Snapper (2020)

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	Depleted	Catch, CPUE, estimated biomass
Western Australia	South Coast	Sustainable	Catch, fishing mortality rate, spawning potential ratio
Western Australia	West Coast	Recovering	Catch, fishing mortality rate, spawning potential ratio
Queensland	Queensland	Depleted	Estimated biomass, standardised catch rates, length and age composition, fishing mortality rate, catch, effort, CPUE
New South Wales	New South Wales	Sustainable	Estimated biomass, standardized catch rates, catch, effort, size and age composition
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
South Australia	Western Victoria	Sustainable	Catch, CPUE, pre-recruit survey, age and length composition

STOCK STRUCTURE

Snapper has a wide distribution in Australia, 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.

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 central 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 are 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 now 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 and increment widths, as well as population characteristics. The study differentiated three stocks. The Western Victorian stock, which extends westward into south-eastern South Australia, 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 stock 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 (microsatellites) over hundreds of kilometres consistent with a semi-continuous genetic stock where gene flow is primarily limited by geographic distance [Gardner and Chaplin 2011, Gardner et al. 2017]. 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]. Tagging studies support these findings with the majority of 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]. A current FRDC project is using genomics, otolith microchemistry and ocean circulation modelling to better understand Snapper stock connectivity in oceanic waters off the Gascoyne and West Coast.

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

The Eastern Victorian biological stock extends from Wilsons Promontory into southern New South Wales [Morgan et al. unpublished]. In this region commercial harvests are mostly by Victorian and Commonwealth licensed operators. Recreational fishing is also important and thought to be growing, 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 t per year since 2009–10, and rarely exceeding 5 t per year [Conron et al. 2020]. Catches by Commonwealth operators are higher, averaging approximately 14.5 t since 2009–10 [Conron et al. 2020]. Snapper is a byproduct species in the Commonwealth fishery. Due to the low and sporadic catches, and lack of any notable targeted commercial fishery, there is no reliable information on biomass trends from fishery dependent catch and effort data for the Eastern Victorian biological stock. Recreational catch is also unknown and there are no time series of catch rates or length/age composition for the recreational fishery.

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 GSVS of Snapper was completed in August 2020 [Fowler et al. 2020], which considered data up to December 2019. This assessment followed from the total closure of this fishery that was implemented on the 1[st] of November 2019. Stock status has deteriorated since 2015, despite the implementation of numerous fishery management changes between

2012 and 2016 to reduce the commercial catch and to 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, the primary fishery performance indicators considered were: total catch, effort and CPUE from commercial fishers; regional estimates of spawning biomass in 2013, 2018 and 2020 determined using the daily egg production method (DEPM); and measures of recruitment strength from annual age compositions, determined from commercial market sampling [Fowler et al. 2020]. All data sets were also integrated in a computer stock assessment model (SnapEst) that produced 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 relates, to some extent, to the transformation from a largely handline to a longline fishery, with the adoption of new longline technology that increased the efficiency of fishing. Targeted longline effort and CPUE both increased rapidly between 2008 and 2010 to record levels and also remained relatively high to 2015. Nevertheless, since 2015, there have been substantial declines in total catch, targeted longline catch, effort, CPUE, and the number of longline fishers targeting Snapper. These trends in the fishery statistics are 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 and 2020 confirm the decline in biomass, from 2,780 t in 2014 to 811 t, despite an expansion of survey area in 2020 [Fowler et al. 2020].

Outputs from SnapEst show fishable biomass increased from a low level in the 1990s to a record level in 2011, before declining by 90% between 2011 and 2020. The estimate of fishable biomass in 2020 was 456 t, the lowest estimated value. The increasing trend in biomass through the 2000s reflected recruitment of numerous strong year classes (1991, 1997, 1999, 2001, 2004, 2007 and 2009) to the population. The subsequent reduction in biomass related to relatively poor recruitment from 2009 to 2017, when catches remained high and harvest fractions increased. Model-estimated egg production in 2020 was 2% of that expected for an unfished stock. Average recruitment over the last three years was 88% lower than the historical level.

In 2019, the status of the GSV stock was changed from 'sustainable' to 'depleting' [Fowler et al. 2019]. 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. The evidence in 2020 demonstrated ongoing deterioration of this stock: (i) commercial fishery statistics show further decline in 2019; (ii) the 2020 DEPM estimate confirmed the low level of spawning biomass; (iii) poor recruitment between 2010 and 2017, despite a moderate year class in 2014; and (iv) model-estimated fishable biomass and egg production have declined since 2011, and were at their lowest levels in 2020.

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. The above evidence indicates that the current fishing mortality is constrained by management to a level that should allow the stock to recover from its recruitment impaired state; however, measureable 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 integrated stock assessment for East Coast Snapper [Wortmann et al. 2018] 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 per cent and 45 per cent of unfished levels. However, the majority of harvest from the East Coast stock occurs in New South Wales waters, with more than 80 per cent of the commercial harvest being taken in New South Wales since the 1980s [Wortmann et al. 2018], mostly in the trap fishery. The New South Wales recreational harvest is also larger than the recreational harvest in Queensland [West et al. 2015, Murphy et al. 2020].

This high relative harvest in New South Wales, in combination with the limited movement of East Coast Snapper [Sumpton et al. 2003, Harasti et al. 2015, Stewart et al. 2019] supports the indices of relative abundance derived from the New South Wales trap fishery as being most likely to represent the New South Wales stock. Based on the most suitable model scenarios for New South Wales, the stock assessment estimated that biomass in 2016 was between 20 and 45 per cent of the virgin level [Wortmann et al. 2018]. Standardized catch rates in NSW since 2016 have increased slightly, despite a slight decrease during 2018-19 [Stewart 2020]. 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 catch and fishing effort are at historically low levels in New South Wales. Commercial landings during 2018–19 were approximately 160 t, lower than the 10-year average of 222 t, and substantially lower than during the early 1980s when commercial landings approached 1 000 t per year [Stewart 2020]. The number of days reported fish trapping when Snapper were landed has declined from 4 790 in 2009–10 to approximately3 000 in 2018–19, largely due to management driven reforms to the sector [Stewart 2020]. The recreational harvest of Snapper in New South Wales has declined from approximately 250 000 fish in 2000–01 to 185 000 fish during 2013–14 to 157 000 fish during 2017-18 (noting this recent estimate is limited to households within which recreational fishing licence holders reside), and effort also declined markedly during this period [West et al. 2015, Murphy et al. 2020]. Trends in the size and age compositions in landed catches suggest population rebuilding from around 2008 onwards, with continual increases in the average sizes and ages of fish in commercial landings [Wortmann et al. 2018, Stewart 2020]. This supports the population model estimates of an increasing biomass in recent times under existing levels of harvest. Further supporting an increase in biomass, age ranges have increased within any given size class, particularly those sizes vulnerable to fish trapping. 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 [Wortmann et al. 2018] (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 per cent 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. The majority of model outputs (93 per cent) for all line-fishing sectors estimated biomass to be at the lower end of this range at below 20 per cent of unfished levels. In contrast, model scenarios using standardised New South Wales trap catch rates ranged between 20 per cent and 45 per cent of unfished levels, with most estimates being above 30 per cents.

Queensland harvests (recreational, charter and commercial sectors combined) approximately one third of the east coast Snapper stock with nearly all of the

Queensland harvest (94 per cent) taken by line fishing. Based on the relevant model scenarios for Queensland using line catch rates, the stock assessment estimated the spawning biomass of the stock in 2016 at between 10 per cent and 23 per cent of the virgin level. The majority of these outputs (51 of 55 scenarios) were below the limit threshold of 20 per cent of unfished biomass. Standardised commercial catch rates have declined further since 2016 indicating a continued low abundance of snapper [Wortmann 2020]. Fishery-dependent biological monitoring showed truncated commercial and recreational age frequencies with declining proportions of larger fish over the duration of the monitoring program (2007–2019). Fishery-independent monitoring of pre-recruit snapper in the Moreton Bay portion of the stock showed the average number of pre-recruits has been variable since 2007 when the stock was considered overfished [Bessell-Browne et al. 2020]. There is no evidence to suggest the biomass of the Queensland component of the biological stock is recovering. The stock is therefore considered to be recruitment impaired.

Commercial harvest of Snapper in Queensland in 2019 was 25 t; a level approximately 19 t (44 per cent) lower than 2016 and 63 per cent lower than the previous 10 year average [QFISH 2020, Fowler et al. 2018]. The number of active line commercial fishing licences (- 32 per cent) and line fishing effort days (- 47 per cent) have continued to decrease over the last decade, indicating a reduction in commercial fishing pressure. The estimated recreational harvest increased by 49 per cent by number and 72 per cent by weight from 2013–14 (around 56 000 fish; est. 80 t) to 2019–2020 (around 83 000 fish; est. 138 t), however catch rates declined over the same period [Taylor et al. 2012, Webley et al. 2015, QDAF In prep.].

Reconstructed total harvest history across the whole eastern 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 2017 levels will not rebuild stocks in Queensland, given the likely depleted state of the stock and low estimated spawning ratios. From 1 September 2019, Snapper in Queensland became a line-caught only species, a total allowable commercial catch limit (42 tonnes) established, and a one month seasonal closure in July-August introduced. Recreational fishing is subject to a possession limit of four fish per person (only one over 700 mm). Fishing pressure is further regulated by a minimum legal size which allows a proportion of mature fish to spawn before becoming available to the fishery. These measures should help reduce fishing mortality of Snapper in Queensland, and support stock recovery from its recruitment impaired state, however it is too early for these to have an effect on the depleted status classification.

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

Shark Bay Inshore Denham Sound

The most recent integrated model-based stock assessment (completed in 2015) that included data to 2012, indicated that spawning biomass at that time was well above the management target of 40 per cent of unfished biomass [Jackson et al. 2015]. More recently (2020), a Catch-MSY analysis using catch data (all sectors) for the period 1980-2019 produced an MSY-estimate of 12.87 t (95% CLs 10.15-15.36) (DPIRD unpublished data). Given the very conservative management arrangements that have been in effect since 2003, and the corresponding low level of catches against the target ranges (see below), the biological stock is not considered to be recruitment impaired.

The commercial catch of Snapper from the Denham Sound biological stock was < 1 t in 2019, well within the target range of < 4 t. The recreational catch (including charter sector) in 2018/19 was around 6 t, well within the target range of < 12 t. This level of fishing mortality is unlikely to cause the biological stock to become recruitment impaired.

On the basis of the evidence provided above, the Shark Bay Inshore–Denham

Sound (Western Australia) biological stock is classified as a **sustainable stock**.

Shark Bay Inshore Eastern Gulf

The most recent integrated model-based stock assessment (completed in 2015) that included data to 2012, indicated that spawning biomass at that time was well above the management target of 40 per cent of unfished biomass [Jackson et al. 2015]. More recently (2020), a Catch-MSY analysis using catch data (all sectors) for the period 1980-2019 produced an MSY-estimate of 24.50 t (95% CLs 17.18-35.12) (DPIRD unpublished data). Given the very conservative management arrangements that have been in effect since 2003, and the corresponding low level of catches against the target ranges (see below), the biological stock is not considered to be recruitment impaired.

The commercial catch of Snapper from the Eastern Gulf biological stock was nil in 2019 (target range of < 4 t). The recreational catch (including charter sector) in 2018/19 was around 2 t, well within the target range of < 12 t. This level of fishing mortality is unlikely to cause the biological 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

The most recent integrated model-based stock assessment (completed in 2015) that included data to 2013, indicated that spawning biomass was well above the management target of 40 per cent of unfished biomass [Jackson et al. 2015]. More recently (2020), a Catch-MSY analysis using catch data (all sectors) for the period 1980-2019 produced an 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 corresponding low level of catches against the target ranges (see below) for much of the period since then, the biological stock is not considered to be recruitment impaired.

The commercial catch of Snapper from the Freycinet Estuary biological stock was nil in 2019 (target range around 1 t). The recreational catch (including charter sector) in 2018/19 was around 13 t, considerably higher than the target range of < 4 t. This level of fishing mortality however is around the estimated mean Catch-MSY and is unlikely to cause the biological stock to become 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

The most recent integrated model-based stock assessment (completed in 2017) that included data to the 2015/16 season indicated that spawning biomass in 2015 was around the management limit level of 20 per cent of the unfished biomass [Jackson et al. 2020]. The stock is considered to be recruitment impaired. Management action was taken in 2018 to reduce fishing mortality (TACC reduced to 51 t) and protect spawning aggregations (northern Bernier Island closed area June-August inclusive).

The commercial catch of Snapper from the Shark Bay Oceanic management unit in the 2018–19 season was 45 t which is below the TACC (51 t). The recreational catch (includes charter) in 2017/18 was around 25 t. This level of fishing mortality where total catch is reduced to 20-25% of the pre-2007 level is expected to assist the stock recovering from its recruitment impaired state. The model-based stock assessment will be updated in 2022 and will include catch and biological data to the 2020/21 season.

On the basis of the evidence provided above, Shark Bay Oceanic (Western

Australia) management unit is classified as a **depleted stock**.

South Coast

The most recent (completed in 2015) stock assessment of Snapper on the south coast of Western Australia [Norriss et al. 2016] that included data to 2014 indicated that estimates of fishing mortality rate and spawning potential ratio were between the management target and threshold levels. The stock is not considered to be recruitment impaired.

The total commercial catch of Snapper from the South Coast management unit in 2019 was 38 t. The recreational catch in 2017/18 was around 10 t. While there are no formal catch limits in place, under the current catch levels that are well within the historic range, the level of fishing mortality, estimated to be above the reference level (i.e. F=M), 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 provides 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, and contribute to population abundance, biomass and fishery productivity for many years [Fowler et al. 2016].

The most recent assessment of stock status was completed in August 2020, having considered data up to December 2019 [Fowler et al. 2020]. This assessment followed from the total closure of this fishery that was implemented on the 1[st] November 2019. Stock status had deteriorated since 2012, despite the implementation of significant management changes between 2012 and 2016 to reduce the commercial catch and to increase reproductive output to provide the opportunity for improved recruitment [Fowler et al. 2016].

For the recent stock assessment, the primary fishery performance indicators considered were: total catch, effort and CPUE from commercial fishers; regional estimates of spawning biomass in 2013, 2018 and 2019 determined using the daily egg production method; and measures of recruitment strength from annual age compositions, determined from commercial market sampling. All data sets were also integrated in a computer 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 over time [Fowler et al. 2020]. 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 three applications of the DEPM confirmed 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 2019 of 177 t represents further stock reduction due to the large expansion in the surveyed area considered in 2019.

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 2017, 2018 and

2019 show the population in NSG was dominated by small, young fish that were up to five years of age, with few older fish. Such age structures contrast with historical ones that included many fish >20 years of age and some >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. Model outputs indicate that this decline in fishable biomass relates to poor recruitment throughout the 2000s and to increasing harvest fractions, related to the continued fishing of a depleting stock. The model outputs also show that egg production in 2019 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 [Fowler et al. 2020]. Indicators of low stock levels include: (i) low estimates of commercial catch, effort and CPUE; (ii) the absence of large, old fish in the population; (iii) lack of evidence for the recruitment of any new strong year classes; 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. 2016a, Fowler et al. 2019], 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. The above evidence indicates that the current fishing mortality is constrained by management to a level that should allow the stock to recover from its recruitment impaired state; however, measureable 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

Four assessments completed between 2007 and 2017, based on catch curve analyses of age composition data, indicated that fishing mortality rate (*F)* in the West Coast management unit of Western Australia exceeded the limit reference point of 1.5 times the natural mortality rate [Wise et al. 2007,Fairclough et al. 2014]. Significant changes were made to the management of the commercial and recreational sectors between 2007 and 2010 to recover stocks, in response to the high fishing mortality rates. To reduce fishing mortality to a level that would allow the stock to recover, the total retained catch of Snapper by all sectors had to be reduced by at least 50 per cent, to no more than 163 t. Catches of Snapper by the commercial West Coast Demersal Scalefish Interim Managed Fishery in this region were above the acceptable level of 120 t for the commercial fishery between 2011 and 2014. Catches of Snapper by the recreational sector recently exceeded the acceptable level of 37 t [Fairclough et al. 2020]. Further management action was taken, which reduced annual commercial catches to less than 90 t [Fairclough et al. 2020], a level expected to allow recovery to continue. Unit entitlements were also reduced for the WCDGDLIMF to limit commercial Snapper catches. Retained catches of Snapper by the recreational sector have exceeded the acceptable level of 37 t since 2011/12 and high releases rates (71% of fish caught in 2017/18) may be resulting in additional fishing mortality (Ryan et al. 2019, Fairclough et al. 2020).

An assessment in 2017 (based on age structure data from 2012–14) indicated that *F* was above the limit and spawning potential ratio (SPR) was between the limit and threshold reference points of SPR = 0.2–0.3. However, *F* had

decreased from that derived from the previous period of age structure data in 2009–11 [Fairclough et al. 2020]. Additional estimates of *F* were derived from the same age structures using a method that allows for a change in fishing mortality, i.e. for cohorts that have recruited to the fishery pre- and post-management changes commencing in 2008 [Fisher 2013]. This demonstrated that *F* estimates were lower for age classes recruited to the fishery after management changes vs those that had recruited before, i.e. $F = 0.14$ vs 0.27, demonstrating that there was a reduction in recent fishing mortality. The above evidence indicates that current fishing mortality is constrained by management to a level that should allow the stock to recover from its recruitment impaired state.

On the basis of the evidence provided above, the West Coast (Western Australia) management unit is classified as a **recovering 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 [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 harvests are from Port Phillip Bay and have dropped considerably since 2010-11, with recent harvests of less than 50 t/yr being among the lowest recorded since 1978 [Conron et al. 2020]. 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 [Conron et al. 2020]. Commercial effort using haul seine is now very low due to removal of most of the netting from Port Phillip Bay and long-line effort has reduced substantially in recent years due to a reduction of licences and the introduction of catch caps [Conron et al. 2020]. There is no recent information on recreational harvest or effort.

Standardised CPUE of adult snapper by the Port Phillip Bay commercial long-line fishery and recreational anglers (October-December creel surveys) has decreased since the late 2000s – early 2010s in Port Phillip Bay [Conron et al. 2020]. The decrease in the recreational catch rate in Port Phillip Bay was rapid from 2013 to 2014 but has since stabilised. 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 [Conron et al. 2020]. 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 [Conron et al. 2020]. The decline in abundance of adult snapper is in agreement with pre-recruit surveys whereby exceptional recruitment in the early 2000's resulted in very high abundance through until the early 2010's.

Catch rates from January to April 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-April was around average in Port Phillip Bay in 2018/19 [Conron et al. 2020], but lower in Western Port.

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 low–moderate recruitment from 2006 to 2017. The recreational fishery for adult snapper in Port Phillip Bay is considered sustainable at its current level, having stabilised since 2014, but a decline in Western Port persists. The decline in Western Port is

thought to be related to local dynamics rather than deterioration in overall stock status. Recent strong recruitment in 2018 is expected to reverse any declining biomass trends and drive a rebuilding of adult biomass and improved fishery performance over the next 5–10 years. 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.

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]

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	Victoria	Western Australia
Charter					
Hook and Line	✓	✓	✓	✓	
Rod and reel					✓

Spearfishing					✓
Commercial					
Beach Seine					✓
Demersal Longline	✓				
Dropline	✓				✓
Fish Trap	✓				✓
Gillnet					✓
Hand Line, Hand Reel or Powered Reels					✓
Handline			✓		
Haul Seine					✓
Hook and Line	✓				
Line		✓			✓
Longline (Unspecified)					✓
Net		✓			
Set longline			✓		
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	✓		✓		
Gear restrictions	✓	✓	✓	✓	
Licence	✓			✓	✓
Marine park closures	✓			✓	
Possession limit		✓			
Seasonal closures			✓		
Size limit	✓	✓	✓	✓	
Spatial	✓	✓	✓		

closures					
Temporal closures		✓			
Commercial					
Catch limits			✓	✓	✓
Gear restrictions	✓	✓	✓	✓	✓
Licence				✓	
Limited entry	✓	✓	✓	✓	✓
Marine park closures	✓				
Seasonal closures			✓		
Size limit	✓	✓	✓	✓	✓
Spatial closures	✓	✓	✓	✓	✓
Temporal closures		✓			
Vessel restrictions	✓				
Recreational					
Bag and boat limits			✓		✓
Bag and possession limits	✓				
Bag limits	✓			✓	
Catch limits					✓
Gear restrictions	✓	✓	✓	✓	✓
Licence	✓			✓	✓
Marine park closures	✓				
Possession limit		✓			✓
Seasonal closures			✓		✓
Size limit	✓	✓	✓	✓	✓
Spatial closures	✓	✓	✓	✓	✓
Temporal closures		✓			

Catch					
	New South Wales	Queensland	South Australia	Victoria	Western Australia
Charter					22 t
Commercial	160.09 t	37.8034 t	280.156 t		140.607 t

Indigenous	Unknown	Unknown	Unknown	Unknown (No catch under permit)	Unknown
Recreational	106 t (2017–18)	138 t (2019–20)	332 t (2013–14)	~600 t (2006–07)	77 t (2017/18)

Western Australia - Recreational (Catch) Ryan et al. 2017.

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

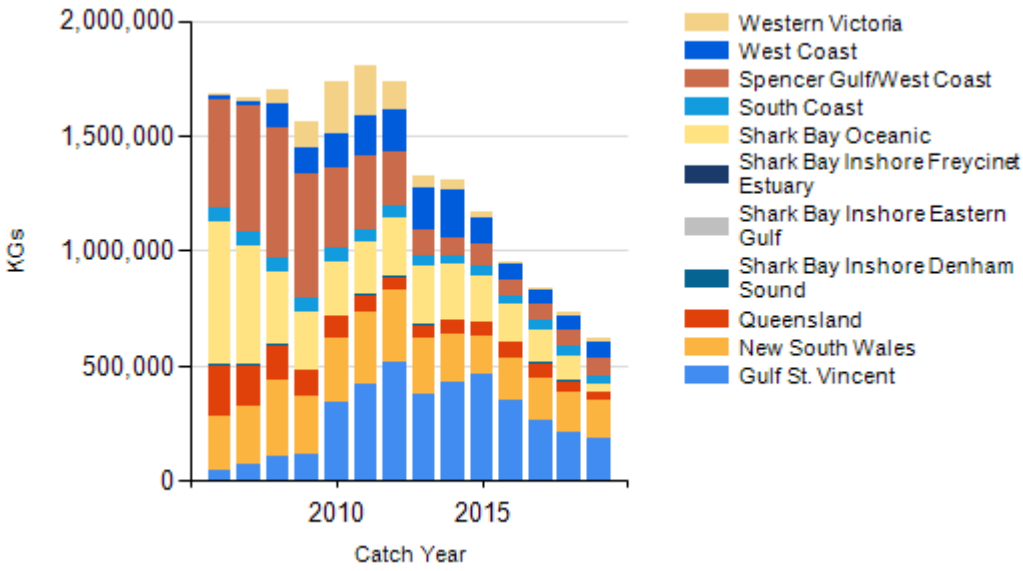
New South Wales – Recreational (Catch) Murphy et al. [2020].

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) Giri and Hall 2015.

CATCH CHART



Commercial catch of Snapper - note confidential catch not shown

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