Mulloway (2023)

Argyrosomus japonicus

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STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Western Australia	Western Australia	Sustainable	Catch MSY, Catch, CPUE
Queensland	Queensland	Undefined	
New South Wales	New South Wales	Recovering	Catch, CPUE, Size Composition, Biomass Depletion, Mortality Rates, Spawning Potential Ratio
South Australia	South Australia	Sustainable	Catch, CPUE, age composition

STOCK STRUCTURE

Mulloway has a wide distribution in Australia, from the Gascoyne region on the west coast of Western Australia, around the southern coasts of the continent, and up to the Wide Bay–Burnett region on the east coast of Queensland [Kailola et al. 1993].

Biological stock structure for Mulloway in Australia is uncertain. It has been suggested that a single panmictic population occurs in Australia [Archangi 2008]. However, regional differences in genetics, and otolith morphology and chemistry suggest sub-structuring between populations in New South Wales, South Australia and Western Australia [Ferguson et al. 2011; Barnes et al. 2015; Hughes et al. 2022].

Here, assessment of stock status for Mulloway is presented at the jurisdictional level—Western Australia, Queensland, New South Wales and South Australia.

STOCK STATUS

New South Wales

Commercial landings of Mulloway in New South Wales steadily declined from almost 400 tonnes (t) in the mid-1970s to a historic low of 37 t in 2008–09 and have been less than 100 t per year since the mid-1990s. In 2021–22, the total state-wide commercial catch was 79 t. Standardised catch per unit effort (CPUE; in days) for the two main fishing methods, estuary mesh netting and ocean line fishing both show substantial increases since 2009–10, particularly in the period from 2019–20 to 2021–22 [Hughes 2023]. Standardised CPUE for offshore handlining (reflecting abundance of mature fish), adjusted for increases in fishing power, increased by approximately 40% between 2009–10 and 2018–19, and has been stable at this level to 2021–22 [Hughes 2023].

The most recent estimate of the recreational harvest of Mulloway in NSW was 6,431 (± 1,888 SE) individuals weighing an estimated 55 t in 2019–20 [Murphy et al. 2022]. In 2017–18, an estimated 13,641 (± 2,843 SE) individuals weighing an estimated 90 t were harvested [Murphy et al. 2020]. These estimates only encompassed harvest from NSW households within which a long-term NSW Recreational Fishing Licence holder resided (RFL household). Re-analysis of the previous survey [West et al. 2015] produced an estimate of 19,319 (± 6,554 SE) individuals weighing an estimated 103 t harvested by RFL households during 2013–14 [Murphy et al. 2020]. In 2000–01, estimated recreational harvest by all fishers in NSW waters was 59,029 (± 25,232 SE) individuals weighing an estimated 274 t [Henry and Lyle 2003]. While these survey results are not directly comparable due to different sampling frames, they likely represent a substantial decline in recreational harvest through time. Total historical harvest of Mulloway in NSW was also reconstructed by estimating recreational harvest prior to, and between, survey estimates [Hughes 2023].

The annual average lengths of Mulloway landed by the commercial fishery have declined since the mid-1990s but have been stable since the mid-2000s except for the effect of increasing the legal minimum length in 2013 [Silberschneider and Gray 2005; Silberschneider et al. 2009; Hughes 2023]. Up until 2016–17, the New South Wales commercial Mulloway fishery was based largely on juveniles, and the truncated length composition of fish in commercial landings since the early-2000s was indicative of a heavily fished stock (around 80% of catch was less than 700 mm, the approximate length at maturity for female Mulloway in New South Wales) [Silberschneider and Gray 2005; Silberschneider et al. 2009; Hughes 2023]. Only since 2015–16 has the average size of Mulloway in commercial landings indicated that the catch consists of adults (greater than 700 mm) and has been greater than 900 mm since 2017–18 [Hughes 2023].

Since the early 2000s, the spawning potential ratio (SPR) for Mulloway in New South Wales [Silberschneider et al. 2009; Hughes 2020] was consistently estimated to be below the threshold reference point of 20% of unfished with high probability indicating a risk of recruitment failure [Goodyear 1993; Mace and Sissenwine 1993]. Catch curve analysis over the same period consistently indicated that fishing mortality (F) was more than double natural mortality (M) [Hughes 2020].

In 2013, a recovery program for Mulloway was introduced in New South Wales designed to arrest the decline in commercial and recreational Mulloway fisheries. Numerous changes to recreational and commercial management have since been undertaken including an increase in legal minimum length from 450 to 700 mm, a staged reduction in daily recreational bag limits to one fish per day, a recreational boat limit of 2 fish per day, and the introduction of daily trip limits

for all commercial fisheries. In addition, after several years of below average rainfall, environmental conditions for successful Mulloway recruitment [Stewart et al. 2020] likely occurred during the period between 2019–20 and 2021–22.

Current median SPR is estimated to be 31% of unfished (range 15–39%) in 2021–22 [Hughes 2023] and infers increasing biomass since 2018–19 [Hughes 2020]. Outputs from integrated modelling approaches under development, including surplus production (CMSY++; [Froese et al 2021]) and within the Stock Synthesis framework [Methot and Wetzel 2013], using reconstructed catch histories (including both commercial and recreational components), standardised commercial CPUE time series and commercial length compositions, are also consistent with increasing biomass in recent years [Hughes 2023]. Model outputs estimate current biomass to be greater than the 20% limit reference point (B20), but not with high certainty [Hughes 2023].

The above evidence indicates that the biomass of this stock may be depleted, and that recruitment may be impaired. However, for the period between 2019–20 and 2021–22 these indicators suggest a recovering stock.

Mortality estimates from integrated modelling approaches being developed indicate current F to be less than the median estimate of M [Hughes 2023]. Outputs from age-based catch curve analysis are also consistent with decreasing fishing pressure since 2018–19 [Hughes 2020].

The above evidence indicates that the current level of fishing mortality should allow the stock to recover from its recruitment impaired state.

On the basis of the evidence provided above, Mulloway in New South Wales is classified as a **recovering stock**.

Queensland

While Mulloway are predominantly taken by recreational anglers in Queensland, no reliable harvest estimates have been possible from data collected in recreational angling surveys [Teixeira et al. 2021]. Mulloway are a minor component of the commercial East Coast Inshore Fishery (ECIF), with around 7.5 t taken by net and line fishing in this fishery between 2021–22, and a ten-year annual average catch of 8.5 t. The legal minimum length for Mulloway in Queensland was raised from 450 to 750 mm total length (TL) in 2009, along with a possession limit reduction from ten to two. This change in legal length likely reduced fishing-related mortality, especially for juveniles. There is no published stock assessment of this species in Queensland, and there are no data available to estimate biomass or exploitation rates. In addition, the recruitment potential of wild populations and harvestable biomass remain unresolved. This prevents assessment of current stock size or fishing pressure. Consequently, there is insufficient information available to confidently classify the status of this stock.

On the basis of the evidence provided above, Mulloway in Queensland is classified as an **undefined stock**.

South Australia

The Lakes and Coorong Fishery (LCF) has historically been the most productive of South Australia's fisheries for Mulloway and contributed 99% of the State's total commercial catch of the species in 2021–22. Small catches are also taken by the Marine Scalefish Fishery (MSF). The most recent assessment for Mulloway in the LCF was completed in 2023 and used a weight-of-evidence approach that considered fishery data to the end of June 2022 and fishery age structures to the end of June 2023 [Earl 2023].

The primary indicators for biomass and fishing mortality are total catch, targeted CPUE using two types of commercial gillnets (large mesh gillnets: 115–150 mm mesh; swinger nets: greater than 150 mm mesh) and fishery age structures. Commercial landings of Mulloway in South Australia peaked at 145 t in 2000–01 and then progressively declined to 22 t in 2010–11. This downward trend was associated with a decline in targeting of Mulloway using gillnets in the LCF during the Millennium Drought in the 2000s and likely reflected a decline in fishable biomass in the Coorong Estuary [Earl 2020]. Since 2010–11, catches have been considerably higher with peaks of 127 t and 123 t in 2017–18 and 2019–20, respectively. These catches were associated with exceptionally high gillnet CPUE. Catch declined to 56 t in 2021–22, reflecting a 55% decline in targeted gillnet effort in the LCF. Nonetheless, high gillnet CPUE in the Coorong Estuary and the adjacent nearshore marine waters in 2021–22 was indicative of high fishable biomass of juvenile and adult Mulloway, respectively. The State-wide recreational catch of Mulloway was estimated at 24 t (± 11) in 2021–22 t [Beckmann et al. 2023], which accounted for around 30% of the State's total annual harvest across all sectors.

Annual age structures for Mulloway from the Coorong Estuary have been stable since 2001–02 (i.e., dominated by juveniles) and are consistent with those for Mulloway from other estuaries around Australia [Silberschneider et al. 2009; Stewart et al. 2020]. The 2022–23 age structure included 2–5-year-old fish and was dominated (80%) by two-year-olds that originated from spawning in 2020–21. The lack of older fish in the age structure likely relates to an ontogenetic migration of individuals from the Coorong Estuary to the adjacent marine environment and the removal of older fish by fishing. Nevertheless, the presence of a strong age class of young fish in the catches from the estuary (i.e., the area that contributes most of the catch) in 2022–23 indicates that relatively strong recruitment occurred in 2020–21.

Since 2001–02, annual age information for Mulloway from the nearshore marine environment adjacent to the Coorong Estuary has been limited due to the small number of samples and small sample sizes available in most years. The age structure from 2022–23, which was based on a relatively large sample size (n=197), was similar to those from recent years. Specifically, the sample included a wide range of ages (5–22 years), was dominated by 6–10-year-olds and consisted primarily (greater than 70%) of individuals above the age at maturity (5–6 years) for the species. The 2022–23 age structure was dominated by 7-year-olds (i.e., 2015–16 year class), with moderate contributions of 6-year-old fish from the 2016–17 year class. Fish older than 12 years were rare despite the potential for this species to reach 41 years of age in South Australia (Ferguson et al. 2014). The lack of older fish in the age structure likely relates to the removal of older fish by fishing and may also reflect an extended period of relatively poor recruitment during the Millennium Drought (2000s).

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Furthermore, the evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, Mulloway in South Australia is classified as a **sustainable stock**.

Western Australia

The majority of Mulloway catches in Western Australia are landed by commercial fishers, making up approximately 70–80% of the total catch over the last ten years. Commercial catches have declined from around 60 t in 2001–02 and have

fluctuated between 6 t and 28 t since 2007–08 [Newman et al. 2023]. The recent lower catch levels are associated with reductions in fishing effort by the main demersal fisheries that catch Mulloway; the West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSIMF) and Gascoyne Demersal Scalefish Managed Fishery (GDSMF). Boat-based recreational and charter catches of Mulloway remain low, i.e., less than 10 t per year, with most landed in the West Coast and Gascoyne coast bioregions [Ryan et al. 2022, Newman et al. 2023]. Shore-based recreational catches of Mulloway are unknown.

Annual CPUE of Mulloway derived from commercial line fishing methods has fluctuated below 6 kg per block per day, reflecting the low level of commercial targeting of this species. Estimates of CPUE for the two main fisheries that land Mulloway (WCDSIMF and GDSF) have also been highly variable over the past 15 years, generally mirroring variations in catch of this species and may not provide a reliable index of abundance. Recent management measures taken to substantially reduce line fishing effort and catch in the West Coast and Gascoyne Coast bioregions are expected to further limit fishing pressure on Mulloway.

Analyses of length composition data available from charter logbooks (in years with adequate catches) show that the mean lengths of Mulloway in the West Coast Bioregion were greater than those in Carnarvon/Shark Bay (Gascoyne) [Crisafulli et al. in prep.]. In both regions, the mean lengths of charter-caught Mulloway show an increasing trend in recent years, increasing within the West Coast Bioregion from 672 mm in 2013 to around the estimated size of 50% maturity of females (approximately 900 mm) in 2021. The applicability of length-based models for estimating fishing mortality and relative spawning biomass of Mulloway in Western Australia is currently limited due to uncertainty about available biological information for this species in the Gascoyne [Crisafulli et al. in prep.].

A data-limited Catch-MSY analysis of the Western Australian stock of Mulloway, based on available catch data from 1975 to 2022, predicts a Maximum Sustainable Yield (MSY) of 32 t (95% CLs: 24–42 t). Annual catches of this species have fluctuated within or below this range since 1975, except for the period of peak catches between 1999 and 2002. While uncertain and based on assumptions about the final level of depletion of the stock (0.3–0.8), the analysis indicates that the recent low catches are likely to have reduced the fishing mortality (F) experienced by the stock to well below the predicted level of FMSY (0.12 year[-1]). This suggests that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. The predicted relative stock biomass (B, i.e., the depletion level) in 2021–22 was 0.65 of the unfished level (95% CLs: 0.38–0.79), i.e., above the threshold level of 0.5 corresponding to BMSY.

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Furthermore, the evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

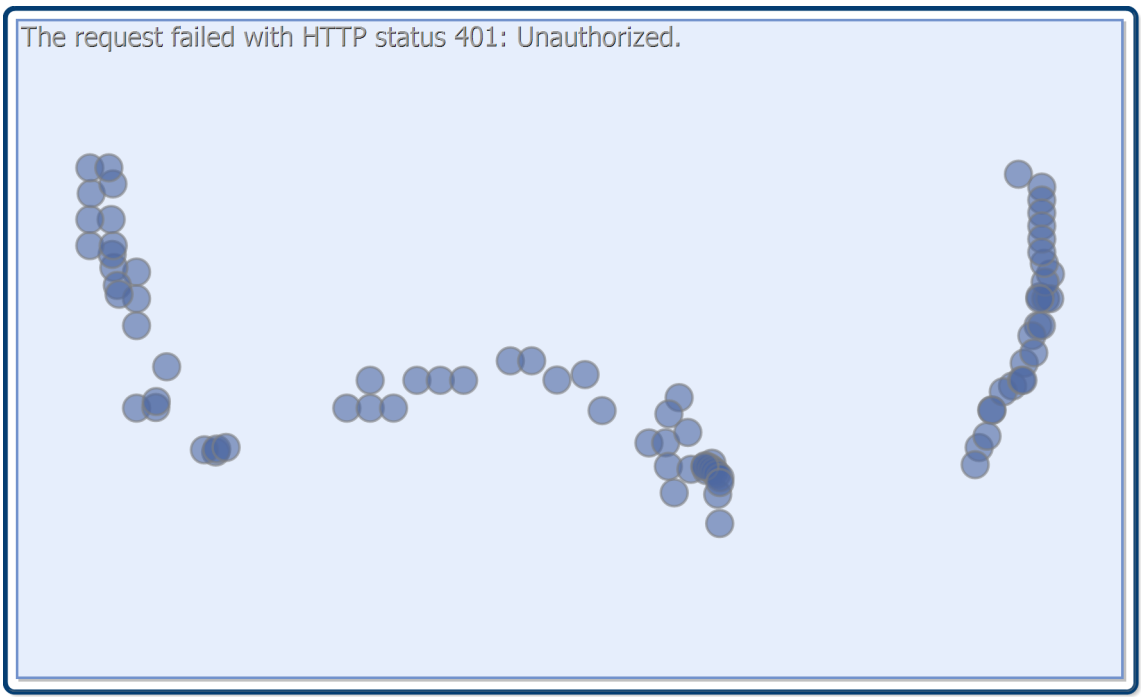
On the basis of the evidence provided above, Mulloway in Western Australia is classified as a **sustainable stock**.

BIOLOGY

Mulloway biology [Farmer 2008; Silberschneider and Gray 2008; Ferguson et al. 2014]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Mulloway	42 years, 1,750 mm TL	2–6 years, 510–1,070 mm TL

DISTRIBUTION



Distribution of reported commercial catch of Mulloway

TABLES

Fishing methods				
	New South Wales	Queensland	South Australia	Western Australia
Charter				
Hook and Line	✓	✓		✓
Commercial				
Gillnet			✓	✓
Hand Line, Hand Reel or Powered Reels				✓
Handline			✓	
Haul Seine	✓			✓
Hook and Line	✓			
Line		✓		✓
Mesh Net	✓			

Net		✓		
Seine Nets			✓	
Set longline			✓	
Unspecified			✓	
Various	✓			
Recreational				
Gillnet			✓	
Hook and Line	✓	✓	✓	✓
Spearfishing	✓	✓		

Management Methods				
	New South Wales	**Queensland**	**South Australia**	**Western Australia**
Charter				
Bag limits	✓	✓		✓
Gear restrictions	✓	✓		
Licence	✓			✓
Limited entry				✓
Marine park closures	✓		✓	✓
Passenger restrictions				✓
Possession limit	✓	✓		✓
Processing restrictions		✓		
Size limits	✓	✓		✓
Spatial closures	✓	✓		
Commercial				
Bycatch limits	✓			
Catch limits	✓			✓
Effort limits	✓		✓	✓
Gear restrictions	✓	✓	✓	✓
Harvest Strategy		✓	✓	
Limited entry	✓	✓	✓	✓

Marine park closures	✓		✓	
Processing restrictions		✓		
Size limits	✓	✓	✓	✓
Spatial closures	✓	✓	✓	✓
Vessel restrictions	✓			✓
Recreational				
Bag limits	✓	✓	✓	✓
Gear restrictions	✓	✓	✓	
Licence	✓			
Licence (boat-based sector)				✓
Marine park closures	✓		✓	✓
Possession limit	✓	✓		✓
Processing restrictions		✓		
Size limits	✓	✓	✓	✓
Spatial closures	✓	✓	✓	

Catch				
	New South Wales	**Queensland**	**South Australia**	**Western Australia**
Charter	229 individuals (in 2021–22)	1.28 t (in 2020–21)	Unspecified	0.7 t (in 2021–22)
Commercial	77.0668 t	7.4707 t	55.9537 t	6.09074 t
Indigenous	Unknown	Unknown	Unknown	Unknown
Recreational	55 t (in 2019–20)	Unknown	23.9 t (in 2021–22)	1 t (in 2020–21)

Western Australia – Recreational (Catch totals). Shore based catches are unknown, thus landings are likely to be underestimated.

Western Australia – Indigenous (Management Methods). Subject to the defence that applies under Section 211 of the *Native Title Act 1993* (Cth), and the exemption from a requirement to hold a recreational fishing licence, the non-commercial take by Indigenous fishers is covered by the same arrangements as that for recreational fishing.

Queensland – Indigenous (Management Methods). For more information see: https://www.daf.qld.gov.au/business-priorities/fisheries/traditional-fishing

Queensland – Commercial (Catch). Queensland commercial and charter data have been sourced from the commercial fisheries logbook program. Further information available through the QueenslandFisheries Summary Report https://www.daf.qld.gov.au/business-priorities/fisheries/monitoring-research/data/queensland-fisheries-summary-report.

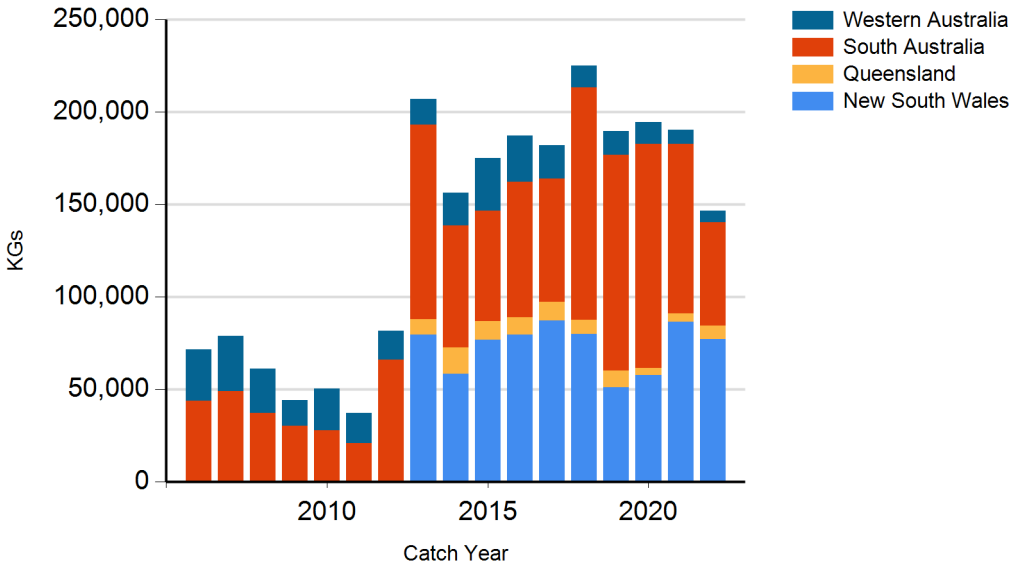
Queensland – Recreational Fishing (Catch). Data with high uncertainty (Residual Error >50 %) has been excluded and listed as unknown. More information available at: https://www.daf.qld.gov.au/business-priorities/fisheries/monitoring-research/monitoring-reporting/statewide-recreational-fishing-surveys

New South Wales – Commercial (Management Methods). Fishers using haul nets in the New South Wales commercial Ocean Hauling Fishery are permitted a bycatch allowance of 500 kg of Mulloway per day.

New South Wales – Recreational (Catch). Murphy et al. [2020], includes charter catch.

New South Wales – Indigenous (Management Methods). https://www.dpi.nsw.gov.au/fishing/aboriginal-fishing

CATCH CHART



Commercial catch of Mulloway - note confidential catch not shown

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