Snapper (2023)

Chrysophrys auratus

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STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Western Australia	Shark Bay Inshore Denham Sound	Sustainable	Catch, estimated biomass
Western Australia	Shark Bay Inshore Eastern Gulf	Sustainable	Catch, estimated biomass
Western Australia	Shark Bay Inshore Freycinet Estuary	Sustainable	Catch, estimated biomass
Western Australia	Shark Bay Oceanic	Recovering	Catch, CPUE, estimated biomass
Western Australia	South Coast	Sustainable	Catch, fishing mortality rate, spawning potential ratio
Western Australia	West Coast	Depleted	Catch, fishing mortality rate, spawning potential ratio
Queensland	Queensland	Depleted	Stock assessment, biomass, standardised catch rates, fishery-dependent length and age, fishery-independent recruitment index, catch, effort

New South Wales	New South Wales	Sustainable	Estimated biomass, standardized catch rates, catch, effort, size and age composition
Victoria, South Australia	Western Victoria	Sustainable	Catch, CPUE, pre-recruit survey, age and length composition
Victoria, Tasmania	Eastern Victoria	Undefined	Catch
South Australia	Gulf St. Vincent	Depleted	Catch, CPUE, age composition, fishery independent biomass survey, estimated biomass
South Australia	Spencer Gulf/West Coast	Depleted	Catch, CPUE, age composition, fishery independent biomass survey, estimated biomass

STOCK STRUCTURE

Snapper has a wide distribution in Australia, ranging from waters off the north coast of Western Australia, around the south of the continent, and up to northern Queensland around Hinchinbrook Island [Kailola et al. 1993]. Within this broad distribution, the biological stock structure is complex and there are considerable differences in the spatial scales over which populations are divisible into separate stocks.

Recent genetic studies of Snapper using microsatellite markers have led to a refined understanding of stock structure for the east Australian coast that have indicated greater complexity than previously thought. Snapper from Queensland to south coast New South Wales show little genetic differentiation and are considered to represent a single genetic stock [Morgan et al. 2019], consistent with earlier studies using allozymes [Sumpton et al. 2008]. This stock is referred to as the East Coast stock, with the Queensland and New South Wales components managed and assessed at the jurisdictional level. Snapper within the East Coast biological stock is thought to be largely resident; however, some individuals do move long distances [Sumpton et al. 2003; Harasti et al. 2015; Stewart et al. 2019]. The majority of commercial landings in New South Wales are thought to consist of fish that recruit from local estuaries [Gillanders 2002]. In addition to the limited mixing within the stock, key biological traits of Snapper (such as the size and age at maturity) vary with latitude [Stewart et al. 2010]. It is therefore appropriate to manage and report on stock status of the East Coast biological stock of Snapper at the jurisdictional level as Queensland and New South Wales jurisdictional stocks.

Snapper from eastern Victoria are now recognised as genetically differentiated from those that inhabit the southern coast of New South Wales, i.e. north of Eden [Morgan et al. 2019]. As such, Snapper from Wilsons Promontory to southern New South Wales are considered a separate biological stock that is referred to as the Eastern Victorian stock. Although there is low genetic variation between the eastern and western sides of Wilsons Promontory [Meggs and Austin 2003; Morgan et al. unpublished], separation between these populations has been supported by tagging and otolith chemistry studies [Coutin et al. 2003; Hamer et al. 2011]. Snapper to the west of Wilsons Promontory, including the important fisheries of Port Phillip Bay and Western Port, constitute the Western Victorian biological stock. This stock extends westward from Wilsons Promontory to near the mouth of the Murray River in south-eastern South Australia [Sanders 1974; Donnellan and McGlennon 1996; Hamer et al. 2011; Fowler et al. 2017].

The South Australian fishery was originally divided into six management units, due to uncertainty about movement among different regional populations [Fowler et al. 2013]. However, a recent study evaluated the stock structure and adult movement among regional

populations within South Australia and western Victoria [Fowler 2016; Fowler et al. 2017], based on inter-regional comparisons of otolith chemistry, otolith increment widths, and population characteristics. The study differentiated three stocks. The Western Victorian stock extends westward into south-eastern South Australia, and depends on recruitment into, and subsequent emigration from, Port Phillip Bay in Victoria. As such, this is a cross-jurisdictional stock, although the components from the two states are still managed independently. The two other stocks are wholly located within South Australia. The Spencer Gulf/West Coast stock depends on recruitment into Northern Spencer Gulf from where some fish eventually emigrate to replenish the populations of Southern Spencer Gulf and the west coast of Eyre Peninsula. The third is the Gulf St. Vincent stock, which relies on recruitment into Northern Gulf St. Vincent, and subsequent emigration to Southern Gulf St. Vincent and Investigator Strait [Fowler 2016; Fowler et al. 2017].

In Western Australia, Snapper is currently divided into six management units. At the smaller geographic scale inside Shark Bay within the Gascoyne bioregion, genetically related but biologically separate stocks have been identified in the Eastern Gulf, Denham Sound and Freycinet Estuary based on otolith microchemistry, tagging and egg/larval dispersal modelling [Johnson et al. 1986; Edmonds et al. 1999; Bastow et al. 2002; Moran et al. 2003; Nahas et al. 2003; Norriss et al. 2012; Gardner et al. 2017]. At the larger scale, Snapper in oceanic waters off the Western Australian coast that comprise the three remaining management units, i.e., Shark Bay Oceanic, West Coast and South Coast, show low levels of genetic differentiation over hundreds of kilometres consistent with gene flow that is primarily limited by geographic distance [Gardner and Chaplin 2011; Gardner et al. 2017; Bertram et al. 2022]. Recent analyses of single nucleotide polymorphisms (SNPs, neutral loci) identified genetic discontinuities between three broad-scale genetic stocks (i.e., upper west coast, lower west coast and south coast) [Bertram et al. 2022], however, differences in biological and fishery characteristics within these boundaries supports the need for assessments to be undertaken at finer spatial scales [Jackson et al. 2023]. Otolith microchemistry has indicated residency of adult Snapper in the Gascoyne, West and South Coast bioregions, but with recruitment likely coming from multiple nursery areas [Wakefield et al. 2011; Fairclough et al. 2013; Jackson et al. 2023]. Tagging studies support these findings with most adults tagged at the key spawning locations in the Gascoyne and West Coast bioregions recaptured within 100 km, as well as philopatry of adults that aggregate to spawn in embayments on the west coast [Moran et al. 2003; Wakefield et al. 2011; Crisafulli et al. 2019].

Here, assessment of stock status for Snapper is presented at the biological stock level—Shark Bay inshore Eastern Gulf, Shark Bay inshore Denham Sound, Shark Bay inshore Freycinet Estuary (Western Australia); Eastern Victoria (Victoria), Western Victoria (Victoria and South Australia), Gulf St Vincent, Spencer Gulf/West Coast (South Australia); the management unit level—South Coast, Shark Bay Oceanic and West Coast (Western Australia); and the jurisdictional level–Queensland and New South Wales.

STOCK STATUS

Eastern Victoria

Considerable overlap occurs between the Eastern and Western Victorian biological stocks of Snapper. Fish from the Western Victorian stock frequently migrate into the east, particularly following high recruitment [Bertram et al. 2023]. The Eastern Victoria stock also contains a large proportion (approximately 50%) of Snapper that are of mixed heritage between the Western Victorian and Eastern Australian stock, and also fish from the Eastern Australian stock [Bertram et al. 2023]. Given the apparent importance of localised spawning and recruitment, and sporadic recruitment in the Western Victorian stock that cannot be relied upon to replenish stocks in this area alone, the Eastern Victorian stock, extending from Wilson's Promontory to the New South Wales border, is managed as an individual stock in Victoria.

In this region, commercial harvests are mostly by Victorian and Commonwealth

licensed operators. Recreational fishing is also important and thought to be increasing, particularly in coastal waters between Lakes Entrance and Corner Inlet-Nooramunga where spawning aggregations are targeted on inshore reefs during the late spring/early summer.

Catch by the Victorian commercial sector is low relative to catches in the Western Victoria stock, averaging approximately 3.5 tonnes (t) per year since 2009–10, and rarely exceeding 5 t per year [Bell et al. 2023]. Catches by Commonwealth operators are higher, averaging approximately 14.5 t since 2009–10 [Bell et al. 2023]. Snapper is a by-product species in the Commonwealth fishery. Recreational catch is unknown and there are no time series of catch rates or length/age composition for the recreational fishery.

There is no published assessment of this stock and there are no data available to estimate biomass or exploitation rates. In addition, there is no knowledge of recruitment or harvestable biomass, and there are no defined target or limit reference levels. 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 presented above, the Eastern Victoria biological stock is classified as an **undefined stock.**

Gulf St. Vincent

The Gulf St Vincent (GSV) stock of Snapper includes two regional populations: Northern Gulf St Vincent (NGSV) and Southern Gulf St Vincent (SGSV). NGSV has recently supported the bulk of the biomass and is the primary nursery area for the stock [Fowler et al. 2016]. The population dynamics are driven by inter-annual variation in recruitment of the 0+ year class and subsequent southward migration from NGSV to SGSV.

The most recent assessment of the GSV stock was completed in October 2022 [Drew et al. 2022] and considered data up to January 2022. This assessment followed from the total closure of this fishery that was implemented on 1 November 2019. Stock status deteriorated from 2015 to 2020, despite the implementation of numerous fishery management changes between 2012 and 2016 to reduce the commercial catch and increase reproductive output to provide the opportunity for improved recruitment [Fowler et al. 2016, Fowler et al. 2019; Fowler et al. 2020].

For the recent stock assessment, stock status was determined using a weight-of-evidence approach that considered both fishery-dependent and fishery-independent information [Drew et al. 2022]. The fishery-dependent data were: commercial fishery statistics to November 2019 (i.e., total catch, effort and CPUE); recreational fishery data; and measures of recruitment developed from annual length and age structures. The fishery-independent data were regional estimates of spawning biomass in 2013, 2018, 2020 and 2022 determined using the daily egg production method (DEPM). All data sets were also integrated in a stock assessment model (SnapEst) that produced a time-series of annual estimates of output parameters that included: fishable biomass; recruitment; harvest fraction; and egg production.

Throughout the mid-2000s, the GSV stock produced the highest catches ever recorded in South Australia [Fowler et al. 2020]. Whilst catches were low between 1984 and 2006, they increased rapidly from 2006 to 2010, culminating in the record catch of 454 t in the latter year. Catches remained high until 2015. This period of high catches related, to some extent, to the transition from a

largely handline to a longline fishery, with the adoption of new monofilament longline equipment that increased fishing efficiency. Targeted longline effort and CPUE both increased rapidly between 2008 and 2010 to record levels and remained relatively high to 2015. Nevertheless, from 2015 to 2019, there were substantial declines in total catch, targeted longline catch, effort, CPUE, and the number of longline fishers targeting Snapper. These trends in the fishery statistics were consistent with an increase in biomass that was maintained until around 2015, followed by a rapid decline. Fishery-independent estimates of spawning biomass from applications of the DEPM in 2014, 2018, 2020, and 2022 support the decline in biomass from 2,780 t in 2014 to 404 t in 2022, despite an expansion of survey area in 2020 and 2022 [Drew et al. 2022].

Outputs from SnapEst show fishable biomass increased from a low level in the 1990s to a record level in 2011, before declining by 92% between 2011 and 2020. The estimate of fishable biomass in 2020 was 343 t, the lowest estimated value, which increased marginally to 368 t in 2022. The increasing trend in biomass through the 2000s reflected recruitment of numerous strong year classes (i.e., 1991, 1997, 1999, 2001, 2004, 2007 and 2009) to the population. The subsequent reduction in biomass related to relatively poor recruitment from 2009 to 2019, when catches remained high and harvest fractions increased. Model-estimated egg production in 2022 was 2% of that expected for an unfished stock. Average recruitment over the last three years was 90% lower than the historical level.

In 2020, the status of the GSV stock was changed from 'depleting' to 'depleted' [Fowler et al. 2020]. This change reflected the decline in spawning biomass estimated from DEPM surveys that had occurred since 2014, poor recruitment since 2009, and persistent high targeted fishery catch and effort. Multiple lines of evidence demonstrate that management has not yet resulted in measurable improvements, and the stock has continued to persist at low levels. These are: (i) poor recruitment between 2010 and 2019, despite the prominence of the 2014-year class in annual age structures from 2018 to 2022; (ii) continued low estimates of spawning biomass using the DEPM; and (iii) continued low estimates of fishable biomass and egg production from the stock assessment model [Drew et al. 2022].

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. Furthermore, current fishing mortality is constrained by management to a level that should allow the stock to recover from its recruitment impaired state; however, measurable improvements are yet to be detected.

On the basis of the evidence provided above, the Gulf St Vincent biological stock is classified as a **depleted stock**.

New South Wales

The most recent published stock assessment for East Coast Snapper that included data from 1880 to 2016 from the entire biological stock (Queensland and New South Wales) produced a range of relative biomass estimates that varied between 10 and 45% of unfished levels [Wortmann et al. 2018]. Model scenarios based on NSW data estimated that biomass in 2016 was between 20 and 45% of the virgin level [Wortmann et al. 2018]. Since 2016, the standardised catch rates for the main fishing method of fish trapping have increased slightly, noting a slight decrease in 2021–22 [Stewart 2023]. Harvest in NSW (all sectors) has remained reasonably stable averaging 345 t per year since 2016 [Stewart 2023]. Stable size compositions in commercial landings with associated increases in the range of ages supports an increase in stock

resilience. There are no indications that the stock has declined since 2016. The available evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired.

Commercial and recreational harvest and fishing effort are at historically low levels in New South Wales. Commercial landings during 2021–22 were approximately 170 t, lower than the 10-year average of 190 t, and substantially lower than during the early 1980s when commercial landings approached 1,000 t per year [Stewart 2023]. Recreational harvest in 2019–20 was estimated at around 160 t [Stewart 2023]. The number of days reported fish trapping when Snapper were landed has declined from around 5,000 in 2009–10 to less than 3,000 in 2021–22, largely due to management driven reforms to the sector [Stewart 2023]. Trends in the size and age compositions of landed catches suggest population rebuilding from around 2008 onwards, with gear selectivity driven stability in size compositions associated with continual increases in the range of ages of fish in commercial landings [Wortmann et al. 2018; Stewart 2023]. These lines of evidence support the population model estimates of an increasing biomass in recent times under existing levels of harvest. The above 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, Snapper in New South Wales is classified as a **sustainable stock**.

Queensland

The most recent integrated stock assessment for East Coast Snapper (Queensland and New South Wales; data from 1880 to 2016) [Wortmann et al 2018] predicted a range of relative spawning biomass estimates that varied between 10 and 45% of unfished levels. The annual age-structured model partitioned the fishery into four sectors: New South Wales trap; New South Wales commercial line and charter; Queensland commercial line and charter, and New South Wales and Queensland recreational. Most (93%) model outputs for line fishing methods estimated biomass to be at the lower end of this range, below 20% of unfished levels. In contrast, model scenarios using standardised New South Wales trap catch rates ranged between 20 and 45% of unfished levels, with most estimates being above 30%. Large differences in the spawning biomass estimates between these fisheries suggests that localised depletion is likely to have occurred in Queensland [Wortmann et al 2018].

Queensland harvest (commercial, charter, and recreational sectors combined) accounted for approximately one third of the East Coast Snapper stock in 2021–22, with the entire Queensland component taken by line fishing. Based on the relevant model scenarios for Queensland using line catch rates, the stock assessment estimated that the spawning biomass of the stock in 2016 was between 10 and 23% of the unfished biomass [Wortmann et al 2018]. Most of the outputs (51 of 55 scenarios) were below the limit threshold of 20% of unfished biomass. Standardised commercial catch rates declined further between 2016 and 2018 indicating a continued decline in abundance of Snapper [Wortmann 2020]. Standardised catch rates are not available for the current period. Fishery-dependent monitoring showed commercial and recreational length frequencies dominated by fish within the first 15 cm above minimum legal size (MLS) [QDAF 2023 Unpublished Data], a pattern which has been consistent since monitoring began in 2007. Fishery-dependent monitoring also showed truncated commercial and recreational age frequencies with declining proportions of larger fish observed since monitoring commenced (2007–21) [QDAF 2023 Unpublished Data]. Fishery-independent monitoring of pre-recruit Snapper in Moreton Bay showed annual variability with no distinct trend [QDAF

2023 Unpublished Data;; Bessell-Browne et al 2020]. Such inter-annual variation in pre-recruit abundance most likely reflects variation in egg and larval survivorship, which is mediated by egg production and the physical environment [Filar et al 2021, Fowler 2023]. Consequently, further research is needed to understand the contribution of pre-recruit Snapper in Moreton Bay to biological stock. There is no evidence to suggest the Queensland component of the biological stock is recovering, and therefore the stock is considered to be recruitment impaired.

Commercial harvest of Snapper in Queensland reduced by 75% from 61 t to 11 t between 2015–16 and 2021–22 and was 78% lower than the previous 10-year average [Fowler et al 2020]. Between 2015–16 and 2021–22 the contribution of the commercial sector to the total Queensland harvest reduced from approximately 45% to just 7%. Active commercial licences and fishing effort days have decreased by 44% and 63% respectively over the last decade. In 2021–22, the Charter sector harvested 19 t of Snapper, equating to approximately 12% of the estimated total Queensland harvest. Fifty-four charter licences fished 1,814 days in 2021–22, similar to the 10-year average. The estimated recreational harvest increased by 49% by number and 72% by weight from 2013–14 (51,402 fish; est. 74 t) to 2019–20 (76,715 fish; est. 127 t); however, catch rates declined over the same period [Webley et al 2015; Teixeira et al 2021].

Reconstructed total harvest history across the East Coast biological stock from the stock assessment showed high fishing pressure in the 1950s to 1990s (above levels to sustain BMSY). Modelling suggested that maintaining total harvest at 2016 levels will not rebuild stocks in Queensland, given the state of the stock and low estimated spawning ratios [Wortmann et al 2018]. From September 2019, Snapper in Queensland became a line caught only species, a total allowable commercial catch limit (42 t) was established, and a one month seasonal closure in July–August introduced. Recreational fishing is subject to a possession limit of four fish per person with only one over 700 mm in addition to a minimum legal size limit of 350mm that allows a proportion of mature fish to spawn before becoming available to the fishery.

Despite this suite of measures, the current management arrangements do not appear to have halted the decline in spawning biomass in Queensland [Campbell et al 2021].

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. Furthermore, the current level of fishing mortality is likely to continue to prevent the stock from recovering from its recruitment impaired state.

On the basis of the evidence provided above, Snapper in Queensland is classified as a **depleted stock**.

Shark Bay Inshore Denham Sound

Since 2003, there have been very conservative management arrangements and correspondingly low levels of catch from the Denham Sound biological stock. The commercial catch of Snapper has averaged around 1 t since 2003 and was less than 1 t in 2022, which was well below the target of less than 4 t. In 2022, the recreational catch, which included the charter sector, was estimated at approximately 6 t, which was well below the target of less than 12 t.

The most recent integrated model-based stock assessment that included data to 2015, indicated that spawning biomass in 2015 was well above the target

reference level of 40% of the unexploited spawning biomass [Jackson et al. 2015]. More recently, a Catch-MSY analysis using catch data from all sectors for the period from 1980 to 2019 produced an MSY-estimate of 12.87 t (95% CLs 10.15–15.36) (DPIRD unpublished data).

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 above 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, the Shark Bay Inshore–Denham Sound (Western Australia) biological stock is classified as a **sustainable stock**.

Shark Bay Inshore Eastern Gulf

Since 2003, there have been very conservative management arrangements and correspondingly low levels of catch from the Eastern Gulf biological stock. The commercial catch of Snapper has averaged less than 0.5 t since 2003 and was 0.5 t in 2022 (target of less than 4 t). In 2022, the recreational catch, which included the charter sector, in 2022 was approximately 2 t, which was well below the target of less than 12 t.

The most recent integrated model-based stock assessment included data to 2015 and indicated that spawning biomass in 2015 was well above the target reference point of 40% of the unexploited spawning biomass [Jackson et al. 2015]. In 2020, a Catch-MSY analysis using catch data from all sectors for the period from 1980 to 2019 produced an MSY-estimate of 24.50 t (95% CLs 17.18–35.12) (DPIRD unpublished data).

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 above 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, the Shark Bay Inshore–Eastern Gulf (Western Australia) biological stock is classified as a **sustainable stock**.

Shark Bay Inshore Freycinet Estuary

Since 2003, the commercial catch of Snapper from the Freyicent Estuary biological stock has been almost nil (target of approximately 1 t). In 2022, the recreational catch, which included the charter sector, was approximately 13 t, which was considerably higher than the target of less than 4 t. However, this level of fishing mortality is around the estimated mean Catch-MSY and is unlikely to cause the biological stock to become recruitment impaired.

The most recent integrated model-based stock assessment included data to 2015 and indicated that spawning biomass in 2015 was well above the target reference level of 40% of the unexploited spawning biomass [Jackson et al. 2015]. In 2020, a Catch-MSY analysis using catch data from all sectors for the period from 1980 to 2019 produced a MSY estimate of 13.86 t (95% CLs 10.83–16.86) (DPIRD unpublished data). Given the very conservative management arrangements that have been in effect since 2003, and the level of catches against the target ranges for much of the period since then (see below), the biological stock is not considered to be recruitment impaired.

On the basis of the evidence provided above, the Shark Bay Inshore–Freycinet Estuary (Western Australia) biological stock is classified as a **sustainable stock**.

Shark Bay Oceanic

InIn 2021–22, the commercial catch of Snapper from the Shark Bay Oceanic management unit was 42 t, which was below the TACC of 51 t. During the same period, the combined catch from the recreational and charter sectors was approximately 25 t. This level of fishing mortality, where total catch is maintained at less than 100 t, is expected to continue to assist the stock recovering to above the threshold level of 30% of unfished levels over the next five years (consistent with the Snapper Recovery Plan and Harvest Strategy).

The most recent integrated model-based stock assessment included commercial catch, catch rate and age composition data to the 2020–21 season and indicated that spawning biomass in 2021 had rebuilt to 0.27 of the unfished level (95% CLs, 0.13–0.42) [Jackson et al. 2023].

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. Although the current value of spawning biomass was below the threshold of 0.3, Shark Bay Oceanic Snapper is expected to recover to above this level over the next five years if the current low level of catch is maintained.

On the basis of the evidence provided above, Shark Bay Oceanic (Western Australia) management unit is classified as a **recovering stock**.

South Coast

The most recent stock assessment of Snapper on the south coast of Western Australia included data to 2014 and indicated that estimates of fishing mortality rate and spawning potential ratio were between the management target and threshold levels [Norriss et al. 2016]. The stock was not considered to be recruitment impaired. The assessment concluded there was no capacity for increased catches beyond historical levels before risk becomes unacceptable.

Annual commercial catches from 2015 to 2021 averaged 33 t compared with the average of 50 t during the preceding decade. The total commercial catch of Snapper from the South Coast management unit in 2022 was 27 t. The recreational catch in 2020–21 was aprroximately12 t. While there are no formal catch limits in place, the current catch levels are well within the historic range.

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 above 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, the South Coast (Western Australia) management unit is classified as a **sustainable stock**.

Spencer Gulf/West Coast

The Spencer Gulf/West Coast (SG/WC) stock encompasses the regional populations of Northern Spencer Gulf (NSG), Southern Spencer Gulf (SSG) and the west coast of Eyre Peninsula (WC) [Fowler et al. 2017]. NSG is the primary nursery area for the whole stock. The population dynamics are strongly driven by inter-annual variation in recruitment of the 0+ year class and subsequent emigration from NSG to adjacent regional populations [Fowler et al. 2017]. In particular, occasional strong year classes are evident in age compositions which contribute to population abundance, biomass and fishery productivity for many years [Fowler et al. 2016].

The most recent assessment of the SG/WC stock was completed in October2022

and considered data up to January 2022 [Drewet al. 2022]. This assessment followed from the total closure of this fishery that was implemented on 1 November 2019. Stock status deteriorated from 2012 to 2019, despite the implementation of significant management changes between 2012 and 2016 to reduce the commercial catch and increase reproductive output to provide the opportunity for improved recruitment [Fowler et al. 2016].

For the recent stock assessment, stock status was determined using a weight-of-evidence approach that considered both fishery-dependent and fishery-independent information [Drew et al. 2022]. The fishery-dependent data were: commercial fishery statistics to November 2019 (i.e., total catch, effort and CPUE); recreational fishery data; and measures of recruitment developed from annual length and age structures. The fishery-independent data were regional estimates of spawning biomass in 2013, 2018, 2019 and 2021 determined using the daily egg production method (DEPM). All data sets were also integrated in a stock assessment model (SnapEst), that produced time-series of annual estimates of output parameters that included: fishable biomass; recruitment; harvest fraction; and egg production.

Across the 36-year time-series of commercial fishery statistics from 1984 to 2019, estimates of total catch, effort and CPUE for the SG/WC stock have varied cyclically [Drew et al. 2022]. Nevertheless, from the mid-2000s, all commercial fishery statistics showed declining trends, with particularly significant drops since 2012. By 2019, most of these fishery performance indicators had declined to their historically lowest levels. Such trends are consistent with persistent declines in biomass. The results of the four applications of the DEPM supported the inference from the commercial fishery statistics that the spawning biomass of Snapper in NSG had further declined from a low level in 2013. The estimate in 2018 of 192 t was 23% lower than the estimate for 2013. The DEPM estimate for 2021 of 108 t represents further stock reduction despite the expansion in survey area considered in 2019 and 2021.

Recent age compositions for both NSG and SSG showed the lack of any strong recruitment year classes since 1999, suggesting that recruitment throughout the 2000s had been relatively weak. Age structures for the years of 2019, 2020 and 2021 showed the population in NSG was dominated by small, young fish that were up to seven years of age, with few older fish. Such age structures contrast with those from the 1990s and 2000s that included many fish greater than 20 years of age and some greater than 30 years old [Fowler et al. 2016]. These data show that the age structures for NSG are severely truncated and that recent recruitment has been low. For SSG, weak year classes in the age structures indicate that rates of migration from NSG have been poor, reflecting low recruitment to the latter region throughout the 2000s.

The estimates of fishable biomass from the SnapEst model declined year-to-year from 5,350 t in 2005 to 468 t in 2020, the lowest estimated value, and have increased marginally to 543 t in 2022. Model outputs indicate that this decline in fishable biomass relates to poor recruitment throughout the 2000s and 2010s and to increasing harvest fractions, related to the continued exploitation of a depleting stock. The model outputs also show that egg production in 2022 was 2% of that expected for an unfished stock and that average recruitment was 81% lower than the historical mean.

Overall, several independent datasets demonstrate that the fishable biomass and recruitment for the SG/WC stock are at historically low levels [Drew et al. 2022]. Indicators of low stock levels include: (i) low estimates of commercial catch, effort and CPUE prior to the fishery closure in 2019; (ii) the absence of large, old

fish in the population; (iii) lack of evidence for the recruitment of any new strong year classes for almost 20 years; and (iv) ongoing declines in spawning biomass, from the low level in 2013. The decline in biomass of the SG/WC stock has occurred over a number of years and has been apparent at the regional and biological stock levels since 2012 [Fowler et al. 2013]. The primary causes of the decline are poor recruitment since 1999, evident as the lack of strong year classes in annual age structures throughout the 2000s [Fowler et al. 2016, Fowler et al. 2019, Drew et al. 2022], coupled with ongoing fishing of a depleting stock.

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. Furthermore, current fishing mortality is constrained by management to a level that should allow the stock to recover from its recruitment impaired state; however, measurable improvements are yet to be detected.

On the basis of the evidence provided above, the Spencer Gulf/West Coast biological stock is classified as a **depleted stock**.

West Coast

Catches of Snapper in the West Coast Bioregion (Western Australia), which have primarily been retained by commercial line fishing, increased rapidly in the 1980s to a peak over 500 t in 1988. Annual catches have fluctuated widely as a result of variability in recruitment of this species, with subsequent minima and maxima of around 200 t and 400 t, respectively, in 1993 and 2004. Total Snapper catches of the commercial and recreational sectors have generally remained below 250 t since 2010, when significant management action was taken to reduce fishing effort and catch of demersal scalefish in the West Coast Bioregion. A 20-year recovery plan is in place to monitor the recovery of the West Coast Demersal Scalefish Resource (WCDSR). In addition to the periodic assessments of indicator species [Newman et al. 2018], annual reviews of retained catches and estimates of post-release mortality (PRM) for key species are also undertaken against recovery benchmarks for each sector to inform management of the resource [DPIRD 2021].

In the West Coast Bioregion, Snapper catches retained by the commercial and recreational fishing sectors in 2020–21 were 109 t and 80 t, respectively, with the latter comprising 52 t landed by private-boat-based fishers and 28 t landed by charter fishers [Ryan et al. 2022; Fisher et al. 2023]. The combined retained catch and estimated PRM (referred to hereafter as total fishing mortality) of Snapper by the commercial sector exceeded the original recovery benchmark for this species of 138 t from 2010 to 2014 but has been maintained below this benchmark level since additional management action was taken in 2015 to reduce effort entitlement in the Mid-west and Kalbarri management areas (133 t in 2021–22). Estimates of total fishing mortality of Snapper in the WCB by the recreational sector have exceeded the original recovery benchmark of 35 t in each survey year since the Statewide recreational fishing survey commenced in 2011–12 (96 t in 2020–21).

The last assessment of Snapper in the West Coast Bioregion was based on biological data collected up to 2017-18 and fishery information (e.g., catches) up to 2020 [Fairclough et al. 2021]. For the first time, the assessment applied an integrated stock assessment model that incorporates relevant biological and fishery information, catches from all fishing sectors, commercial catch rate data as an index of abundance, and age composition data sampled from the catch of commercial and recreational fishers. The model accounts for the PRM of fish that are selected by fishing gear but are not retained due to being below the

minimum legal length of 500 mm in the southern (South-West and Metropolitan) management areas, and 410 mm in the northern (Mid-West and Kalbarri) management areas.

The 2021 assessment of Snapper in the West Coast Bioregion estimated that spawning biomass (*B,* relative to unfished levels) in 2020 was just below the limit reference point of 0.2 [Fairclough et al. 2021]. While the estimated *B* for the combined southern management areas in 2020 was more optimistic than that for the combined northern management areas, it was only slightly above the limit reference point. The model outputs show that the decline in *B* at the bioregion level has been halted since management action was taken between 2007 and 2010 to reduce catches, however, there was limited recovery by 2020. Model projections based on future catches being equivalent to the original catch limits (recovery benchmarks) outlined in the harvest strategy demonstrated that *B* at the bioregion level would unlikely rebuild stocks to above the threshold by 2030.

Catch curve estimates of long-term, average fishing mortality (*F*) for fully-selected Snapper, calculated from age composition data from 2015–16 to 2017–18 using a model that accounts for recruitment variability [Fisher 2013], were above the limit reference level of 1.5 times the value of natural mortality (*M*) in the Metropolitan, Mid-West and Kalbarri management areas [Fairclough et al. 2021]. The estimated *F* for the South-West area was between the limit and the threshold level of *M*. These results, and the continued low proportion of older (greater than10 years) Snapper in the West Coast Bioregion, indicate that fishing pressure has remained too high, particularly in the Metropolitan, Mid-West and Kalbarri management areas.

Following a review of the 2021 assessment outputs against the WCDSR Harvest Strategy [DPIRD 2021], management action was taken in February 2023 to reduce the original recovery benchmarks for the demersal suite and key species by 50% for both sectors. The indicator species approach is based on management being focused on species at highest risk to further depletion, to ensure the WCDSR is sustainably fished [Newman et al. 2018]. Although action has been taken to reduce the recovery benchmarks for Snapper in the West Coast Bioregion (to 69 t commercial and 17.5 t recreational, comprising both retained catches and PRM), there is not yet any evidence to show that the new management arrangements have reduced the total fishing mortality to the levels required to rebuild Snapper stocks by 2030.

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. Furthermore, the above evidence indicates that current fishing mortality levels are expected to prevent the stock recovering from a recruitment impaired state.

On the basis of the evidence provided above, the Snapper West Coast (Western Australia) management unit is classified as a **depleted stock**.

Western Victoria

Assessment of the stock is based on consideration of catch-per-unit-effort (CPUE), and fishery-independent trawl surveys of pre-recruit (young-of-the-year) abundance in Port Phillip Bay, the main spawning and nursery area for the stock [Hamer et al. 2011]. Although this stock extends throughout the coastal waters of central/western Victoria and south-east South Australia, the main indicator data are derived from the major bay fisheries in Victoria: Port Phillip Bay and Western Port.

Most of the commercial harvest comes from Port Phillip Bay and has dropped considerably since 2010–11, with recent harvests of around, or less than 50 t per year, being among the lowest recorded since 1978 [Bell et al. 2023]. Since 2009–10 harvests by non-Victorian licensed operators from the western stock region have also declined to very low levels due to inter-jurisdictional agreements [Bell et al. 2023]. Commercial net fishing in Port Phillip Bay has now ceased due to buy-outs and long-line effort has reduced substantially in recent years due to a reduction of licences and the introduction of quota management [Bell et al. 2023]. The most recent estimate of recreational landings was 561 t in 2010.

Standardised CPUE of adult Snapper by the Port Phillip Bay commercial long-line fishery and recreational anglers (October to December creel surveys) has decreased since the late 2000s–early 2010s in Port Phillip Bay [Bell et al. 2023]. The decrease in the recreational catch rate in Port Phillip Bay was rapid from 2013 to 2014 but has since stabilised, with slight improvement in 2021–22. The decline in standardised commercial long-line CPUE has not been as rapid as for anglers, likely representing the superior skill and experience of the few remaining commercial longline fishermen [Bell et al. 2023]. Standardised CPUE for recreational anglers in Western Port for the October-December period has followed a similar trend to Port Phillip Bay, though the decline has been greater and has not increased in 2021–22 [Bell et al. 2023]. The decline in abundance of adult Snapper is in agreement with pre-recruit surveys whereby very high recruitment in the early 2000s resulted in very high abundance through until the early 2010s, and reduced recruitment from 2006–17 has seen the biomass of the stock reduce.

Catch rates from January to May provide information on the passage of juvenile and sub-adult cohorts in the fishery and are therefore inherently variable, reflecting the passage of weaker and stronger cohorts through the fishery. Standardised CPUE for the recreational creel surveys in January–May have increased in both Port Phillip Bay and Western Port over the last two years as the very strong 2018 cohort entered the fishery [Bell et al. 2023].

The rapid drop in recreational CPUE from 2013 to 2014 indicates that depletion of strong cohorts has been occurring. Nevertheless, fishery performance remains reasonable for both commercial and recreational fisheries and it was anticipated that the stock would enter a period of lower abundance following the abovementioned eleven years of reduced recruitment. The third highest recruitment event was recorded in 2022 and is predicted to drive further rebuilding of adult biomass and improved fishery performance over the next 5–10 years [Bell et al. 2023]. Length compositions are not showing signs of truncation, and commercial fishing pressure has reduced substantially in recent years due to the Port Phillip Bay buy-outs and reduced targeting by South Australian and Commonwealth operators due to various inter-jurisdictional agreements.

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

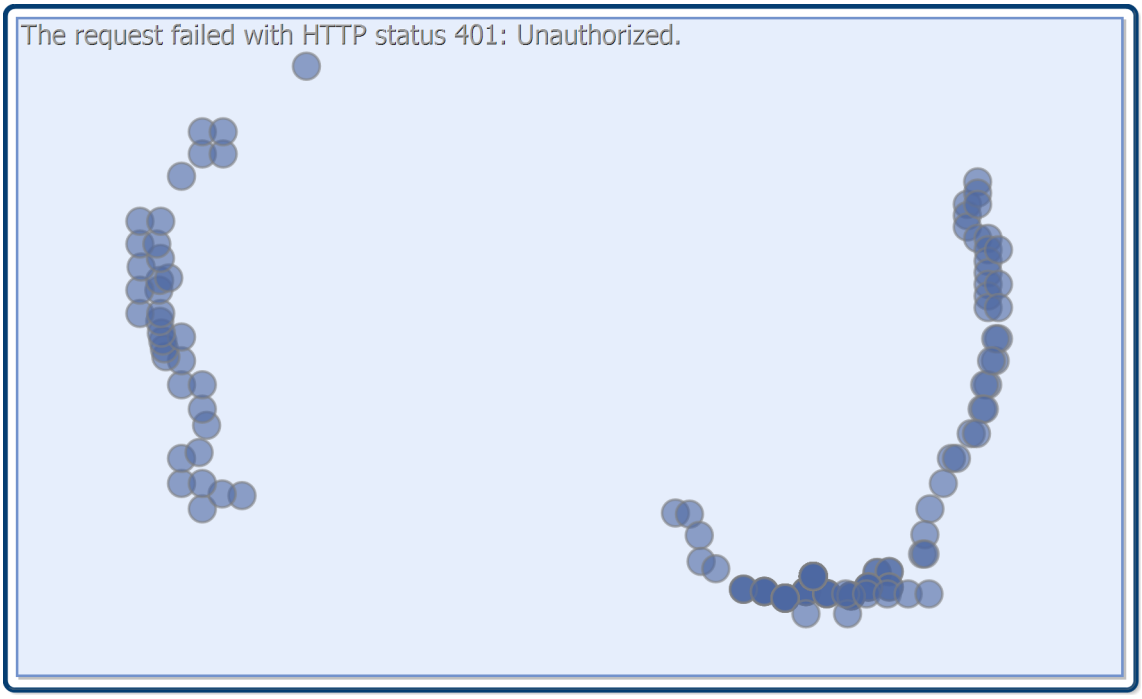
On the basis of the evidence provided above, the Western Victorian biological stock is classified as a **sustainable stock.**

BIOLOGY

Snapper biology [Jackson et al. 2010, Stewart et al. 2010; Wakefield et al. 2015; Fowler et al. 2016; Wakefield et al. 2016; Jackson et al. 2023]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Snapper	30–40 years, 1300 mm TL	2–7 years, 220–560 mm TL

DISTRIBUTION



Distribution of reported commercial catch of Snapper

TABLES

Fishing methods					
	New South Wales	Queensland	South Australia	Tasmania	Victoria
Charter					
Hook and Line	✓	✓	✓		✓
Rod and reel					
Spearfishing					
Commercial					
Beach Seine					
Demersal Longline	✓				
Dropline	✓				
Fish Trap	✓				
Gillnet					

Western Australia
✓
✓
✓
✓
✓
✓
✓

Hand Line, Hand Reel or Powered Reels					
Handline			✓		
Haul Seine					
Hook and Line	✓				✓
Line		✓			
Longline (Unspecified)					
Net		✓			✓
Otter Trawl	✓				
Set longline			✓		
Squid Jigging					
Traps and Pots					✓
Unspecified			✓	✓	
Various	✓				
Recreational					
Hook and Line	✓	✓	✓		✓
Spearfishing	✓	✓	✓		✓

Management Methods					
	New South Wales	Queensland	South Australia	Victoria	Western Australia
Charter					
Bag and possession limits	✓			✓	
Bag limits	✓		✓		
Boat limits		✓			
Gear restrictions	✓	✓	✓	✓	
Licence	✓			✓	✓
Marine park closures	✓			✓	
Possession limit		✓			
Processing restrictions		✓			

✓
✓
✓
✓
✓
✓

Seasonal closures			✓		
Seasonal or spatial closures		✓			
Size limit	✓	✓	✓	✓	
Spatial closures	✓		✓		
Commercial					
Catch limits			✓	✓	✓
Gear restrictions	✓	✓	✓	✓	✓
Licence				✓	
Limited entry	✓	✓	✓	✓	✓
Marine park closures	✓			✓	
Processing restrictions		✓			
Seasonal closures			✓		
Seasonal or spatial closures		✓			
Size limit	✓	✓	✓	✓	✓
Spatial closures	✓		✓	✓	✓
Total allowable catch		✓		✓	
Vessel restrictions	✓				
Recreational					
Bag and boat limits			✓		✓
Bag and possession limits	✓				
Bag limits	✓			✓	
Boat limits		✓			
Catch limits					✓
Gear restrictions	✓	✓	✓	✓	✓
Licence	✓			✓	✓
Marine park closures	✓			✓	

Possession limit		✓			✓
Processing restrictions		✓			
Seasonal closures			✓		✓
Seasonal or spatial closures		✓			
Size limit	✓	✓	✓		✓
Size limits				✓	
Spatial closures	✓		✓	✓	✓

Catch					
	New South Wales	**Queensland**	**South Australia**	**Tasmania**	**Victoria**
Charter					
Commercial	159.557 t	10.9883 t	24.9862 t	0 t	53.9264 t
Indigenous	Unknown	Unknown	Unknown		Unknown (No catch under permit)
Recreational	159 t (2019–20)	85 t (2013–14)	332 t (2013–14)		Approximately 600 t (2006–07)

Western Australia
39 t (2021–22)
162.325 t
Unknown
79 t (2020–21) (all stocks/management units combined)

Western Australia - Recreational (Catch). Ryan et al. 2022.

Western Australia – Recreational (Management Methods) In Western Australia, total recreational catch limits (that is, maximum catch limits) have been applied to stocks of Snapper in inner Shark Bay and the West Coast, to aid recovery of stocks.

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

Queensland – Recreational Fishing (Catch). Data are based at the whole of Queensland level and derived from statewide recreational fishing surveys. Where possible, estimates have been converted to weight (tonnes) using best known conversion multipliers. Conversion factors may display regional or temporal variability. In the absence of an adequate conversion factor, data presented as number of fish.

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

Queensland – Commercial (Management Methods). Recent management changes are available at https://www.daf.qld.gov.au/business-priorities/fisheries/sustainable/legislation and harvest strategy information is available at https://www.daf.qld.gov.au/business-priorities/fisheries/sustainable/harvest-strategy

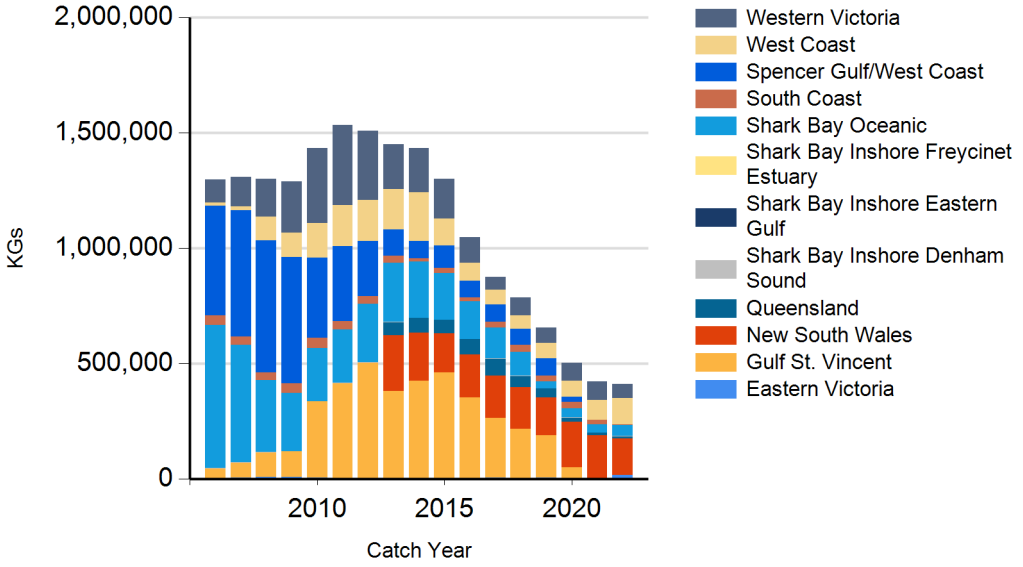
New South Wales – Recreational (Catch). Murphy et al. 2022; Stewart 2023.

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

Victoria – Indigenous (Management Methods). A person who identifies as Aboriginal or Torres Strait Islander is exempt from the need to obtain a Victorian recreational fishing licence, provided they comply with all other rules that apply to recreational fishers, including rules on equipment, catch limits, size limits and restricted areas. Traditional (non-commercial) fishing activities that are carried out by members of a traditional owner group entity under an agreement pursuant to Victoria's *Traditional Owner Settlement Act 2010* are also exempt from the need to hold a recreational fishing licence, subject to any conditions outlined in the agreement. Native title holders are also exempt from the need to obtain a recreational fishing licence under the provisions of the Commonwealth's *Native Title Act 1993*.

South Australia – Recreational (Catch). Beckmann et al. 2023.

CATCH CHART



Commercial catch of Snapper - note confidential catch not shown

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