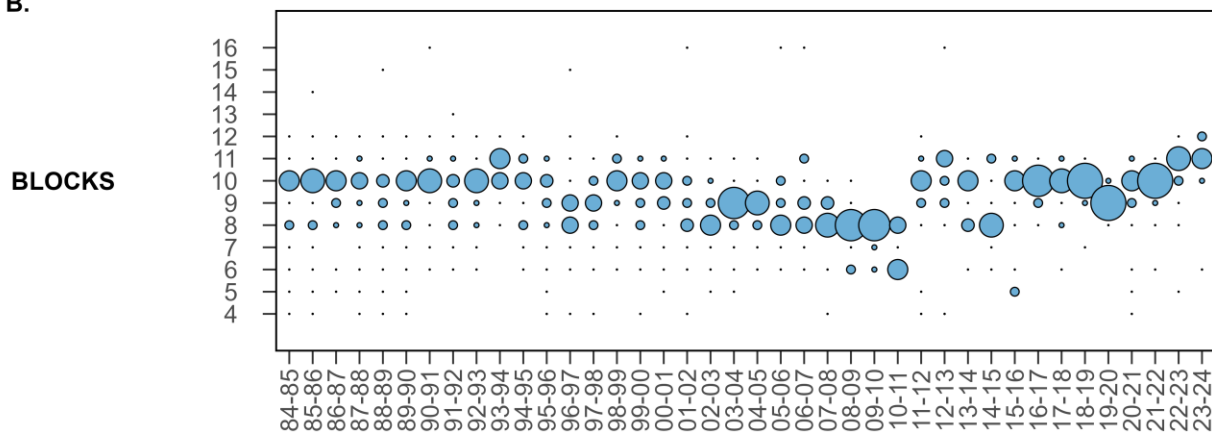
Over the past 40 years, catches taken in reporting blocks 8–10 have contributed the most to total annual catches of Flounder (Figure 4-11A; 4-11B). In 2023/24, 56.1% of the catch was taken in reporting block 11, followed by block 12 (28.1%), block 10 (15.8%), and block 6 (0.1%). In the years that produced the highest catches, the period between October and May was generally the most productive for the fishery, with catches highest during October and November in 2023.24 (Figure 4-11C).

A. 2022/23

2023/24



B.



C.

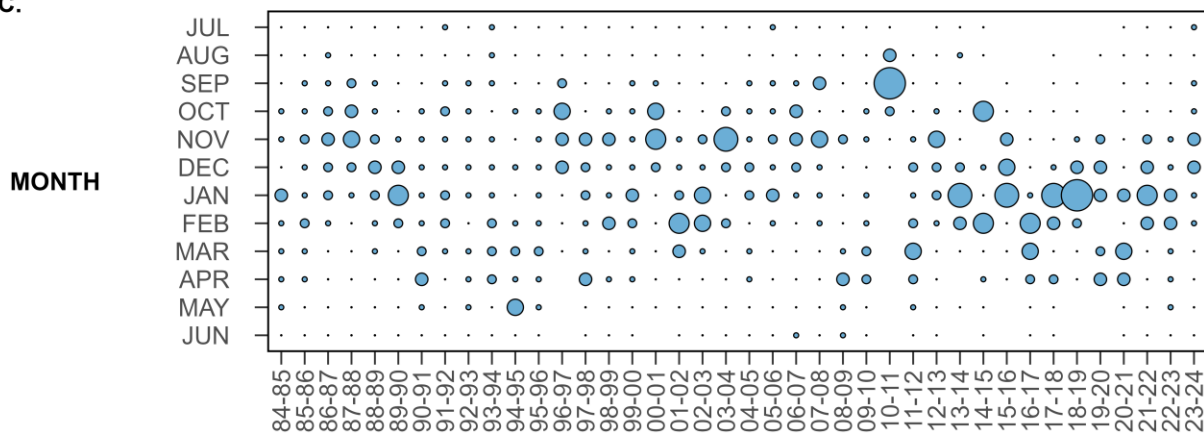


Figure 4-11. Fishery statistics for Greenback Flounder presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

Stock status

Historically, variations in recruitment of Greenback Flounder to the fishable biomass in the Coorong Estuary have been driven by environmental conditions associated with freshwater inflows from the Murray River, which have caused extreme fluctuations in abundance and catches. The most recent stock assessment for Greenback Flounder in the Coorong was completed in 2016 and classified the stock as 'environmentally limited' (Earl and Ye 2016). Since 2018, when the 'environmentally limited' classification was removed from the NFSRF and merged into the 'depleted' classification (Roelofs et al., 2024), the stock has been classified as 'depleted'. In 2022/23, the stock was classified as 'sustainable' (Sarakinis and Earl 2024).

Long-term trends in annual catches of Greenback Flounder indicate high interannual variability in fishable biomass in the Coorong Estuary. Annual catches were variable during the 1980s and 1990s, declined to historically low levels during the Millennium Drought of the 2000s, and have been low in most years since. An exception was in 2011/12, (i.e., the year after drought-breaking River Murray flows reached the Coorong Estuary), when a large biomass of legal-sized Greenback Flounder moved into the estuary from the adjacent marine environment (Earl and Ye 2016; Earl et al., 2017) and catch subsequently increased from 0.9 t in 2009/10 to 31.1 t – its fourth highest level on record. A similar increase in fishable biomass also occurred in 2022/23, when high freshwater inflows resulting from La Niña events in 2021/22 and 2022/23, resulted in a sharp increase in catch to 25.8 t – its fifth highest on record. In 2023/24, catch decreased to 9.3 t – the second highest in the past decade and 72% above the decadal average catch. The moderate catch and near-record high targeted CPUE_{LMGN} in 2023/24 was not consistent with a biomass that was recruitment overfished. However, the recent catch and CPUE declines and concurrent reduction in freshwater inflows to the Coorong Estuary is indicative of a decline in fishable biomass, which will likely continue given the absence of high flows to the system during 2024/25. The State-wide recreational catch of Greenback Flounder was estimated at 0.5 t in 2021/22, although the proportion of the State-wide recreational catch taken in the Coorong region is not known (Beckmann et al., 2023).

High interannual variation in annual catches since 1984/85 has been strongly associated with variation in freshwater inflow to the estuary, with a lag of 1–3 years (Earl and Ye 2016). This variation was because the areas of estuarine habitat that support high abundances of Greenback Flounder are only available after years of high freshwater inflow (e.g., 1990/91, 1996/97, 2010/11 and 2021/22–2022/23). It is likely that low flow conditions reduce the favourable habitat for Flounder in the estuary, during which time some individuals move from the estuary to the ocean where they remain, possibly returning when estuarine conditions improve (Earl et al., 2017). This was indicated by the rapid increase in Flounder catch in the Coorong Estuary in 1990/91, 1991/92 1995/96, 1998/99, 2011/12, and 2022/23, shortly after high inflow events. Recent moderate catches and high catch rates reflect moderate fishable biomass in the Coorong Estuary, likely a result of recent recruitment to the estuary

by adult fish from the adjacent coastal waters, a response triggered by recent high freshwater inflows and subsequent increased habitat availability in the system (i.e., non-fishing effects).

The decline in the Greenback Flounder catch rate in 2023/24 was similar to 2012/13, with a decline in fishable biomass from the previous year likely associated with decreasing habitat availability and adult fish moving out into the adjacent marine environment. Nonetheless, the moderate catch and high CPUE in 2023/24 is the second highest in over a decade and indicates the fishable biomass in the Coorong Estuary is unlikely to be depleted and recruitment is unlikely to be impaired. On this basis, the LCF for Greenback Flounder is classified as a **sustainable** stock.

Biological performance indicator

Targeted CPUE_{LMGN} for Greenback Flounder has historically fluctuated across the TRP, TrRP, and LRP but has been above the TRP since 2021 (Figure 4-12). In the 2024 calendar year, targeted CPUE_{LMGN} of 2.27 kg/net-day was above the TRP of 1.86 kg.net-day. The biological performance indicator for the Greenback Flounder stock is only used in the harvest strategy and not the 2023/24 assessment of stock status.

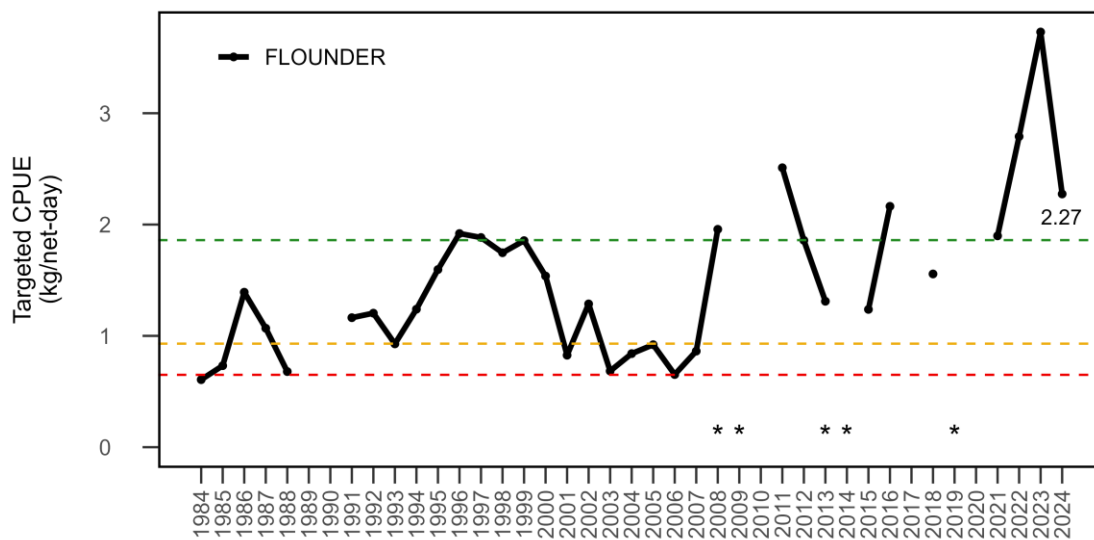


Figure 4-12. Time series of annual estimates of the ELMGN biological (secondary) performance indicator (targeted CPUE) for Greenback Flounder from 1985 to 2024 (calendar years), showing target (green dashed line), trigger (orange dashed line) and limit (red dashed line) reference points. Crosses represent confidential data reported by less than five licence holders.

4.3.2 Estuarine small-mesh gillnet sector

Environmental performance indicator

Modelled daily salinity concentrations for the Coorong Estuary indicated that the amount of suitable habitat for Yelloweye Mullet (i.e., salinity was <68 ppt) fluctuated notable between the 2023/24 and 2024/25 reporting years (1 February–31 January; Figure 4-13). Specifically, higher freshwater inflows during 2023/24 led to an extension of suitable habitat for Yelloweye Mullet all the way to Salt Creek (i.e., 100% habitat availability). During the 2024/25 reporting year, the modal proportion of suitable habitat for Yelloweye Mullet (i.e., salinity was <68 ppt) throughout the system was 68%, with an increase to 100% habitat availability between August 2024 to mid-October 2024. The lowest proportion of available habitat was 60% in February 2024. The ESMGN performance indicator for habitat available to Yelloweye Mullet in the Coorong Estuary for the 2024/25 reporting year was 69%, which was above the TRP of 50% (Figure 4-13).

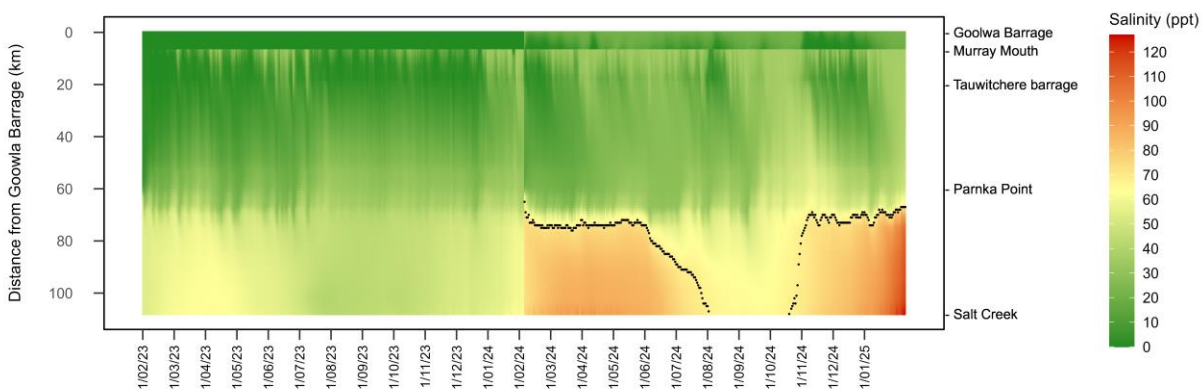


Figure 4-13. Estimated salinity concentration with distance from the Goolwa Barrage for the 2023/24 and 2024/25 reporting years, with the approximate salinity threshold for Yelloweye Mullet (68 ppt) shown as a dashed line. Salinity threshold represents the level of salinity that was lethal for 10% of test fish, as determined by Ye et al., (2013).

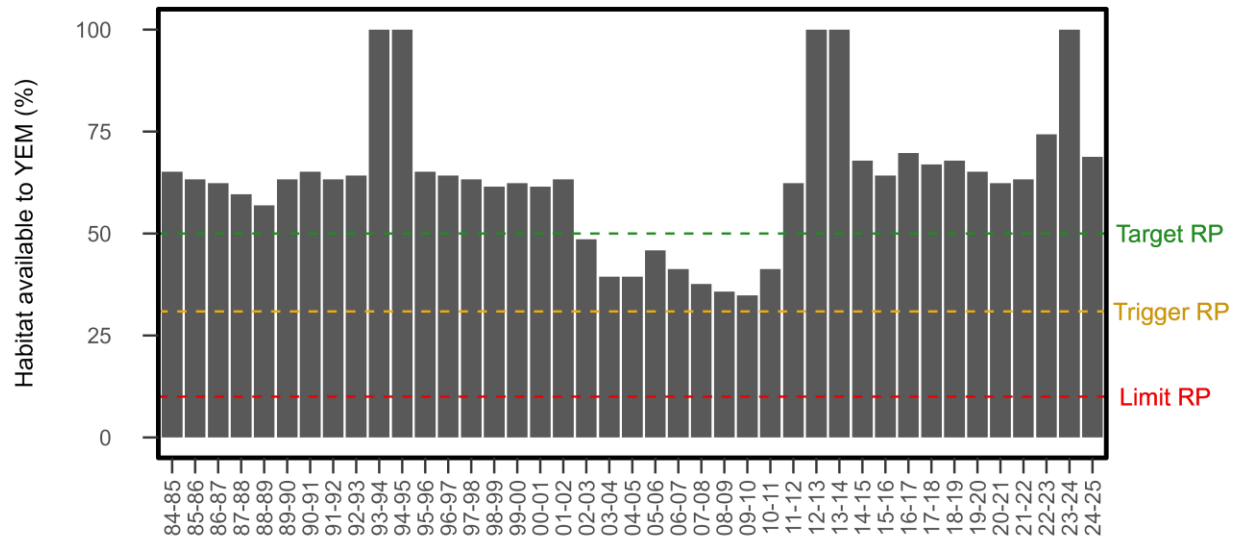


Figure 4-14. Estimates of the ESMGN performance indicator for habitat available to Yelloweye Mullet (YEM) in the Coorong Estuary from 1984/85 to 2024/25 (reporting years), showing target, trigger, and limit reference points (RP).

Yelloweye Mullet

Biology

Yelloweye Mullet (*Aldrichetta forsteri*) is a member of the Mugilidae family (Gomon et al., 2008). It is characterised by a silvery, slender, small–medium bodied adult form that can reach ~440 mm total length (TL) and 10 years of age (Thomson 1957; Gaughan et al., 2006). Yelloweye Mullet inhabit bays, estuaries, and coastal waters in New Zealand and along the southern coast of Australia, from Murchison River in Western Australia to the Hunter River in New South Wales and around Tasmania (Kailola et al., 1993). They typically occur in schools in brackish and inshore coastal waters over sandy and muddy substrates to depths up to 20 m. Larger fish show a preference for deeper habitats such as channels or gutters, whereas juveniles tend to occupy shallow habitats (Higham et al., 2005). This species is well adapted to the dynamic environmental conditions in estuaries and the nearshore coastal environment. They have a wide tolerance of water temperatures (i.e., from 14 to 33 °C) and have been recorded in salinities up to 95 ppt in the Coorong Estuary (Ye et al., 2015).

Yelloweye Mullet is considered a marine estuarine-opportunist as it spawns at sea and regularly enters estuaries, particularly as juveniles, but uses coastal waters as an alternative nursery habitat (Potter et al., 2015; Bice et al., 2018). For the Coorong population, macroscopic staging of gonads and gonadosomatic indices indicated a protracted reproductive season that extends from winter to early-

autumn (Harris 1968; Ye et al., 2013). The estimated size at maturity (L_{50}) for Yelloweye Mullet in the Coorong Estuary is ~245 mm TL (Earl and Ferguson 2013).

Biological stock structure for Yelloweye Mullet is uncertain. It has been suggested that populations in Australia form two stocks, i.e., the western and eastern stocks, based on the number of lateral scales and gill rakers (Pellizzari 2001). The Western Stock comprises populations in Western Australia and western South Australia (Smith et al., 2008), while the Eastern Stock comprises populations in South Australia's Spencer Gulf, Gulf St Vincent and South East, and extends eastwards to Victoria, New South Wales and Tasmania (Pellizzari 2001). While there is limited evidence that fish in the Coorong Estuary may be part of the Eastern Stock, further work is required to confirm biological stock delineation. This assessment of stock status is undertaken at the management unit level – the LCF.

Fishery

In Australia, Yelloweye Mullet support commercial fisheries in Victoria, South Australia, Western Australia and Tasmania (SAFS 2020; Kailola et al., 1993). It is an important recreational species in these States, as well as New South Wales. In South Australia, commercial and recreational catches are taken in most nearshore coastal areas around the State, including the Coorong Estuary.

The commercial fishery for Yelloweye Mullet in South Australia has two main sectors: the LCF and the Marine Scalefish Fishery (MSF). Over the past 30 years, the majority of the State's commercial catch has been taken by fishers in the LCF who target the species using SMGN. The Northern Zone Rock Lobster Fishery (NZRLF) and Southern Zone Rock Lobster Fishery (SZRLF) also have limited access to Yelloweye Mullet, though catches from these sectors are low and not considered here.

Recreational fishers harvest Yelloweye Mullet using rod and line in semi-protected nearshore coastal waters of South Australia (SAFS 2020; Kailola et al., 1993). They can also target the species using registered monofilament nylon nets in the Coorong Estuary and Lake George (PIRSA 2022). Recreational net fishing is prohibited in all other coastal waters of South Australia.

Management arrangements

For the commercial LCF, arrangements are in place to manage targeted fishing effort and limit the take of Yelloweye Mullet. These arrangements include general gear restrictions, spatial and temporal closures and a LML of 210 mm TL. The recreational sector is managed through a combination of input and output controls including bag and boat limits that apply to all State waters. The personal daily bag limit is 60 fish, and there is a boat limit (when three or more people are onboard) of 180 fish. The LML of 210 mm TL applies to the recreational sector. Management arrangements also comprise general gear restrictions. A small number of registered mesh net owners can use nylon gillnets to target finfish in the Coorong Estuary. Recreational mesh nets must be less than 75 m long with 50–64 mm mesh,

and the registered net owner must be within 50 m of the net at all times when fishing. Temporal and spatial closures apply to the use of recreational nets in the region.

Commercial Fishery statistics

Trends in total catch, effort and CPUE

Total annual catch of Yelloweye Mullet in the LCF increased from 128.3 t in 1984/85 to 342.4 t in 1989/90 (Figure 4-15A). From then, catch progressively declined to a low of 109.6 t in 2004/05. It then increased to between 206.5–243.3 t per year between 2007/08 and 2010/11, before declining to 120.8 t in 2014/15. Catches gradually increased after 2015/16, with sharp increases in 2018/19 and 2019/20. The total catch of 457.9 t in 2019/20 was the highest annual catch recorded in the fishery since 1984/85. Annual catches have remained relatively high since 2018/19, with 210.3 t caught in 2023/24.

The dominant gear type used to target Yelloweye Mullet in the LCF has been the SMGN (Figure 4-15B), which has accounted for around 96% of the annual catch over the past 40 years. Most of the remaining catch in each year was taken using haul nets, or as by-product when other species were targeted. In 2022/23, 99.9% of the catch was taken as targeted catch using SMGN. Targeted SMGN effort has gradually declined since peaking at 22,396 net-days in 2014/15, down to 7,762 net-days in 2022/23, the lowest on record (Figure 4-15B). In 2023/24, targeted SMGN effort increased to 8,359 net-days.

Estimates of annual targeted $CPUE_{SMGN}$ were stable at moderate levels during the 1990s (6.3–8.5 kg/net-day), and then increased to around 14 kg/net-day in 2008/09 (Figure 4-15C). Targeted $CPUE_{SMGN}$ declined to 5.2 kg/net-day in 2014/15, reflecting a possible decline in fishable biomass in the Coorong. Since then, catch rates have increased to unprecedented high levels. Targeted $CPUE_{SMGN}$ in 2022/23 was 29.7 kg/net-day, the third highest on record, and in 2023/24 was 22.4 kg/net-day.

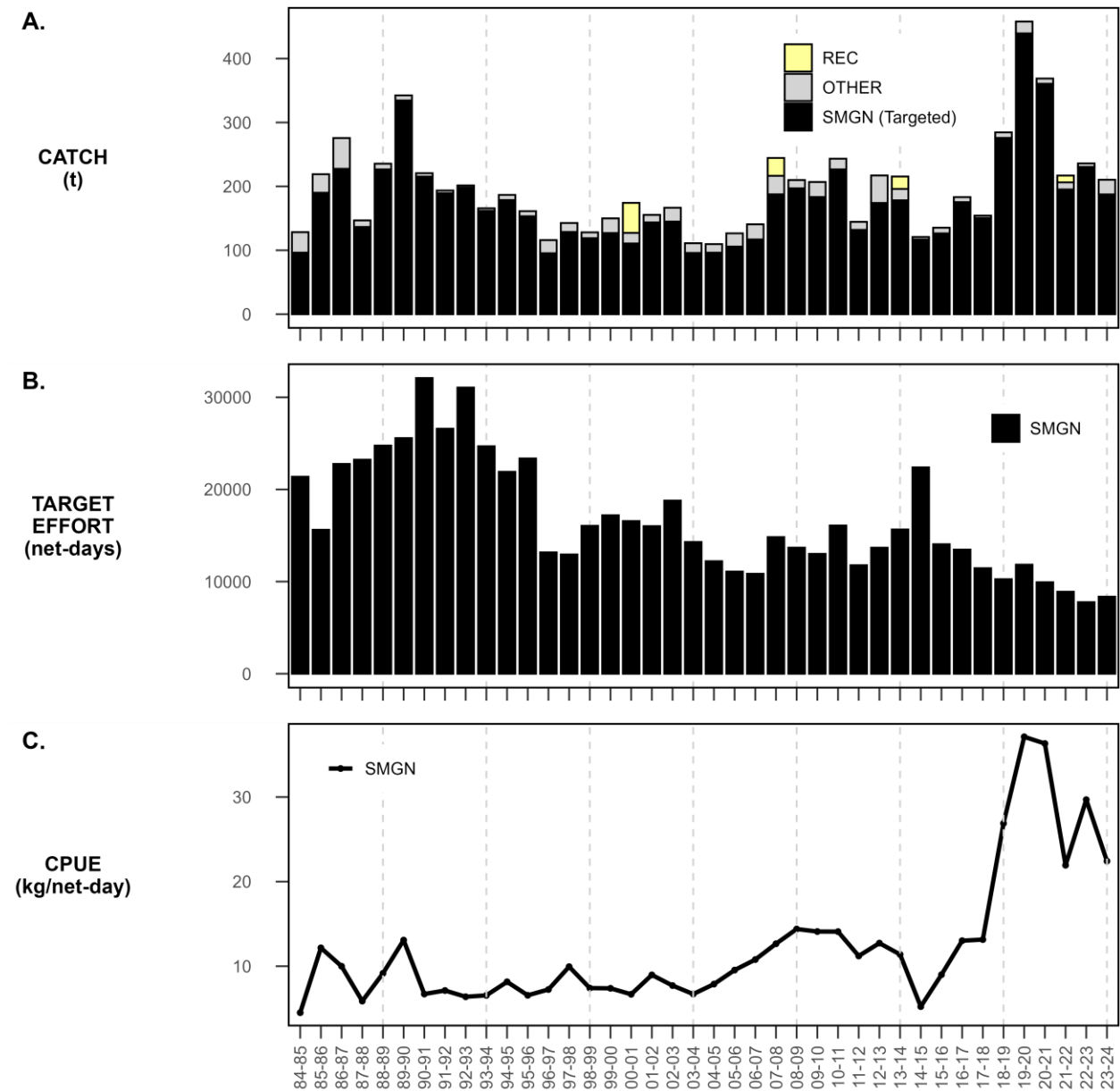


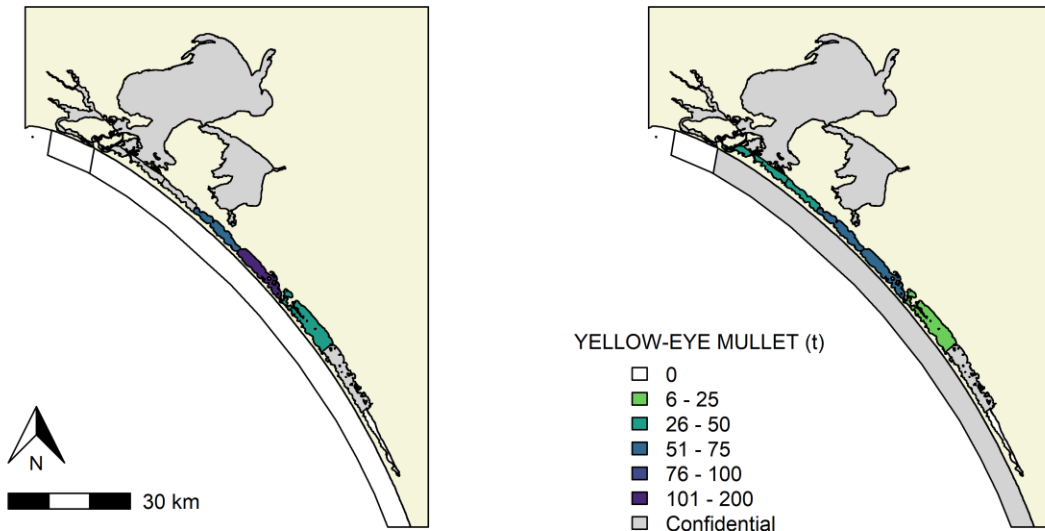
Figure 4-15. Fishery statistics for Yelloweye Mullet presented by financial year. Long term trends in: (A) total catch for small-mesh gillnets (SMGN), the recreational sector (REC) and by all other means (OTHER); (B) targeted effort for SMGN; and (C) targeted CPUE for SMGN.

Spatial and temporal trends in catch

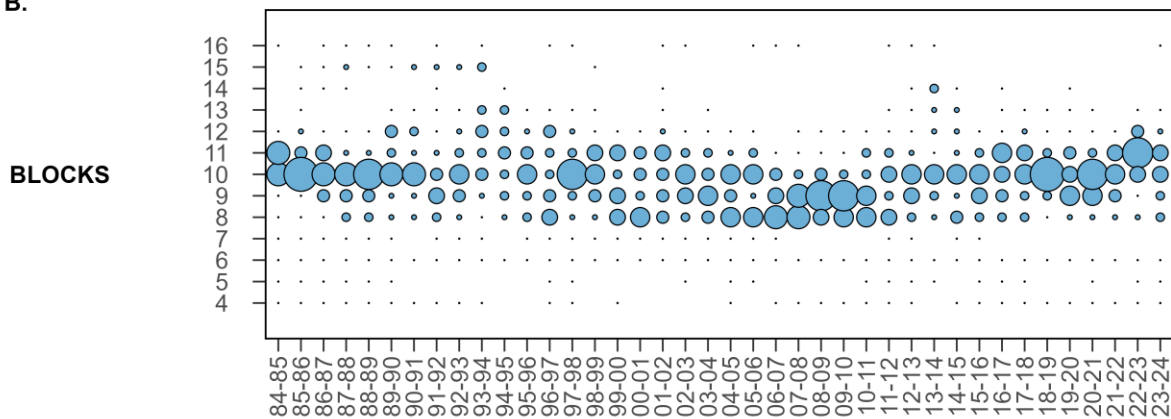
Reporting blocks 9–11 have consistently contributed most to the annual catches of Yelloweye Mullet in the LCF since 1984/85 (Figure 4-16A; 4-16B). Over this time, the most notable exception to this occurred during the 2000s (i.e., the Millennium Drought) when there was an increase in the relative contributions of catches from reporting blocks 8 and 9. This spatial contraction of the fishery was associated with a reduction in the amount of suitable estuarine habitat available for the species in the Coorong Estuary (Earl 2020). In 2022/23, catches from reporting blocks 10–12 accounted for 91.6% of the total catch, reflecting the extension of suitable habitat into the southern part of the north lagoon as a consequence of the Murray River flooding event and subsequent high freshwater inflows to the Coorong Estuary. In 2023/24, commercial catch distribution shifted back north, with a ~10% reduction in relative catch in reporting block 12 (lower Coorong Estuary) and a ~10% increase in relative catch in block 8 (upper Coorong Estuary), with majority of Yelloweye Mullet catch in block 11 (44.2%) and block 10 (28.3%). Historically, the Yelloweye Mullet fishery was seasonal with higher catches taken between May and November. In 2023/24, catches were consistent across the financial year (Figure 4-16C).

A. 2022/23

2023/24



B.



C.

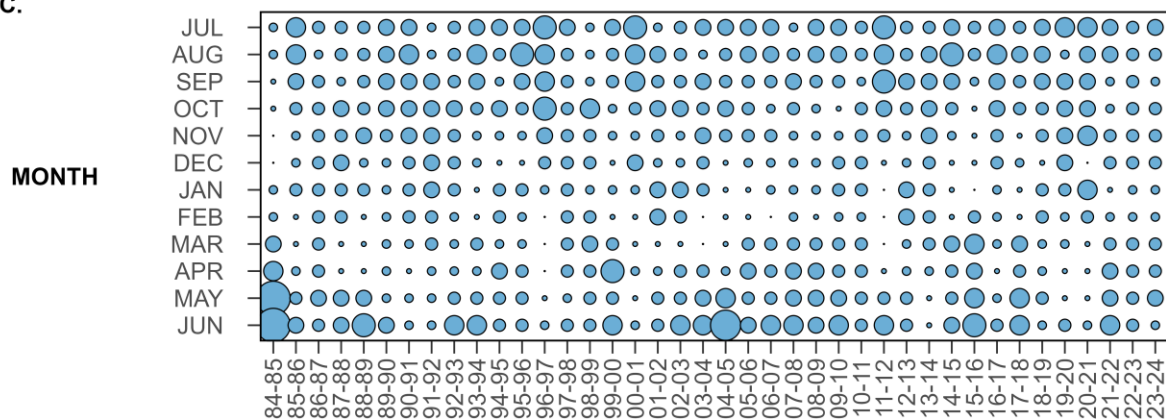


Figure 4-16. Fishery statistics for Yelloweye Mullet presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

Stock status

Yelloweye Mullet is a primary species for the commercial LCF (PIRSA 2016). The most recent stock assessment was completed in 2024 and used a weight-of-evidence approach that considered commercial catch and effort data to the end of June 2023 and fishery size and age structures to the end of June 2024 (Sarakinis and Earl 2024).

The LCF has historically been the most significant fishery for Yelloweye Mullet in South Australia, contributing more than 90% of the state's total catch in the past decade. Commercial landings by the LCF increased to 342.4 t in 1989/90 and then progressively declined to a historical low of 109.6 t in 2004/05. This long-term decline reflected redirection of targeted fishing effort to higher value species (e.g., Mulloway and Golden Perch) rather than a declining biomass, because targeted CPUE_{SMGN} was stable during this period. Catch rates declined from 2010/11 to 2014/15 suggesting a possible decline in fishable biomass in the Coorong Estuary. Since 2014/15, catches and catch rates have been considerably higher than previously. Total catch increased to a record-high of 457.9 t in 2019/20 and was associated with unprecedented high catch rates. While total catch has gradually declined to moderate levels since 2021/22, reaching 210.3 t in 2023/24, targeted CPUE_{SMGN} has remained at near-record high levels, reflecting high relative abundance of Yelloweye Mullet in the Coorong Estuary. The State-wide recreational catch of Yelloweye Mullet was estimated at 10.6 t in 2021/22, although the proportion of the State-wide recreational catch taken in the Coorong region is not known (Beckmann et al., 2023).

The regular recruitment of Yelloweye Mullet to the fishable biomass in the Coorong Estuary in recent years (Sarakinis and Earl 2024) and consistently high targeted catch rates indicate that the biomass of this stock is unlikely to be depleted, recruitment is unlikely to be impaired, and the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On this basis, and using the definitions from the NFSRF, the LCF for Yelloweye Mullet is classified as a **sustainable** stock.

Biological performance indicator

Historically, targeted CPUE_{SMGN} of Yelloweye Mullet (calendar years) has fluctuated across the TRP, TrRP, and LRP prescribed in the Management Plan (PIRSA 2022) (Figure 4-17). The TRP was last breached in 2017, before CPUE increased to 35.7 kg/net-day in 2020, the highest on record. For the 2024 calendar year, the Yelloweye Mullet targeted CPUE_{SMGN} (21.42 kg/net-day) remained above the TRP for the seventh consecutive year.

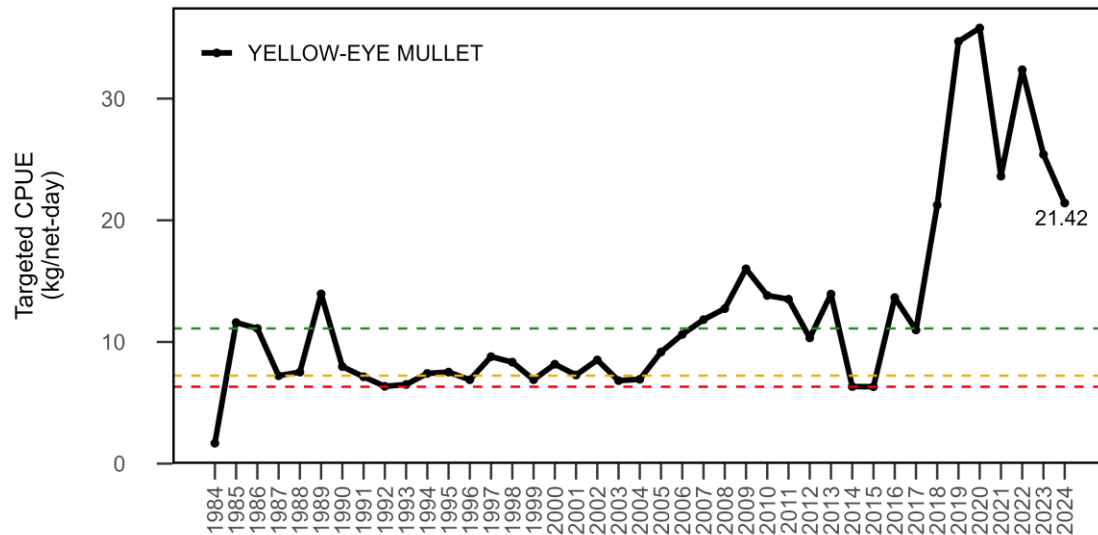


Figure 4-17. Time series of annual estimates of the ESMGN biological (secondary) performance indicator (targeted CPUE_{SMGN}) for Yelloweye Mullet from 1985 to 2024 (calendar years), showing target (green dashed line), trigger (orange dashed line) and limit (red dashed line) reference points.

4.3.3 Freshwater large-mesh gillnet sector

Bony Herring

Biology

Bony Herring (*Nematalosa erebi*) is a member of the Clupeidae family (Classon and Booth 2002). It occurs throughout the MDB, in the Lake Eyre Basin and across Queensland, most of the Northern Territory and in northern Western Australia. In South Australia, the species is abundant in the River Murray and Lower Lakes. It is the only large native fish species in the lower River Murray whose abundance appears not to have declined since the advent of flow regulation in the 1940s (Puckridge and Walker 1990).

Bony Herring is a medium-sized, laterally compressed, deep-bodied fish with a small head and blunt snout (Lintermans 2007). It can grow to 470 mm TL but is commonly 150–270 mm TL (Classon and Booth 2002). Spawning occurs in spring and summer after reaching maturity at a size of approximately 80 mm TL and two years of age. Stock structure in South Australia is uncertain. The assessment of stock status in this report is undertaken at the management unit level—the LCF.

Fishery

Bony Herring is a secondary species for the LCF (PIRSA 2022), reflecting its low wholesale value. Most of the catch is taken as by-product in the Lower Lakes, which is supplied as bait to the SZRLF and NZRLF. This species is not generally targeted by recreational fishers in South Australia. There are no catch and effort data for Aboriginal and traditional fishing.

Management arrangements

For the commercial sector of the LCF, management arrangements are in place to manage targeted fishing effort and limit the take of Bony Herring. These include temporal and spatial netting closures, and restrictions to net lengths and mesh sizes (PIRSA 2022). No specific management arrangements are in place for Bony Herring in the recreational sector.

Commercial fishery statistics

Trends in total catch, effort and CPUE

Total catches of Bony Herring increased to a peak of 1,157 t in 1989/90, before steadily declining to a low of 212 t in 2002/03 (Figure 4-18A). Annual catches increased to 550 t in 2009/10 and then progressively declined to 269 t in 2019/20, which was the lowest catch since 2004/05. In 2023/24, total catch increased to 367 t, the highest since 2016/17 (Figure 4-18B). The dominant gear type of Bony Herring is LMGN, with LMGN effort being 50,346 net-days in 2023/24 and targeted CPUE_{LMGN} relatively stable at a moderate–high level of 5.5 kg/net-day (Figure 4-18C).

Spatial and temporal trends in catch

Catches taken in reporting block 4 (Lake Alexandrina) have consistently accounted for >90% of annual total catches since 1984/85, with smaller quantities taken in block 5 (Lake Albert) (Figure 4-19A; 4-19B). However, in 2021/22 reporting block 4 contributed only 64.5% of the total catch, with block 5 contributing 34.6%, the highest contribution from Lake Albert since 1990/91. In 2023/24, reporting block 4 contributed 89.0% and block 5 contributed 10.8%. Over the last 20 years, spring and summer have been the most productive seasons for the Bony Herring fishery, with the highest catch in 2023/24 occurring between August and October (Figure 4-19C).

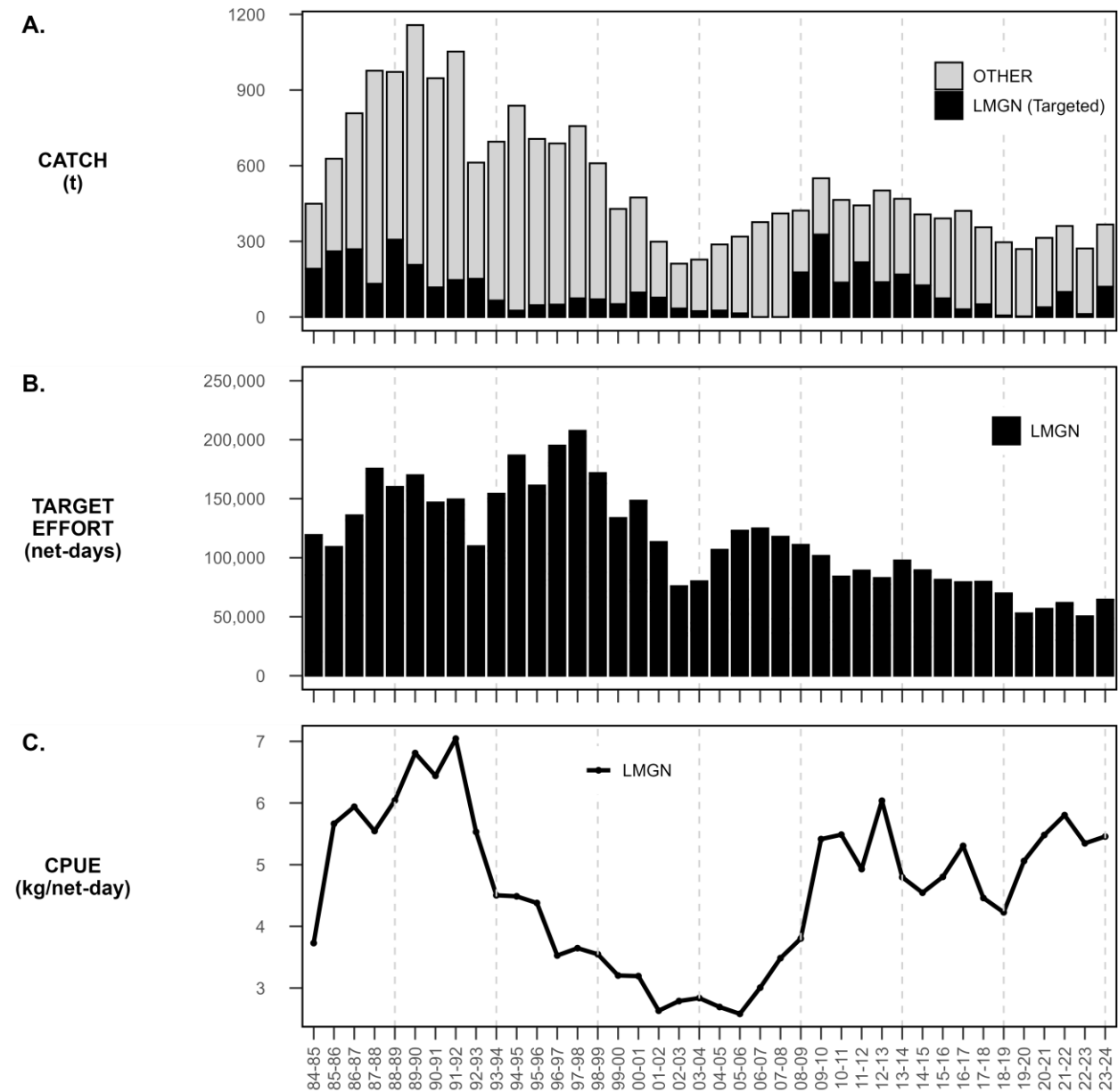


Figure 4-18. Fishery statistics for Bony Herring presented by financial years. Long term trends in: (A) total catch, including targeted catch for the main gear type - large-mesh gillnets (LMGN) and targeted and non-targeted catch for all gear types (OTHER); (B) total effort that produced catches of Bony Herring for LMGN; and (C) CPUE for LMGN, based on total catch and total effort that produced catches of Bony Herring. No estimates of recreational catch are available for Bony Herring.

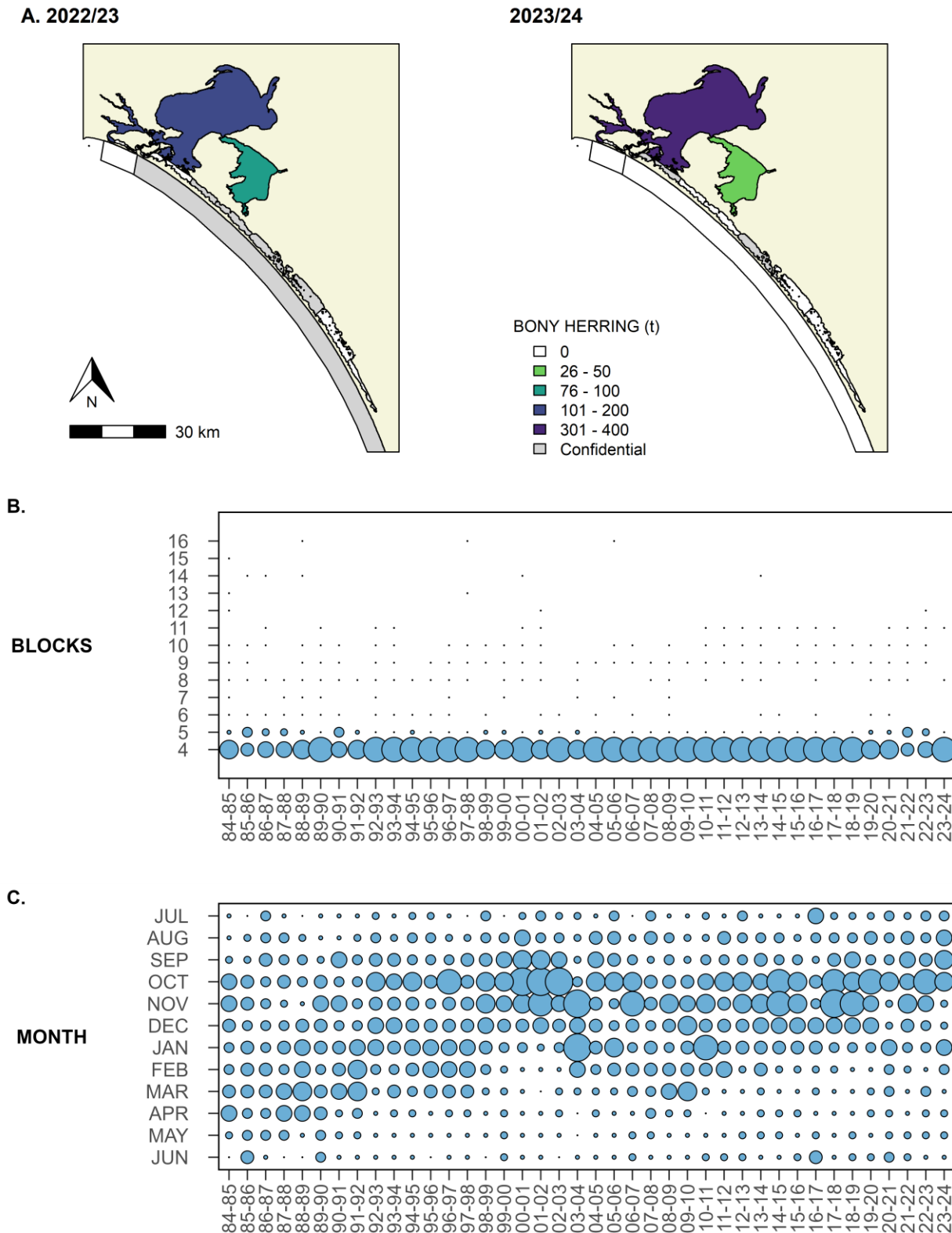


Figure 4-19. Fishery statistics for Bony Herring presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

Stock status

Bony Herring is a secondary species for the commercial LCF (PIRSA 2022). This reflects its low wholesale value compared to other species that support the fishery. Most of the catch is taken as by-product and supplied as bait to local Rock Lobster fisheries. No stock assessments have been completed for Bony Herring in the LCF.

Annual catches of Bony Herring declined considerably during the 1990s, owing to declines in LMGN gillnet effort and catch rates in the Lower Lakes. Since then, catches have been higher in most years but have progressively dropped over the last decade. The recent low catches have been associated with low LMGN fishing effort in the Lower Lakes. Catch rates have been stable at moderate to high levels over the last three years. The increase in Bony Herring catch and targeted effort in 2023/24 was associated with relatively high CPUE_{LMGN}. The consistently high catch rates since 2019/20 indicate that the biomass of this stock is unlikely to be depleted, recruitment is unlikely to be impaired and the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On this basis, the LCF for Bony Herring is classified as a **sustainable** stock.

Biological performance indicator

For the 2024 calendar year, the biological performance indicator for targeted Bony Herring CPUE_{LMGN} fell to 4.97 kg/net-day, which was below the TRP of 5.42 kg/net-day (Figure 4-20). This information is only used in the harvest strategy and not the 2023/24 assessment of stock status for Bony Herring.

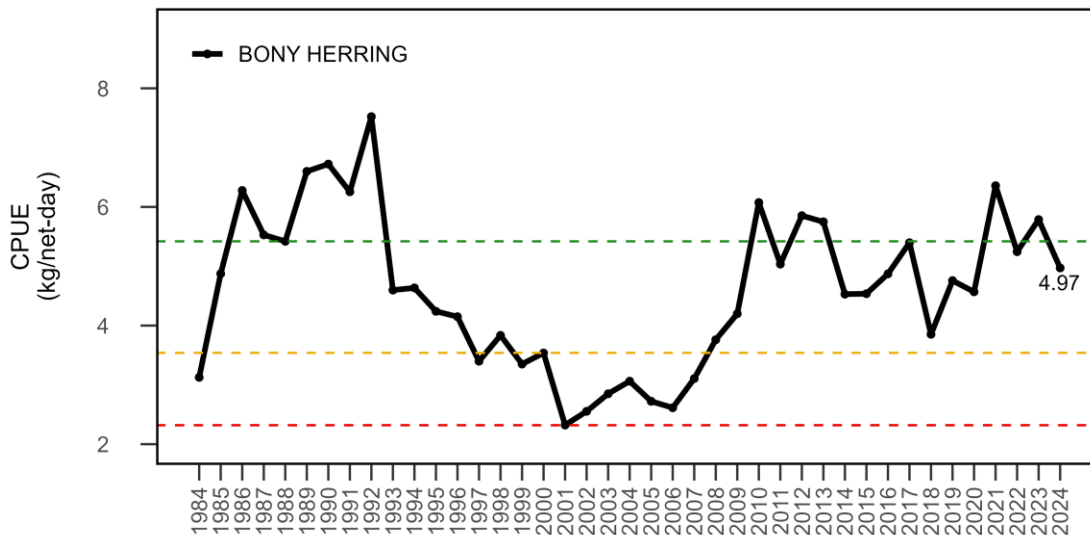


Figure 4-20. Time series of annual estimates of the FLMGN biological (secondary) performance indicator (targeted CPUE) for Bony Herring from 1985 to 2023 (calendar years), showing target (green dashed line), trigger (orange dashed line) and limit (red dashed line) reference points.

Carp

Biology

Carp (*Cyprinus carpio*) is a member of Cyprinidae family (Classon and Booth 2002). Native to China, Carp was introduced to Australian waterways in the 1850s and has since established populations in every state and territory, except the Northern Territory. It spread rampantly throughout the MDB in the 1980s and is now considered one of Australia's major aquatic pests. In South Australia, the species has been declared noxious under the *Fisheries Management Act 2007*.

Carp can tolerate a wide range of conditions including warm, low-oxygen and brackish water. Individuals can grow to 1,200 mm TL but are typically <500 mm TL and mature at 1–3 years of age. Spawning occurs during spring and summer in shallow, slow-flowing areas such as wetlands, with each large female able to produce and release up to one million eggs each year.

Fishery

In Australia, commercial fishing for Carp occurs in Victoria, South Australia, and NSW. The species is a popular target for recreational fishers in these States, as well as Queensland and the Australian Capital Territory. The LCF is the main commercial fishery for Carp in South Australia. It targets Carp using LMGN in the Lower Lakes, with most of the catch supplied as bait to local Rock Lobster fisheries, while a small and increasing proportion of the catch is sold for human consumption (EconSearch 2024). Recreational fishers harvest Carp using rod and line along the length of the River Murray in South Australia, as well as from numerous other freshwater catchments around the State. In 2021/22, the estimated State-wide recreational catch of Carp was 99 t (± 17.9 SE based on confidence interval of retained fish numbers for comparison among surveys) (Beckmann et al., 2023). There are no catch and effort data for Aboriginal and traditional fishing.

Management arrangements

Carp is a primary species of the commercial LCF, making a relatively high contribution to the total commercial production value of the fishery (PIRSA 2022). For the commercial sector, management arrangements are in place that limit targeted fishing effort for finfish. These include general gear restrictions, and spatial and temporal closures. For the recreational sector, management arrangements are limited to general gear restrictions. No LML applies to Carp.

Commercial fishery statistics

Trends in total catch, effort and CPUE

Total annual catches of Carp increased to a peak of 1,021 t in 1991/92, and subsequently declined to 209 t in 2001/02 before increasing to a smaller peak of 749 t in 2005/06 (Figure 4-21A). Since 2010/11,

catches have been lower, ranging from 308 t in 2011/12 to 538 t in 2019/20. In 2023/24, the total catch of 250 t was the lowest annual catch since 2001/02.

The temporal trends in total annual LMGN effort that produced catches of Carp have followed those of total catch since 1984/85, with a peak of 236,804 net-days in 1997/98 and a subsequent decline to 86,785 net-days in 2002/03 (Figure 4-21B). From 2010/11 to 2017/18, total effort was relatively stable and ranged between 80,588 and 100,462 net-days, before it declined to ~65,000 net-days in 2023/24. Annual CPUE_{LMGN} also followed a similar temporal trend up until 2019/20, when it increased sharply to 8.8 kg/net-day – the highest catch rate recorded in the fishery (Figure 4-21C). In 2021/22, CPUE_{LMGN} declined to 5.6 kg/net-day, and further declined to 3.6 kg/net-day in 2023/24, the lowest in over a decade.

Spatial and temporal trends in catch

The LCF for Carp is mostly limited to the Lower Lakes, with most of the catch taken in Lake Alexandrina (reporting block 4) (92% of the total catch in 2023/24) (Figure 4-22A; 4-21B). Catches of Carp are taken throughout each year, with the largest quantities usually harvested during the warmer months from September to March, with the highest catch in 2023/24 during September (Figure 4-22C).

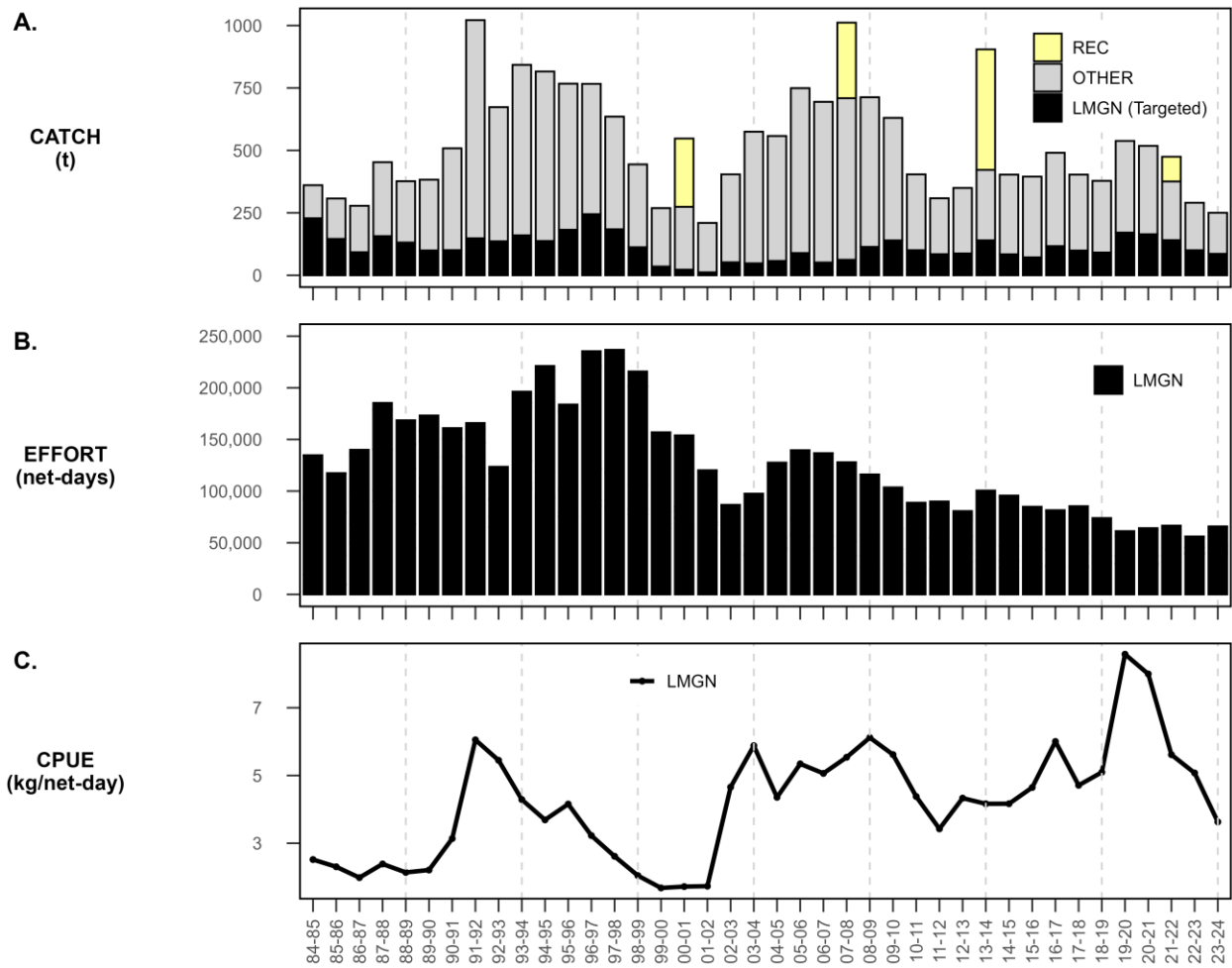


Figure 4-21. Fishery statistics for Carp presented by financial year. Long term trends in: (A) total catch, including targeted catch for the main gear type - large-mesh gillnets (LMGN), combined targeted and non-targeted catch for all gear types (OTHER), and for the recreational sector (REC) (from all State waters for 2000/01, 2007/08, 2013/14, 2021/22); (B) total effort that produced catches of Carp for LMGN; and (C) CPUE for LMGN, based on total catch and total effort that produced catches of Carp.

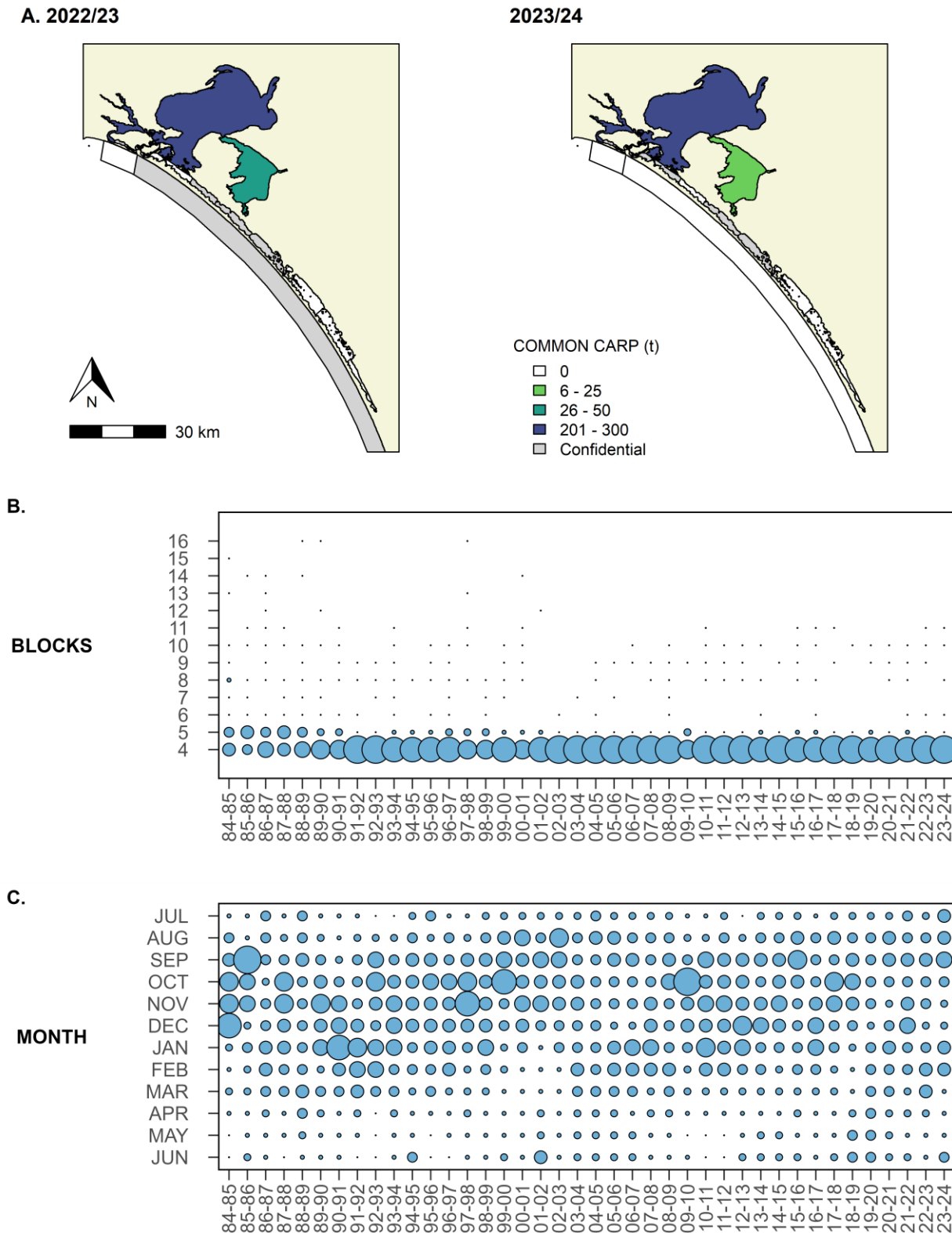


Figure 4-22. Fishery statistics for Carp presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

4.3.4 Pipi sector

Biology

Pipi (*Donax deltoides*) is a member of the Donacidae family of marine bivalves (Edgar 2000). Recent taxonomic study suggests that the best available taxonomic description for the Australian Pipi is *Latona deltoides* within the family Donacidae (Combosch et al., 2017; Moncada et al., 2022). It is common on high-energy sandy beaches from southern Queensland to the mouth of the River Murray in South Australia (Murray-Jones and Ayre 1997). The Coorong beaches adjacent to the Murray Mouth provide high quality habitat for Pipi, and it is likely that the stock in the Coorong region represents the largest single population of this species in Australia (King 1976).

For the population of Pipi on the Youngusband Peninsula, the sizes (shell width) at which 50% and 95% were reproductively mature were 28.4 mm and 32.5 mm, respectively (Ferguson and Mayfield 2006). Spawning typically occurs between September and November (Ferguson and Ward 2014). Despite several genetic studies, the biological stock delineation for Pipi is unclear. Here, assessment of stock status is presented at the management unit level—the LCF.

Fishery

Pipi is an important target species for the commercial and recreational fishery sectors in South Australia (Hall et al., 2015). The commercial Pipi fishery is located on the ocean beach of the Youngusband Peninsula and comprises three sectors: (i) the LCF; (ii) MSF; and (iii) SZRLF. The commercial fishery harvests Pipi manually using cockle rakes, which consist of a pole and frame with a net attached. As of June 2022, there were 15 licence holders with Pipi catch quota entitlements (13 from the LCF and two from the MSF). Other licence holders in the MSF and SZRLF have access to 10 kg of Pipi per day for personal bait use only.

Recreational fishers in South Australia catch Pipi using cockle rakes (nets), bait spades, bait forks or collect them by hand (Durante et al., 2022; Beckmann et al., 2023), with most of the catch taken from Sir Richard Peninsula (Goolwa Beach) (Murray-Jones and Johnson 2003; Giri and Hall 2015; Durante et al., 2022).

Management arrangements

Pipi is a primary species of the LCF, making a relatively high contribution to the total production value of the fishery (PIRSA 2022). The commercial sector is managed using a combination of input and output controls including: (i) restrictions on the number of operators and agents; (ii) gear restrictions; (iii) a LML of 35 mm; and (iv) spatial and temporal closures. Since 2007/08 the fishery has been managed under a total allowable commercial catch (TACC) with individual transferable quotas. The TACC has effectively constrained commercial catches since 2009/10. The Pipi fishing season was from 1 November to 31 May throughout most of the history of the fishery. Following a program of winter

harvest trials conducted as part of a Fisheries Research and Development Corporation (FRDC; project 2008/008) funded research project (Ferguson and Ward 2014), fishing over 12 month season from July 1 to June 30 was allowed from 2010/11 under Ministerial Exemption, with the 12 month season formally adopted from 2023/24.

The Management Plan includes a harvest strategy for Pipi (PIRSA 2022). The harvest strategy uses two biological performance indicators and a set of decision rules to inform setting of the annual TACC: (i) primary biological performance indicator – mean annual relative biomass of legal-sized Pipi (harvestable biomass); secondary biological performance indicator – presence/absence of pre-recruits in size distributions from November to February of the previous year (Ward et al., 2010; Ferguson et al., 2015). The objectives of the harvest strategy are to: (i) maintain mean annual relative biomass of legal-sized Pipi above the TRP of 12 kg/4.5 m²; but (ii) not less than the TrRP of 9 kg/4.5 m²; and (iii) to ensure that mean annual relative biomass does not fall below the LRP of 4 kg/4.5 m².

The recreational sector for Pipi is managed through a combination of input and output controls, aimed at ensuring the total catch is maintained within sustainable limits and to ensure that recreational access to the fishery is equitably distributed between recreational participants (PIRSA 2022). Daily bag and vehicle limits apply and vary geographically. For areas east of longitude 136°E, which includes Goolwa Beach, a personal daily bag limit of 300 Pipi applies, and there is a vehicle limit (when three or more people are present) of 900 Pipi. For areas west of longitude 136°E, the daily bag limit is 100 Pipi and a vehicle limit (when three or more people are onboard) of 300 Pipi applies. A temporal closure applies from 1 June to 31 October each year (inclusive) and recreational fishing for Pipi is prohibited in the commercial fishing grounds on the Youngusband Peninsula between the Murray Mouth and 28 Mile Crossing. The legal minimum size of 35 mm (across the widest part of the shell) also applies to the recreational sector.

Commercial fishery statistics

Trends in total catch, effort and CPUE

Total annual commercial catches (combined catches from LCF and MSF) of Pipi ranged from 310 to 457 t between 1984/85 and 1989/90, and then increased to an historic peak of 1,250 t in 2000/01 (Figure 4-23A). Annual catches exceeded 1,000 t between 1999/00 and 2006/07 and then declined to 470 t in 2008/09. From 2009/10, catches were constrained by annual TACCs, which steadily increased from 300 t in 2009/10, to 650 t in 2017/18 and 2018/19, before decreasing to 450 t in 2019/20 and 2020/21. The TACC was further reduced to 400 t in 2021/22, before increasing to 550 t in 2023/24. The total catch of 442 t in 2023/24 was below the TACC (550 t).

Targeted effort using cockle rakes (LCF only) has gradually decreased from 2,509 fisher-days in 2021/22 to 2,101 fisher-days in 2023/24 (Figure 4-23B). Annual targeted CPUE for cockle rakes (LCF only) increased from 483 kg/fisher-day in 1988/89 to a peak of 531 kg/fisher-day in 1996/97 (Figure 4-23C). From then, CPUE progressively declined to 132 kg/fisher-day in 2008/09 and remained low at 123–177 kg/fisher-day until 2016/17, before increasing to 209 kg/fisher-day in 2023/24 – the highest since 2006/07.

The estimates of CPUE for Pipi should be interpreted with caution due to considerable uncertainty around CPUE (kg/fisher-day) as a measure of relative abundance resulting from differences in reporting effort among individual licence holders and changes in fisher practices when targeting different size classes of Pipi for bait and human consumption markets (Ferguson et al., 2015; Ferguson and Hooper 2025). Data on catch and CPUE for the MSF are not presented due to data confidentiality (i.e., reported by <5 fishers).

Spatial and temporal trends in catch

Catches taken from reporting block 16 have consistently accounted for >99% of annual total catches since 1995/96. Prior to 2010/11, the fishery for Pipi was closed from 1 May to 30 September each year, with the months of November to April being the most productive for the fishery (Figure 4-24). Since 2010/11, fishing has occurred throughout the year under Ministerial Exemption (Ferguson and Hooper 2017). In 2022/23, catches were highest between December and April.

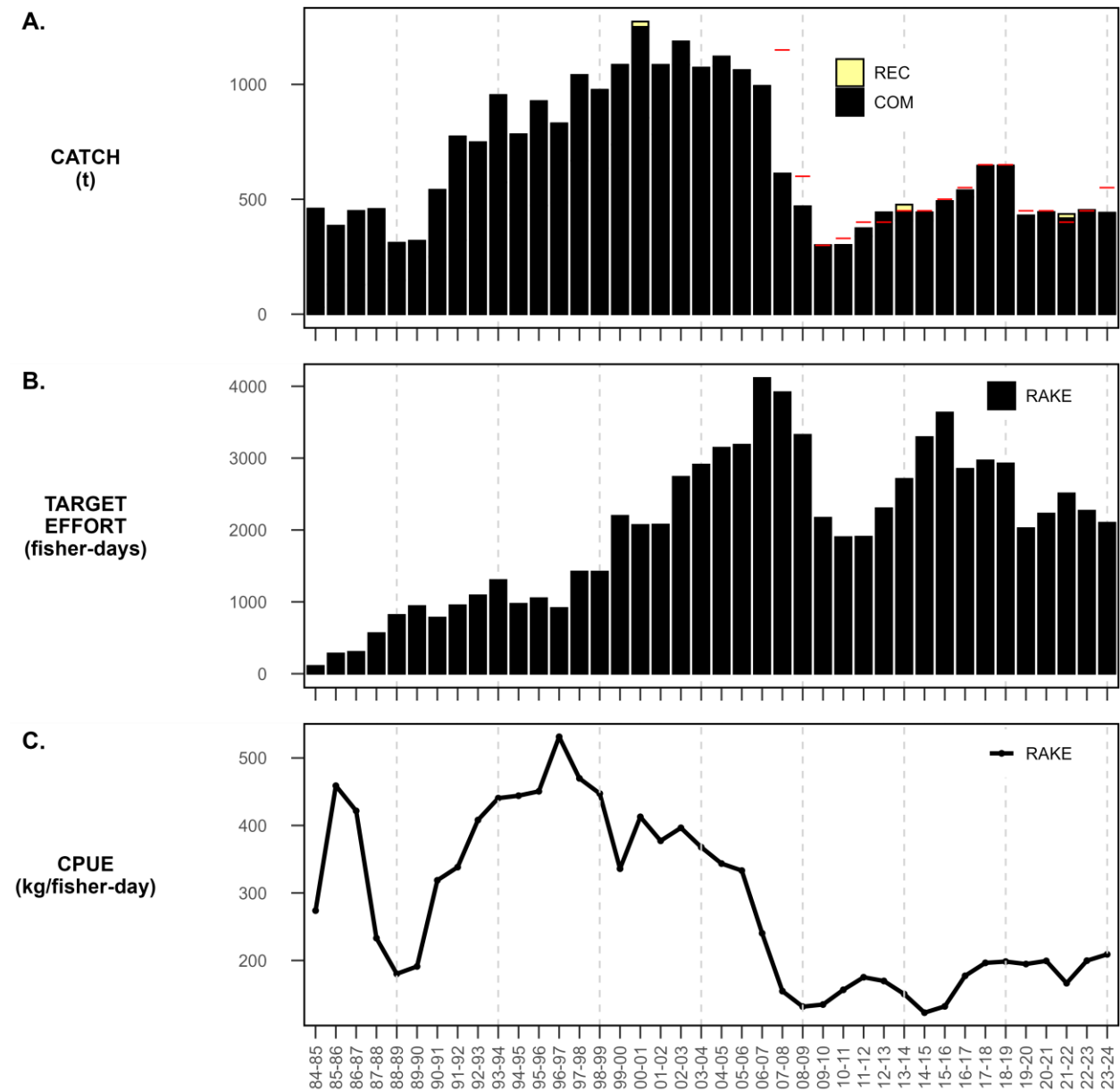


Figure 4-23. Fishery statistics for Pipi presented by financial year. Long term trends in: (A) total catch for the commercial (LCF and MSF combined) and recreational sector (REC) (for 2000/01, 2007/08, 2013/14, 2021/22); (B) targeted effort in fisher-days for cockle rakes; and (C) CPUE (kg/fisher-day) for cockle rakes. Note: (i) total catch has been constrained by the TACC (red bars) since 2009/10; (ii) catch rates should be interpreted with caution due to considerable uncertainty around CPUE (kg/fisher-day) as a measure of relative abundance (see Ferguson and Ward 2014; Ferguson et al., 2015).

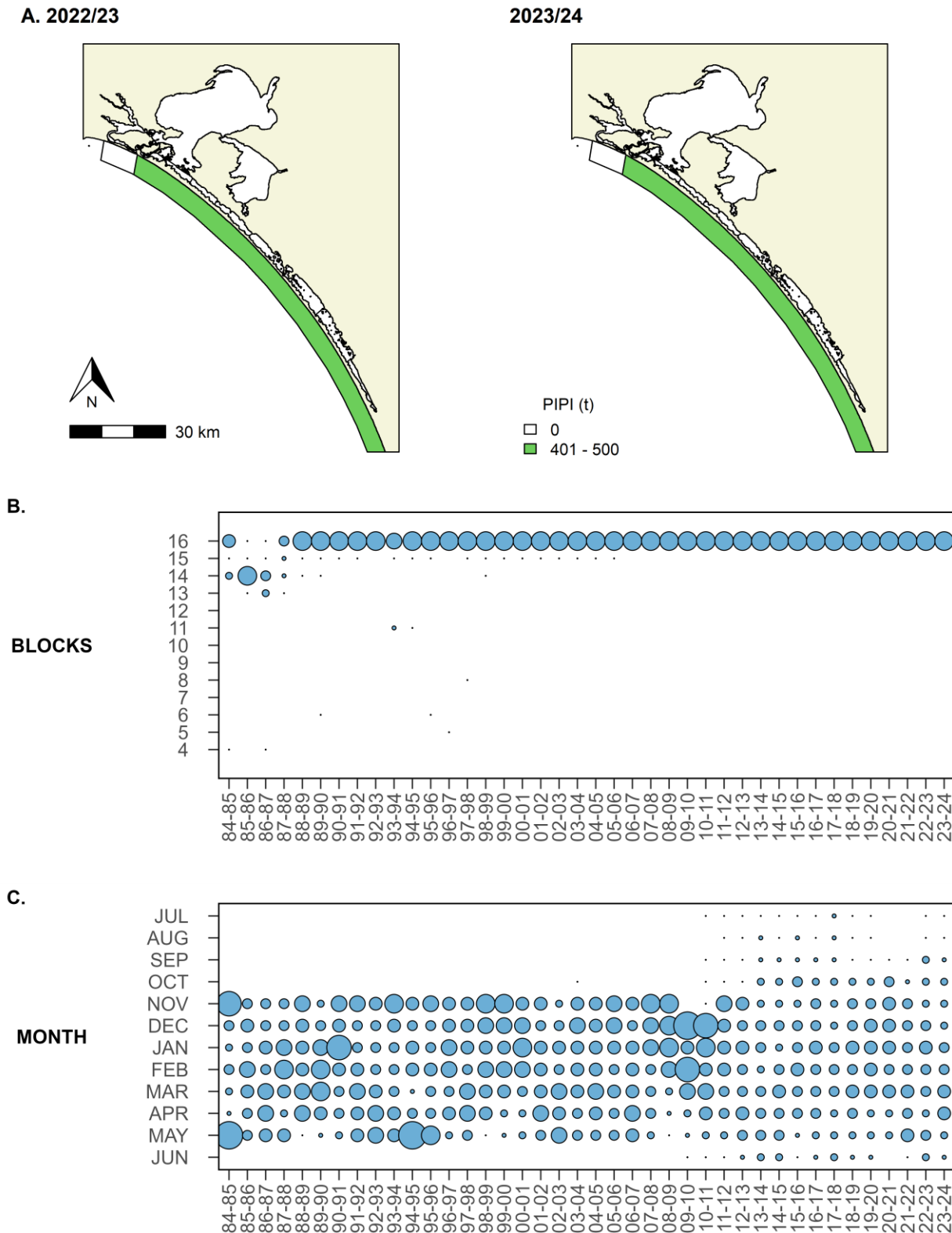


Figure 4-24. Fishery statistics for Pipi presented by financial year. (A) Map of the LCF reporting blocks showing the catch distribution for 2022/23 and 2023/24; Long-term trends in (B) the annual distribution of catch among LCF reporting blocks; and (C) the annual distribution of catch among months. Diameter of the bubbles represent the relative contribution of each reporting block to total annual catch.

Biological performance indicators

The harvest strategy for Pipi aims to maintain mean annual relative biomass above a TRP of 12.0 kg/4.5 m² and not less than a TrRP of 9.0 kg/4.5 m² (PIRSA 2022). In 2023/24, the estimate of mean annual relative biomass was 23.7 kg/4.5 m² – the highest level since surveys commenced in 2007/08 (Figure 4-25). Pre-recruits comprised 33% of size structures in November 2023, and so were considered present (>30%) in 2023/24 (Figure 4-26).

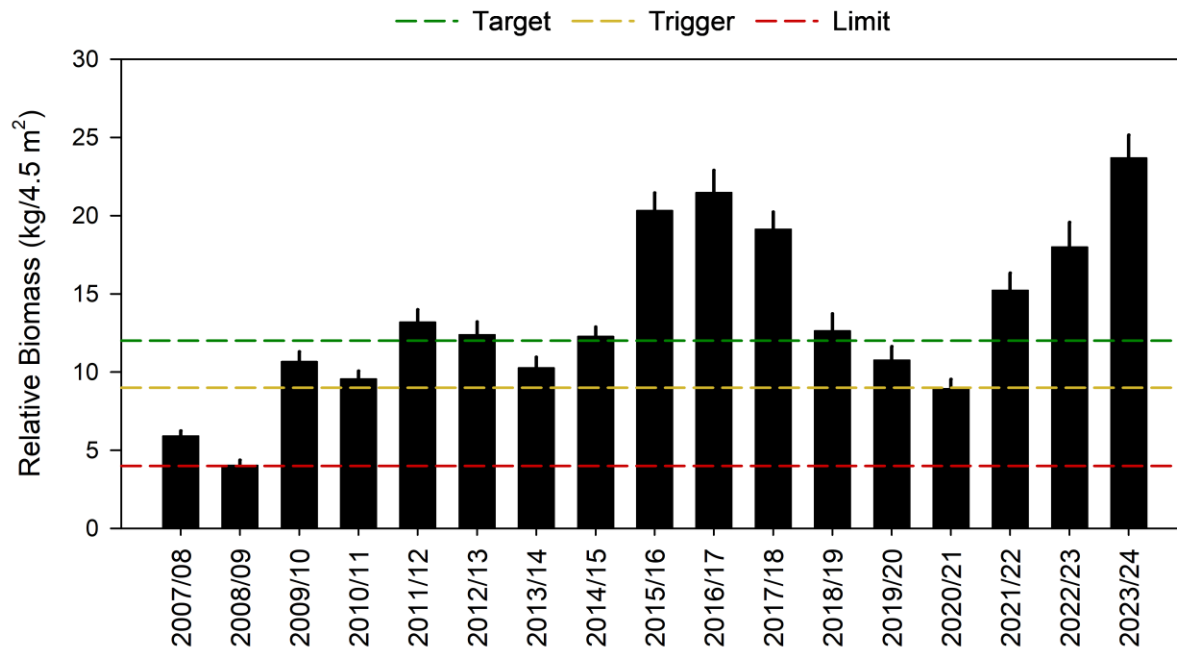


Figure 4-25. Estimates of fishery-independent mean annual relative biomass of Pipi from 2007/08 to 2023/24 (financial years) showing target, limit and trigger reference points. The harvest strategy aims to maintain relative biomass above a target of 12 kg/4.5 m² (green dashes) and not less than the trigger reference point of 9 kg/4.5 m² (orange dashes). The lower limit reference point (red dashes) represents a historically low mean annual relative biomass of 4 kg/4.5 m² below which there may be risk of recruitment overfishing.

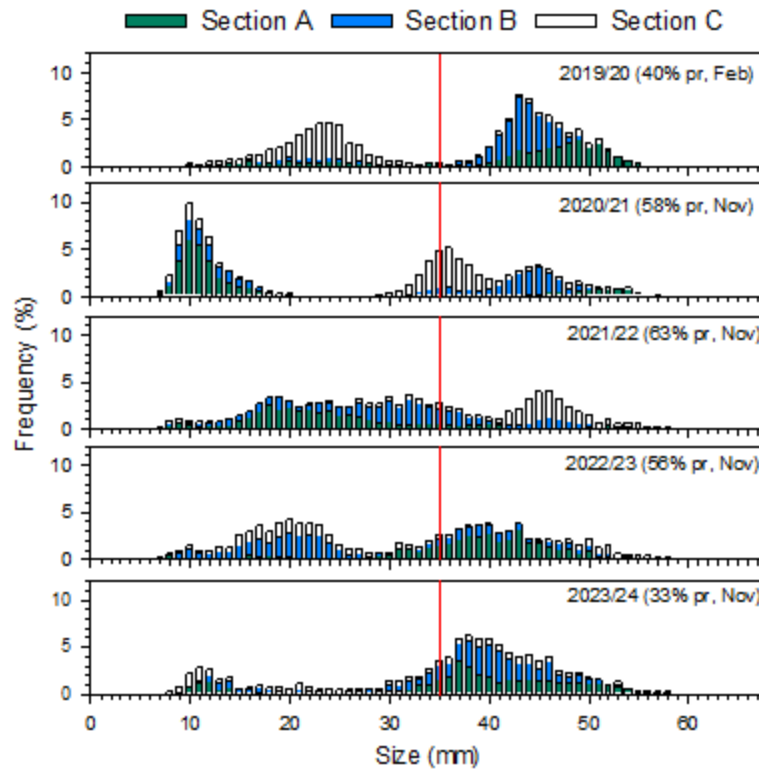


Figure 4-26. Estimates of the secondary biological performance indicator for Pipi: presence/absence of pre-recruits (pr) in February in 2019/20 and November from 2020/21 to 2023/24 (financial years). Vertical red line represents legal minimum size of 35 mm. Green = 0 to < 20 km, blue = 20 to 40 km, and white = 40 to < 60 km).

Stock status

Pipi is a primary species for the commercial LCF (PIRSA 2022). The most recent stock assessment for Pipi was completed in 2021 and reported fishery data up to June 2020 and biological information up to 2020/21 (Ferguson and Hooper 2021). The status of the Pipi fishery is determined primarily from the ongoing fishery-independent research program that undertakes structured surveys to determine the relative biomass and size structure of the Pipi resource across the fishing ground on the Younghusband Peninsula (Ferguson and Hooper 2017). The key objective of these surveys is to collect the biological information required to inform the harvest strategy for Pipi (PIRSA 2022), which is used to set the annual TACC.

The primary measures for biomass and fishing mortality for Pipi are fishery-independent estimates of mean annual harvestable biomass (Ferguson et al., 2015) and population size structure. From 2009/10, increasing relative biomass and increasing complexity of size structures indicated recovery of the resource after a period of steeply declining catches and long-term declining catch rates in the mid-2000s (Ferguson et al., 2015). From 2015/16 to 2017/18, following several years of strong recruitment, estimates of annual relative biomass were the highest on record. Then, from 2017/18–

2019/20, annual relative biomass decreased to levels that were similar to those observed during 2009/10–2014/15, likely due to combined effects of natural mortality of Pipi originating from spawning during 2012/13–2014/15 and exploitation. In 2023/24, relative biomass increased to its highest level since surveys commenced in 2007/08 and remained above the TRP for the third consecutive year, while pre-recruits were present (33%) in the population size structure. The above evidence indicates that the biomass of this stock is unlikely to be depleted, recruitment is unlikely to be impaired and the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On this basis, the LCF for Pipi is classified as a **sustainable** stock.

5 GENERAL DISCUSSION

5.1 SYNTHESIS

This report for South Australia's LCF provided an overview of the dynamics of the fishing fleet from 1984/85 to 2023/24, a stock assessment for Golden Perch, assigned stock status to a further six species using the NFSRF, and provided a summary of the catch and effort data for Carp. The assessments of status used a weight-of-evidence approach that considered a range of species-specific information relating to population biology, fishing access, management, and trends in commercial fishery data from 1 July 1984 to 30 June 2024. The exception was Black Bream, for which PIs in the Black Bream Recovery Strategy (PIRSA 2023) were used to assign stock status. Updated estimates of the environmental and biological PIs for finfish, as well as the biological PIs for Pipi were also provided (PIRSA 2022).

Of the seven stocks assessed in this report, six were classified as 'sustainable' and one was classified as 'recovering'. For each stock, the status classification in 2023/24 was the same as that from 2022/23 (Sarakinis and Earl 2024), except for the secondary species Black Bream, which was reclassified from 'depleted' (its status since 2016) to recovering. The six 'sustainable' stocks are those of four primary species—Mulloway, Yelloweye Mullet, Golden Perch, and Pipi, and two secondary species—Bony Herring and Greenback Flounder, which along with Carp have consistently accounted for most of the fishery's annual catches since 1984/85.

The stock assessment for Golden Perch was the third of its kind since the 2003 fishing year (Ye 2004; Ferguson and Ye 2012). The 2012 stock assessment considered the LCF for Golden Perch to be 'sustainably exploited' (under a previous classification framework), and all subsequent assessments of stock status have classified the stock as 'sustainable' (e.g., Sarakinis and Earl 2024). A stock status classification of 'sustainable' was retained in this assessment on account of: (i) an increase in annual catch that was associated with a near-record high annual targeted catch rate; (ii) the presence of

multiple young age classes in the population age structure indicating regular recruitment has occurred over recent years; and (iii) the environmental performance indicator for the FLMGN sector (a proxy for Golden Perch abundance) being above the TRP (PIRSA (2022)). The next Golden Perch stock assessment is planned for 2026/27.

For the FLMGN sector, Golden Perch remained the primary target in 2023/24 with large volumes of the low-value species Bony Herring and Carp taken by fishers that reported 'any target' in their logbooks. The relatively low catches of Bony Herring and Carp in 2023/24 was partly attributable to an overall decline in fishing effort in the FLMGN sector over the past five years due to reduced market demand for Bony Herring and Carp, which are primarily supplied as bait to commercial fishers in the SZRLF. Nevertheless, the assessments for Bony Herring raised no sustainability concerns.

Mulloway continued to be the primary target species of the ELMGN sector in 2023/24. Based on long-term trends, catch rates for both LMGN and SN were relatively high in 2023/24, and this contributed to a substantial (by almost four times) increase in catch from the previous year. The increase in catch was associated with similarly substantial increase in targeted fishing effort in the Coorong Estuary in 2023/24 (from its lowest level on record in 2022/23), which reflected the recommencement of regular gillnet fishing activities in the Coorong Estuary as freshwater inflows from the Murray River flood event across 2021/22 and 2022/23 subsided. The passing of the flood waters and subsequent reduction of inflows meant that fishers could effectively anchor their gillnets in traditional Mulloway fishing areas without risk of gear loss, which they were unable to do for most of 2022/23. The high LMGN and SN catch rates in 2023/24 were similar or higher than those recorded in the years immediately prior to the recent flood event and reflect high fishable biomass of both juvenile Mulloway in the Coorong Estuary and adult Mulloway in the adjacent nearshore marine environment. Consequently, there are no sustainability concerns for Mulloway.

The current management arrangements to recover the Black Bream stock in the Coorong Estuary appear to be taking effect as indicated by small improvements in Black Bream fishery performance over recent years. Biological performance indicators in the Black Bream Recovery Strategy (PIRSA 2023) are trending favourably, with evidence of a progressive increase in relative abundance since 2018/19 and recent recruitment of a strong year class to the fishable biomass. Smoothed incidental CPUE has increased over the past five years and was above the LRP in both 2021/22 and 2022/23 as a depleted stock, and for the third consecutive year in 2023/24; which along with the presence of a single, strong cohort of young fish in the age structure, warranted a stock status reclassification from 'depleted' to 'recovering'. This classification is different to that defined in PIRSA (2023) – 'depleting' – highlighting the need for the terminology of stock status classifications in the recovery strategy, particularly those that relate to the Black Bream stock that is in transition between 'depleted' and 'sustainable' (and vice versa), to be reviewed.

Future monitoring will confirm if current levels of fishing mortality and management measures (e.g., seasonal fishery closures) continue to support stock recovery. In addition, the FIS that commenced in 2022/23 detected the presence of relatively strong cohorts of pre-recruits in the Coorong Estuary. The FIS will continue in 2025/26, with findings, in conjunction with catch, effort, and age-structure data, expected to inform stock status in the next assessment provided sufficient FIS sampling can be completed. Overall, these positive signs for Black Bream over recent years are consistent with anecdotal reports from industry of substantial improvements in the fishery for Black Bream. The recovery strategy will continue to monitor Black Bream stock recovery and is not expected to be reviewed until at least 2026.

Greenback Flounder fishery performance has decreased since 2022/23, although remains relatively high compared to trends over the past decade. The moderate total catch and high targeted CPUE relative to historic levels is indicative of a high fishable biomass of 2023/24. Fishery production for this species has been closely linked to freshwater inflows, which is consistent with recent high fishery production of this 'marine estuarine-opportunist' and high freshwater inflows to the Coorong Estuary over recent years (Earl and Ye 2016). Since the 1970s, the spawning biomass of this stock, which likely extends beyond the spatial extent of the fishery and into the Southern Ocean (Earl et al., 2017), has repeatedly demonstrated its capacity to replenish the Coorong population in the 1–3 years after a year of high freshwater inflow (e.g., 1990/91, 1996/97, 2010/11). This biological response occurred again in 2022/23, with an increase in fishable biomass in the Coorong Estuary following high flow years (i.e., increased habitat availability), followed by a decline in freshwater flow in 2023/24 reducing available habitat and subsequent fishable biomass. Based on the historical relationship between catch (biomass) and barrage discharge, fishery performance is expected to decline in 2025/26 given the current low flow conditions in 2024/25.

Yelloweye Mullet remained the sole target of the ESMGN sector in 2023/24. Fishery performance has remained stable since 2021/22, and with reduced targeted effort has resulted in exceptionally high targeted CPUE_{SMGN} since 2018/19. The high catch rates are indicative of high fishable biomass but could also reflect changes in the relative efficiency of the fleet in recent years as fishers continue to adapt to the presence of Long-nosed Fur Seals. These interactions occur as seals attempt to eat fish caught in gillnets, which results in catch losses and damage to nets. Some of the operational changes made by fishers have included: (i) reducing the number of gillnets used per fishing day, allowing them to attend their nets more regularly (i.e., reduce soak time of individual gillnets); (ii) changing the time of the day that nets are in the water; and (iii) more frequent shifting between fishing areas to be less predictable to foraging seals (EconSearch 2019; Earl et al., 2021). The influence of such changes is not yet detectable in fishery logbooks. This will be partially addressed by incorporating additional

reporting fields (e.g., soak time) in the Inland Waters Catch and Effort logbook in 2025/26 and the implementation of the new electronic logbook.

For each of the three gillnet sectors, updated estimates of the environmental (primary) and biological (secondary) performance indicators were assessed against their respective reference points, as prescribed in the finfish harvest strategy (PIRSA 2022). The results of these comparisons will guide setting of the annual TACE for each sector for the 2025/26 fishing season. Estimates of the environmental performance indicator for each sector for the 2024/25 reporting year (1 February 2024 to 31 January 2025) were above their TRPs. Estimates of the biological performance indicators for all species for the 2025 calendar year were above their respective TRP, with the exception of Bony Herring, which fell below the TRP point but was above the TrRP.

For Pipi, 2017/18 and 2018/19 were the most productive years for the LCF in terms of total catch since quota-management arrangements for this species were introduced in 2007/08. Fishery-independent surveys undertaken in 2023/24 indicated that relative biomass of legal-sized Pipi was the highest on record and was above the TRP. The survey also determined that pre-recruits were present in 2023/24. These results indicate that the biomass of the Pipi stock along the ocean beach of the Younghusband Peninsula is in a strong position.

5.2 CHALLENGES AND UNCERTAINTIES

The weight-of-evidence approach used to determine stock status for the LCF stocks considered in this report relied heavily on fishery-dependent data. The assessments relied on interpreting trends in catch, effort and CPUE for the primary gear types used to target or take each species. For most species in this report, the primary measure of fishable biomass is targeted CPUE using gillnets, whereby CPUE is assumed to be proportional to, and therefore a reliable index of, relative abundance. However, CPUE has likely been affected by changes in the relative efficiency of the fleet over time, especially since 2009/10 when fishers modified their fishing practices to avoid interactions with seals (Earl et al., 2021). Standardisation of CPUE may improve the usefulness of CPUE as an index of relative abundance and may help account for differences in the relative contributions of targeted and non-targeted catches to the total catch. Improving the reliability of CPUE as an indicator of biomass would improve the confidence in assessments of stock status. Development of a more reliable proxy for relative abundance through CPUE standardisation commenced in 2024/25 and is planned to be included in the next fishery assessment report.

An additional source of uncertainty in these assessments are the unknown levels of incidental mortality of sub-legal sized individuals of LCF species discarded by commercial and recreational fishers in the Lower Lakes, Coorong Estuary, and marine waters. Estimates of discarding for the commercial fishery

are available from limited sampling undertaken during the Millennium Drought (Ferguson 2010), and while operators in the LCF are required to submit daily catch and effort data for all species, information on the composition and magnitude of discarded catches and survival rates of discarded species is lacking. To address this, the introduction of mandatory discard reporting of nine key species taken in the fishery through electronic catch and effort logbooks has been implemented in 2025. The data captured through this process is planned to be included in the next fishery assessment report. Furthermore, although recreational release rates are available at the State-wide level for LCF species, the precision of these estimates is poor when results are disaggregated to regional scales (Beckmann et al., 2023). For the commercial sector, this could be addressed by contemporary estimates of discarded catches and rates of capture of discarded species. Such estimates would build on the data collected by Ferguson (2010) and extend beyond the Coorong Estuary and into the freshwater and marine habitats of the LCF.

Interactions between LCF fishers and Long-nosed Fur Seals has been a major issue for the fishery over the last 17 years. Despite recent mitigation initiatives, reports from industry suggest that the seal-fisher conflict and associated economic impacts continued in 2022/23 (EconSearch 2024). The lack of quantitative information on the impacts of seals on the fishery (i.e., loss of catch and damaged catch which is then discarded) precludes this (potentially large) source of fishing mortality being accounted for in fishery assessments. If better information were available, this could be incorporated into CPUE standardisation to help explain, and account for, the effect of changes in fisher behaviour on catch rates. A FRDC-funded project (no. 2018-036; 'Seal-fisher-ecosystem interactions in the Lower Lakes and Coorong: understanding causes and impacts to develop longer-term solutions') is seeking to address this knowledge gap.

A further challenge for assessing the status of LCF stocks is determining the relative contribution of catches taken by the recreational fishing sector to total State-wide catch. The total harvest by the recreational sector has traditionally been determined through longitudinal phone surveys that are undertaken on an approximate five-year cycle (Henry and Lyle 2003, Jones 2009, Giri and Hall 2015, Beckmann et al., 2023). Although these surveys adopt a standard methodology that allows the results to be compared through time, phone surveys were designed to provide estimates of participation, catch and effort at State-wide level, resulting in low sample sizes and high uncertainty of estimates when survey data is disaggregated. The lack of recreational estimates at smaller scales has implications for the assessments of Mulloway, Golden Perch, Black Bream, and Pipi, for which the estimated relative recreational contribution to overall State-wide catch is significant. Probability-based on-site surveys is an alternative method to estimate recreational catch of species with land-based access and limited geographic distribution, as observed for Pipi in South Australia (Durante et al., 2022). However, depending on the number of access points, supplementary data (e.g., remote

cameras and recreational App) would likely be required to improve temporal coverage (Beckmann et al., 2023).

Another source of uncertainty in the LCF assessment is the presence of the harmful algal bloom (HAB) and the long-term effects on the health of local fish stocks. In 2025, southern Australian waters have been impacted by the ongoing HAB that included the dinoflagellate *Karenia mikimotoi* and other *Karenia* species (PIRSA 2025), which has been previously linked to both finfish and shellfish mortalities (Rolton et al., 2022; Li et al., 2019). The combined effects of annual upwelling, a sustained marine heatwave, and relatively calm sea conditions may have contributed to formation and duration of the HAB off the coast of South Australia. Reported presence of the HAB in the North Lagoon and South Lagoon of the Coorong Estuary questions the future health of LCF stocks, with higher risk species in South Australia suggested to be those with high site-fidelity inhabiting shallow waters (Roberts et al., 2019). This report assessed fishery statistics up to the 2023/24 financial year, which was prior to the 2025 HAB. Therefore, the extent to which the recent HAB has impacted fishery stocks is yet to be quantified. Future LCF reports will need to consider effects from the HAB on both the finfish and pipi sectors when assessing stock health and status.

5.3 RESEARCH PRIORITIES

The most important research needs for the LCF fishery and its management are: (i) CPUE standardisation to improve the usefulness of CPUE as an index of relative abundance for key species; (ii) evaluating the extent of the effects of the HAB on stocks within the LCF; (iii) independent monitoring of discarding of sub-legal sized individuals of LCF species from commercial and recreational gillnets in the Coorong Estuary, Lower Lakes, and marine waters of the LCF; (iv) ongoing development of a time series of annual age structures, particularly for the long-lived species Mulloway, Black Bream, and Golden Perch; (v) continuation of the fishery-independent surveys for Black Bream and Greenback Flounder to provide reliable information on relative abundance and recruitment that can be used to monitor stock recovery; and (vi) quantitative information on the extent of seal impacts on the fishery, with respect to catch losses and damaged discarded catch.

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APPENDIX

Appendix 1. Summary table showing annual total commercial catches (tonnes) for twelve LCF species defined as 'primary', 'secondary', 'tertiary' or 'other' species in the Management Plan (PIRSA 2022). Total catches for Pipi include LCF and MSF catches. Crosses indicate confidential data.

	Primary					Secondary			Tertiary			Other
	Mulloway	Yelloweye Mullet	Golden Perch	Carp	Pipi	Bony Herring	Greenback Flounder	Black Bream	Snapper	Australian Salmon	Australian Herring	Redfin Perch
84/85	40.5	128.3	36.3	360.6	459.2	449.0	20.4	46.8	0.0	1.0	0.0	15.2
85/86	32.0	219.0	30.8	307.2	384.9	627.6	29.1	35.5	x	2.0	0.0	51.7
86/87	30.5	275.6	18.4	278.3	449.3	807.6	23.4	36.9	0.0	1.0	0.0	54.3
87/88	13.8	146.7	32.8	452.7	457.5	976.6	10.5	21.3	0.0	2.0	0.0	72.2
88/89	25.9	235.4	19.0	376.6	310.5	971.8	4.2	15.7	x	4.0	0.0	91.4
89/90	36.7	342.4	17.8	382.8	319.1	1157.4	3.3	10.4	0.0	8.0	x	57.6
90/91	41.8	220.6	21.1	508.1	541.2	946.8	65.3	3.7	0.0	4.0	x	35.4
91/92	45.1	193.6	22.0	1021.4	773.5	1052.6	58.1	4.7	0.0	23.0	x	28.5
92/93	34.3	201.4	99.8	673.1	748.3	612.3	27.4	2.6	0.0	3.0	0.0	35.8
93/94	84.6	165.6	104.0	842.4	953.6	695.2	9.6	3.1	0.0	1.0	x	63.5
94/95	78.0	186.7	206.4	816.0	783.0	837.7	3.0	3.3	x	x	0.0	42.5
95/96	57.3	161.2	172.9	767.1	927.1	706.1	30.3	3.9	0.0	5.0	0.0	22.6
96/97	55.6	115.8	136.7	766.6	830.3	688.3	15.3	3.8	0.0	3.0	0.0	29.6
97/98	50.2	142.6	151.0	635.0	1041.3	757.1	11.4	4.3	1.0	4.0	0.0	21.6
98/99	95.2	128.0	98.1	443.9	976.3	609.5	27.5	3.4	1.0	3.0	0.0	44.5
99/00	69.3	149.9	56.9	268.7	1085.3	428.7	39.9	4.1	2.0	4.0	0.0	23.9
00/01	135.7	127.1	71.1	274.0	1250.5	473.8	18.6	7.5	0.0	2.0	0.0	25.0
01/02	109.3	155.3	36.3	209.5	1085.2	298.6	25.6	8.2	0.0	1.0	0.0	9.7
02/03	45.4	166.5	37.7	404.2	1187.1	211.6	5.8	11.6	0.0	1.0	x	6.3
03/04	31.0	111.0	81.8	574.7	1073.0	227.5	5.5	10.0	x	2.0	0.0	8.5
04/05	39.1	109.6	102.7	557.6	1121.3	287.5	8.5	5.6	0.0	4.0	0.0	10.6
05/06	38.6	126.5	125.5	749.1	1062.3	318.8	6.6	6.6	0.0	3.0	0.0	22.9
06/07	43.9	140.6	151.9	694.3	993.6	376.0	5.2	4.5	1.0	4.0	0.0	15.8
07/08	32.4	216.5	117.1	709.0	607.3	410.6	2.0	4.1	0.0	6.0	0.0	28.9
08/09	29.7	209.9	87.0	712.7	469.6	422.0	0.5	1.8	0.0	10.0	0.0	27.6
09/10	25.8	206.8	49.2	630.1	300.6	549.9	1.0	1.1	3.0	10.0	0.0	41.5
10/11	19.4	243.3	67.6	403.9	301.2	464.2	0.1	2.3	3.0	8.0	0.0	60.6
11/12	63.8	144.4	56.5	308.2	374.3	442.5	31.1	3.0	1.0	1.0	0.0	68.2
12/13	103.4	217.0	33.9	349.4	443.1	501.6	9.2	1.9	x	1.0	0.0	11.9
13/14	68.0	196.0	88.2	421.8	443.6	468.8	1.0	1.9	x	0.0	0.0	7.9
14/15	59.2	120.8	84.5	402.9	443.1	406.8	0.3	2.4	0.0	1.0	0.0	13.6
15/16	72.9	135.2	79.5	395.0	492.1	390.8	4.5	1.9	0.0	3.0	0.0	11.7
16/17	62.2	183.1	80.8	490.3	539.1	420.8	2.1	1.6	0.0	1.6	0.0	11.6
17/18	121.3	154.2	105.9	403.0	646.5	355.6	0.7	1.3	0.0	0.6	0.0	27.2
18/19	109.3	284.5	61.3	378.2	647.0	296.4	1.9	0.7	0.3	0.3	0.0	42.6
19/20	120.6	457.9	50.6	538.0	430.0	269.4	0.2	1.8	0.0	1.1	0.0	31.8
20/21	92.3	368.7	54.9	518.1	444.4	313.6	4.5	3.2	0.0	2.6	0.0	23.2
21/22	55.6	206.3	35.2	375.6	417.5	360.9	4.6	3.4	0.0	3.3	0.0	25.8
22/23	28.9	235.9	52.4	290.5	453.0	271.7	25.9	3.9	0.0	2.6	0.0	16.4
23/24	112.2	210.3	60.2	250.2	441.6	366.7	9.3	3.0	0.0	0.5	0.0	32.1