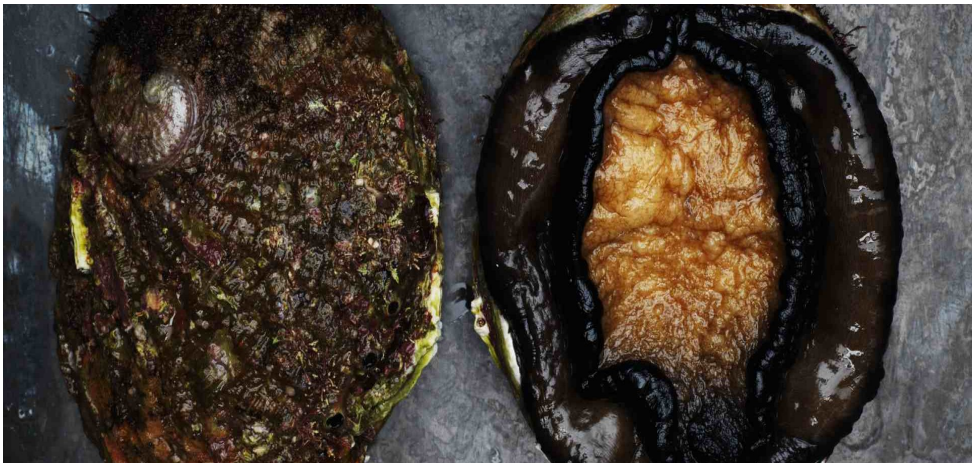
Blacklip Abalone (2020)

Haliotis rubra rubra



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STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Western Australia	Western Australia	Negligible	Catch
New South Wales	New South Wales	Undefined	Catch, CPUE, mean weight, legal-size biomass
Victoria	Victoria Central Zone Fishery	Depleting	Catch, CPUE, fishery independent surveys
Victoria	Victoria Eastern Zone Fishery	Depleting	Catch, CPUE, fishery independent surveys
Victoria	Victoria Western Zone Fishery	Sustainable	Catch, CPUE, fishery independent surveys
Tasmania	Tasmania Bass Strait Zone Fishery	Sustainable	Catch, CPUE
Tasmania	Tasmania Eastern Zone Fishery	Sustainable	Catch, CPUE
Tasmania	Tasmania Northern Zone Fishery	Sustainable	Catch, CPUE
Tasmania	Tasmania Western Zone	Depleted	Catch, CPUE

	Fishery		
South Australia	South Australia Central Zone Fishery	Depleted	Catch, CPUE
South Australia	South Australia Southern Zone Fishery	Sustainable	Catch, CPUE, survey density
South Australia	South Australia Western Zone Fishery	Sustainable	Catch, CPUE, survey density

STOCK STRUCTURE

There are substantial difficulties in applying classical stock assessment models to abalone resources, given the possibly large number of stocks in each fishery, and that stock structure in abalone depart substantially from dynamic pool assumptions required by integrated models. In some regions *Haliotis rubra rubra* also displays spatially variable growth rates and maturity curves. All jurisdictions therefore rely on indicators and empirical performance measures. Primarily these are commercial catch and catch per unit effort (CPUE; as kg of abalone harvested per hour). but they can also include commercial catch per area searched (CPUA), and metrics derived from fishery independent surveys, and commercial and fishery-independent size composition. CPUE and similar indicators from individual fishing events are relevant locally but are not indicative of status broadly [Parma et al. 2003], and status of the many populations within a management unit cannot be assumed to be trending in the same direction. Thus, it is only the average CPUE across each spatial reporting unit that provides the broader perspective for fishery assessment. Fishery assessment is usually based on a combination of indicators, and some jurisdictions combine the indicators to give a combined score for stock status. The annual catch by Blacklip Abalone fisheries is generally close to the established total allowable commercial catches (TACCs), with little over-catch or under-catch of the TACC.

STOCK STATUS

New South Wales

The New South Wales Abalone Fishery is managed as a single jurisdictional stock with a single total allowable commercial catch (TACC). However, assessment of the stock is done at the scale of four geographically defined Spatial Management Units (SMUs), and a whole of stock status is not defined within the assessment. Assessments rely on fishery-dependent data from commercial fisher logbooks, including catch, catch rate (whole weight, kg per hour) and mean weight (catch divided by the number of abalone harvested). More recent assessments also derive estimates of fishery and stock performance from GPS logger data and data from logbooks, including measures of legal-size biomass density (kg per hectare) and productive area of reef (i.e. cumulative area fished in the most recent three years) to estimate legal-size biomass.

Blacklip Abalone stocks continue to recover from historical overfishing [Liggins and Upston 2010, TACSRC 2017, TAFC 2018]. Historical stock status, inferred largely from differences in catch rate, indicate stocks were subject to recruitment overfishing and were depleted in the mid-1980s (catch rate less than 20 kg per hour) and that overfishing continued throughout the 1990s to the mid-2000s (catch rate less than 20 kg per hour, with intermittent peaks to less than 25 kg per hour). TACCs and annual catches exceeded 330 t throughout the 1990s, were reduced during the early 2000s from 305 to 130 t and further reduced, reaching the lowest level of 75 t, in 2009–10, during which time the

legal minimum length (LML) was also increased [NSW DPI unpublished]. Subsequently, catch rate and mean weight of abalone increased to levels not previously recorded. In 2010, catch rate exceeded 30 kg per hour for the first time since the early 1980s and was >45 kg per hour in 2014, at or among the highest levels recorded. These changes in catch and catch rate together with increased levels of legal-size biomass density (kg per hectare) indicated legal-size biomass had about doubled over this period [TAFC 2018, NSW DPI 2020], and the TACC was incrementally increased, reaching 130 t in 2015. However, from about 2015 to 2018–19, stock productivity declined, partially owing to extreme sea conditions causing high abalone mortality in mid-2016, but catch levels were maintained. This combination of relatively high catch rates and reduced productivity lead to depletion of biomass to levels similar to those of 2011–12 (catch rate ~40 kg per hour and reduced legal-size biomass). These patterns were consistent among the three (of a total of four) most significant (consistently >95 per cent of total catch) SMUs (i.e. SMUs 2, 3, and 4). The TACC was reduced to 100 t in 2018, and has been maintained at that level [NSW DPI 2020]. In 2019–20, increased catch rates and legal-size biomass density in SMU 2 and SMU 3 indicate an arrest of the depletion of biomass rebuilt during 2009–14. Similar changes are not evident in SMU 4 [NSW DPI unpublished, TAFC 2018]. Persistence or an increase in current measures of stock performance beyond the one or two current years would provide greater certainty in the determination of a sustainable stock status in SMU 2 and 3. However, continued declines in catch rate and legal-size biomass in 2019–20 in SMU 4, to levels similar to those in 2010–13, indicate continued depletion of biomass and decline in stock status in this SMU, despite management interventions [NSW DPI unpublished].

The most northern areas of the State (SMU 1), which have typically contributed ≤ 10 percent of the total annual catch over at least the last decade, were subject to high fishing mortality through the mid-1980s to the early-1990s, then further depleted by mortality associated with infection by the parasite *Perkinsus sp.* from the 1990s to the early-2000s [Liggins and Upston 2010, TACSRC 2015]. Fishery-dependent data have not indicated recovery of these stocks to historical levels [TACSRC 2017].

In addition to TACC changes, protection for the stock has been achieved through several increases in the LML from 100 mm established in 1972, through four increases to 117 mm in 2008 (for all fishing sectors), 118 mm in 2018 and 120 mm in 2019 (commercial sector only). In the most southern areas of the state, the LML for the commercial fishery was increased to 120 mm in 2010, 123 mm in 2013 and 125 mm in 2018. It is estimated that these changes have resulted in 27 per cent fewer abalone commercially harvested in 2019–20 than in 2017–18 [NSW DPI unpublished]. Mean weight of commercially harvested Blacklip Abalone has generally increased through time since about 2008, consistent with changes to the LML.

Fishery-dependent data (catch, catch rate and legal-size biomass) have supported recent changes in stock status and together with substantial contrast to historical levels, provide information to infer historical status, reference levels of catch rate and a relative measure of stock abundance through time. However, there is no formal harvest strategy describing reference points from which stock status can be directly defined, either at the whole fishery or SMU scale.

The evidence presented above indicates that the Blacklip Abalone stock in New South Wales was overfished through the mid-1980s and into the early-2000s. After the early-2000s, management measures supported strong stock rebuilding through to 2014–15. Whereafter, stocks declined through to about 2018–19 in SMU 2 and 3, and into 2019–20 in SMU 4. Recent management measures, including the TACC reduction (to 100 t in 2018, maintained to the current fishing period 2020–21 [NSW DPI 2020]) and increases to LMLs have reduced fishing mortality, evidenced by recent measures of fishery performance in SMU 2 and 3 that are more consistent with a sustainable stock status. However, fishing mortality has remained too high in SMU 4 and its persistence is likely to cause

the stock in this SMU to become recruitment impaired. These contrasts in fishery-dependent measures of stock performance among SMUs, together with recent changes in some fisher operations (e.g. fishing to specific markets) and impacts on fishing operations and markets from bushfires (declared a natural disaster in NSW in 2019) and the COVID-19 pandemic, provide further uncertainty to the current and future assessments, including the determination of stock status [NSW DPI unpublished], and preclude determination of a stock status of sustainable with reasonable confidence. A fishery harvest strategy that provides clear guidance on the measures used and criteria for determination of fishery stock status is critical for improved transparency and certainty in decision making.

On the basis of the evidence provided above, Blacklip Abalone in New South Wales is classified as an **undefined stock**

South Australia Central Zone Fishery

The fourth management plan for the South Australian Abalone Fishery (SAAF) was developed from 2015–16 to 2019–20 and is currently in draft form (PIRSA 2020 in prep). The draft management plan includes the draft harvest strategy intended to be the primary tool used to achieve the goal of sustainably harvesting the abalone resource and allocating stock status in accordance with the National Status Reporting Framework (NSRF). The draft harvest strategy provides a structured, species-specific and spatially explicit framework for decision making and includes assignment of stock status consistent with the NSRF. It has three main phases: (1) a monitoring phase in which information is collected for the two performance indicators, catch per unit effort (CPUE) and legal density of abalone from fishery-independent surveys (FIS), along with other relevant fishery information; (2) the stock assessment phase where the performance of each spatial assessment unit (SAU; minimum spatial scale currently used to assess the fishery) is scored based on a CPUE score and, for some key SAUs, a legal density score. This scoring is based on a range from 0 to 10 where the target reference point is 5 and the limit reference point is 0. Aggregated scores for the SAUs provide an overall stock status based on trigger reference points for biomass (zone score used as a proxy) and fishing mortality (zone score trend used as a proxy); and (3) the final step where zone score is translated to a recommended zonal catch. During this step a workshop is held with industry to share relevant information, and zonal catch can be adjusted within a 10 per cent range based on the information through harvest decision rules. The adjusted zonal catch helps to inform a total allowable commercial catch (TACC) for the following season.

Following the implementation of a TACC in 1990, Blacklip Abalone catches and CPUE in the South Australia Central Zone Fishery (SACZF) were stable for more than a decade, at ~13 t meat weight per year and ~25 kg meat weight per hour, respectively. A long-term decline in CPUE began in the mid-2000s, and despite multiple reductions in TACC from 14.1 to 6.4 t, by 2016 CPUE had declined to 21 kg per hour. In 2017, CPUE declined further to 18 kg per hour, which was the lowest catch rate on record (38 years) and 12 per cent below the next lowest value. At the start of the 2018 season, the fishery was voluntarily closed by industry, with the TACC set at zero, and was subsequently classified as 'depleted'. These declines in catch rate, despite the reduced catches, indicate that recent recruitment levels have been substantially below those that have historically supported substantially larger catches. There had also been an apparent spatial contraction of the fishery, principally into the south-western corner of Kangaroo Island, from a previously broader spatial distribution across the south coast of Kangaroo Island.

The most recent assessment for the SACZF was completed in 2020, reporting up to the conclusion of the 2019 calendar season [Burnell et al. 2020a]. The key indicator for biomass and fishing mortality is commercial CPUE. While the TACC of 6.4 t was reinstated in 2019, catches were limited under an industry-managed agreement, with approximately 1 t of Blacklip Abalone harvested. These small

catches, often taken as a bycatch when targeting Greenlip Abalone, were insufficient to estimate CPUE, or infer changes in stock biomass. Application of the proposed harvest strategy in 2019 resulted in a zone score of 0.6 that, in combination with the zone trend score of 4.4 (reflecting a decreasing trend), define the stock status for Blacklip Abalone in the SACZF in 2019 as 'depleted'.

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 has been reduced 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 South Australia Central Zone Fishery management unit is classified as a **depleted stock**.

South Australia Southern Zone Fishery

The fourth management plan for the South Australian Abalone Fishery (SAAF) was developed from 2015–16 to 2019–20 and is currently in draft form (PIRSA 2020 in prep). The draft management plan includes the draft harvest strategy intended to be the primary tool used to achieve the goal of sustainably harvesting the abalone resource and allocating stock status in accordance with the National Status Reporting Framework (NSRF). The draft harvest strategy provides a structured, species-specific and spatially explicit framework for decision making and includes assignment of stock status consistent with the NSRF. It has three main phases: (1) a monitoring phase in which information is collected for the two performance indicators, catch per unit effort (CPUE) and legal density of abalone from fishery-independent surveys (FIS), along with other relevant fishery information; (2) the stock assessment phase where the performance of each spatial assessment unit (SAU; minimum spatial scale currently used to assess the fishery) is scored based on a CPUE score and, for some key SAUs, a legal density score. This scoring is based on a range from 0 to 10 where the target reference point is 5 and the limit reference point is 0. Aggregated scores for the SAUs provide an overall stock status based on trigger reference points for biomass (zone score used as a proxy) and fishing mortality (zone score trend used as a proxy); and (3) the final step where zone score is translated to a recommended zonal catch. During this step a workshop is held with industry to share relevant information, and zonal catch can be adjusted within a 10 per cent range based on the information through harvest decision rules. The adjusted zonal catch helps to inform a total allowable commercial catch (TACC) for the following season.

Catches of Blacklip Abalone in the South Australia Southern Zone Fishery (SASZF) were consistent around 140 t after TACCs were introduced in the early 1990s. Commercial CPUE increased consistently through time, almost doubling between the mid-1980s and 2010–11. Following record high CPUE (~122 kg per hour) and TACC-constrained catch (~150 t) between 2010–11 and 2011–12, a number of key indicators of stock performance began to decline across the SZ. Subsequently, the fishery was classified as 'depleting' between 2013–14 and 2015–16, and TACCs decreased from 151.5 t to 126 t. Preceding this period of depleting stock status, widespread abalone mortalities were reported across the SASZF as a result of anomalously high water temperatures during the summer of 2012–13, which likely contributed to stock decline.

The most recent assessment report for the SASZF was completed in 2020 and reported up to the conclusion of the 2018–19 season [Burnell et al. 2020b]. The primary measures for biomass and fishing mortality are commercial CPUE and FIS of legal-size abalone density. During the past two fishing seasons CPUE in the SASZF has increased to levels slightly below historical peaks (~112 kg.hr[-1]). Estimates of CPUE for most SAUs were increasing and/or well above historical averages, while the FIS indicate the number of abalone at key locations within the fishery have been relatively stable over the last five seasons. In 2018–19, these stable or increasing proxies for biomass, were accompanied

by a modest increase in catch and TACC from 126 to 132 t. This current position of the stock contrasts with the period of declining stock status and relative instability prior to 2016.

Application of the proposed harvest strategy in 2018–19 resulted in a zone score of 7.0 that, in combination with the zone trend score of 6.4 (reflecting an increasing trend), define the stock status for Blacklip Abalone in the SASZF in 2019 as 'sustainable'. 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 Australia Southern Zone Fishery management unit is classified as a **sustainable stock**.

South Australia Western Zone Fishery

The fourth management plan for the South Australian Abalone Fishery (SAAF) was developed from 2015–16 to 2019–20 and is currently in draft form (PIRSA 2020 in prep). The draft management plan includes the draft harvest strategy intended to be the primary tool used to achieve the goal of sustainably harvesting the abalone resource and allocating stock status in accordance with the National Status Reporting Framework (NSRF). The draft harvest strategy provides a structured, species-specific and spatially explicit framework for decision making and includes assignment of stock status consistent with the NSRF. It has three main phases: (1) a monitoring phase in which information is collected for the two performance indicators, catch per unit effort (CPUE) and legal density of abalone from fishery-independent surveys (FIS), along with other relevant fishery information; (2) the stock assessment phase where the performance of each spatial assessment unit (SAU; minimum spatial scale currently used to assess the fishery) is scored based on a CPUE score and, for some key SAUs, a legal density score. This scoring is based on a range from 0 to 10 where the target reference point is 5 and the limit reference point is 0. Aggregated scores for the SAUs provide an overall stock status based on trigger reference points for biomass (zone score used as a proxy) and fishing mortality (zone score trend used as a proxy); and (3) the final step where zone score is translated to a recommended zonal catch. During this step a workshop is held with industry to share relevant information, and zonal catch can be adjusted within a 10 per cent range based on the information through harvest decision rules. The adjusted zonal catch helps to inform a total allowable commercial catch (TACC) for the following season.

In response to a depleting stock status from 2013 onwards, the TACC in the South Australia Western Zone Fishery (SAWZF) was reduced in 2013, 2014, 2016, 2018 and 2019. The total catch was further reduced through a voluntary reduction in catch by the commercial sector in 2015, 2016 and 2019 [Stobart et al. 2020]. Overall, this resulted in a 45 per cent catch reduction from 93.4 t in 2012 to 51.1 t in 2019.

The most recent assessment for the SAWZF was completed in 2020 and reported up to the conclusion of the 2019 financial year season [Stobart et al. 2020]. The primary measures for biomass and fishing mortality used are commercial CPUE and FIS of legal-sized density by financial year. The financial-year CPUE for Blacklip Abalone in the SAWZF increased from 24.4 kg per hour in 1979 to 30.7 kg per hour in 2005, the highest level on record. CPUE then decreased and, in 2018, was 20.0 kg per hour, the lowest value on record. CPUE has subsequently increased to 21.4 kg per hour in 2019. With one exception, the long-term declining trend between 2005 and 2018 occurred across all of the high and medium importance SAUs for the fishery [Stobart et al. 2020]. Estimates of legal-sized density from FIS also show general decreases following the late 2000s, with subsequent stabilisation or increases by 2019, generally matching the observed CPUE trend. The recent increase in CPUE and increases in legal density from most FIS sites suggest that the reductions in catch may now have arrested the observed declines in CPUE from 2005 to 2018. The trend

reversal in both metrics is evidence that, although biomass is low, fishing mortality is likely to be adequately controlled to avoid the stock becoming recruitment impaired. Additional years of CPUE and FIS data are required to confirm the recent change in harvestable biomass trajectory remains.

Application of the proposed harvest strategy resulted in a zone score of 3.3 that, in combination with the zone trend score of 5.04 (reflecting an increasing trend), define the stock status for Blacklip Abalone in the WZ in the 2019–20 FY as 'sustainable'. 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 abovethe South Australia Western Zone Fishery management unit is classified as a **sustainable stock**.

Tasmania Bass Strait Zone Fishery

Two different legal minimum lengths (LMLs) are in place (110 mm and 114 mm) in this zone, reflecting the variation in growth rates across the fishery. Since the creation of this zone in 2003, catch and standardised catch per unit effort (SCPUE) have been relatively stable. The Bass Strait Zone was closed in 2007 due to concerns around the possible risk of transferring abalone viral ganglioneuritis (AVG) from Victoria to Tasmania and re-opened in 2008. In 2016, the total allowable commercial catch (TACC) for the Bass Strait Zone was increased to 77 t on request from industry based on increasing catch rates and retained for 2017. In 2018, Blocks 48 and 49 were transferred from the Northern Zone to the Bass Strait Zone, with a small increase in TACC, to 91 t. In 2019 the zone-wide catch weighted mean SCPUECW (mean SCPUE across SAUs, weighted by catch) declined from 91.6 Kg/Hr in 2016 to 76.5 in 2019, compared with 79.1 kg per hour when the zone was established in 2003 [Mundy and McAllister 2020]. Proxies for Biomass and Fishing Mortality are derived from the Empirical Harvest Strategy outputs, where Biomass is represented by the catch-weighted mean zonal score for the Target CPUE performance measure, and Fishing Mortality is represented by the catch-weighted mean score for the 4-year CPUE gradient score. The zone-wide proxy for biomass is 5.8, well above the limit reference point, and the zone-wide proxy for fishing mortality is 0.5, just above the target reference point for sustainability [Mundy and McAllister 2020].

The above evidence indicates that the biomass of stocks in the Tasmania Bass Strait Zone is unlikely to be depleted and that recruitment is unlikely to be impaired. Additionally, the above evidence also indicates that the current level of fishing mortality is unlikely to cause these stocks to become recruitment impaired.

On the basis of the evidence provided above, the Tasmania Bass Strait Zone Fishery management unit is classified as a **sustainable stock**.

Tasmania Eastern Zone Fishery

The majority of the Tasmania Eastern Zone Fishery management unit has a legal minimum length (LML) of 138 mm, while the LML for a small area around Freycinet is set at 145 mm as part of a rebuilding program [Mundy and McAllister 2020]. Relative stock biomass in this fishery (estimated using standardised catch per unit effort (SCPUE) as a proxy) has oscillated widely since 1992, with evidence of an approximate eight-year cycle [Mundy and McAllister 2020]. Based on declining mean SCPUECW (mean SCPUE across SAUs, weighted by catch) between 2000 (76 kg per hour) and 2003 (53.8 kg per hour), the total allowable commercial catch (TACC) was reduced from 1190 t to 857 t in 2002 and to 770 t in 2004 [Tarbath and Mundy 2004]. Subsequent increases in SCPUE and increasing median length of the commercial catch led to increases in the TACC by five per cent in 2008, 2009 and 2010 [Tarbath and Gardner 2011], resulting in a TACC of 896 t by 2010. Between 2007 and 2009, the mean SCPUECW was stable at around 90 kg per hour, but reports from

divers suggested the resource was declining in late 2009. Subsequent rapid declines in SCPUE in most SAUs in late 2010 resulted in a reduced TACC of 721 t for 2011. Mortality of abalone in the wild across a large proportion of the Eastern Zone was observed in March 2010; this was coincident with a marine heat wave and the overall mortality from these deaths is unknown. Further rapid decline in SCPUE in 2011 resulted in an additional TACC reduction to 549.5 t for 2012. In 2013, minor reductions in the TACC to 528.5 t were made to address local concerns in one sub-region and held for 2014 and 2015 [Mundy and McAllister 2020].

The most significant marine heat wave ever recorded on the east coast of Tasmania peaked in March 2016, with mortalities observed along the central and southern east coast [Oliver et al. 2017, Oliver et al. 2018]. In June 2016, a significant winter storm with the largest swells recorded in a 36 year time series impacted stocks on coastlines exposed to a north-easterly direction [Mundy and Jones 2017], with immediate impacts on abalone availability. Stock rebuilding observed in several key areas of the Tasmania Eastern Zone in 2014 and 2015 ceased in 2016. In late 2017, there was concern about abalone abundance in the areas worst affected by the marine heat wave and winter storm from Cape Pillar to Eddystone Point and a 75 per cent TACC reduction was imposed for 2018. The SCPUE improved through 2018 and 2019, and in 2019 the mean SCPUECW had increased to 62.6 kg per hour. Proxies for Biomass and Fishing Mortality are derived from the Empirical Harvest Strategy outputs, where Biomass is represented by the catch-weighted mean zonal score for the Target CPUE performance measure, and Fishing Mortality is represented by the catch-weighted mean score for the 4-year CPUE gradient score. Overall, the zone-wide proxy for biomass is 3.8, above the limit reference point of 1, and the zone-wide proxy for fishing mortality is 1.2, above the target reference point for sustainability [Mundy and McAllister 2020].

The above evidence indicates that the biomass of stocks in the Tasmania Eastern Zone is unlikely to be depleted and that recruitment is unlikely to be impaired. The above evidence also indicates that the current level of fishing mortality is unlikely to cause these stocks to become recruitment impaired.

On the basis of the evidence provided above, the Tasmanian Eastern Zone Fishery management unit is classified as a **sustainable stock**.

Tasmania Northern Zone Fishery

The geographic variability in growth dynamics within the Tasmania Northern Zone is reflected in three different legal minimum lengths (LMLs) (120 mm, 127 mm and 132 mm) [Mundy and McAllister 2020]. Regional catch and catch rates have varied between 2000 and 2015 as a function of changing market preference and adaptive management, including effort redistribution and change in LML. The majority of abalone landed from this zone are traditionally unsuited to the live market, and are processed for canned or frozen markets. In 2008, the first of two industry-driven experimental fisheries to improve fish quality commenced in Block 5 with a reduction in LML from 132–127 mm and a 50 t increase in catch, and a second industry-driven experimental fishery commenced in Block 49 in 2011, increasing the total allowable commercial catch (TACC) for the Northern Zone to a peak of 402.5 t. This initiative was not successful [Jones et al. 2014] and has had longer-term negative impacts on biomass. Standardised catch per unit effort (SCPUE) varies across different geographic regions within the Northern Zone, but the catch-weighted SCPUECW (mean SCPUE across SAUs, weighted by catch) for the zone has fallen in all the key fishing grounds targeted in the industry program over the past five years despite TACC reductions every year from 2012 to 2017 [Appendix D, Mundy and McAllister 2020]. In 2018, Blocks 48 and 49 were transferred out of the Northern Zone an into the Bass Strait Zone, while Sub-Blocks 6A, 6B, 6C were transferred out of the Central Western Zone and into the Northern Zone. A small decrease in TACC associated with this restructure was made, independent of TACC reductions based on Harvest Strategy outcomes. The mean SCPUECW in 2007 prior to the

industry experiments was 93.1 kg per hour at a TACC of 280 t, compared with a mean SCPUECW of 54.7 kg per hour in 2019 at a TACC of 98t [Mundy and McAllister 2020]. The rate of decline in SCPUE from 2012 to 2017 was sharp, despite consecutive TACC reductions. In 2018 SCPUECW improved and that improvement continued in 2019. Proxies for Biomass and Fishing Mortality are derived from the Empirical Harvest Strategy outputs, where Biomass is represented by the catch-weighted mean zonal score for the Target CPUE performance measure, and Fishing Mortality is represented by the catch-weighted mean score for the 4-year CPUE gradient score. The zone-wide proxy for biomass is 2.5, above the limit reference point, while the proxy for fishing mortality is 1.05, which is marginally above the target reference point for sustainability [Mundy and McAllister 2020].

The above evidence indicates that the biomass of stocks in the Tasmania Northern Zone is unlikely to be depleted and that recruitment is unlikely to be impaired. The above evidence also 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 Tasmania Northern Zone Fishery management unit is classified as a **sustainable stock**.

Tasmania Western Zone Fishery

The Tasmania Western Zone Fishery management unit has a legal minimum length (LML) of 140 mm. In 1993–99, the majority of the Western Zone was under-fished (catches ranging from 500–750 t) with effort concentrated in the Eastern Zone where a higher beach price could be achieved. This resulted in substantial accumulation of biomass and high catch rates (1993 mean catch-weighted standardised CPUE (SCPUECW) 104.5 kg per hour; 1999 mean SCPUECW 163.0 kg per hour). With the introduction of zones in 2000–01 to manage the distribution of effort, the Western Zone total allowable commercial catch (TACC) was elevated to 1260 t [Mundy and McAllister 2018], and remained at this level through to 2008, with mean SCPUECW declining to below 130 kg per hour. Widespread selective fishing for animals less than 160 mm SL, along with long-term declines in standardised catch per unit effort (SCPUE) in most SAUs, led to a further zonal restructure in 2009 with a new Central West Zone containing blocks 6, 7 and 8 previously managed under the Western Zone. Additionally, spatial catch limits were set annually for four geographic regions , to prevent excess catches in response to economic pressures. The TACC was also reduced in 2009 to 924 t. In 2013, Sub-Block 6D, and Blocks 7 and 8 were moved from the Central Western Zone back into the Western Zone and the Zone TACC increased to 1001 t, associated with the increased fishing area, but effectively retaining the same level of catch across blocks 6D, 7 to 13 as in 2012 [Tarbath and Mundy 2014]. In 2013, mean SCPUECW declined to 111.7 kg per hour triggering a TACC reduction to 840 t in 2014, and maintained for 2015. In 2016 the TACC was again reduced by 123 t to 717 t, and minor improvements in SCPUECW were observed in2018. In 2019 the SCPUECW declined to 91.1 Kg per hour, the lowest catch rate on record for this zone.

Proxies for Biomass and Fishing Mortality are derived from the Empirical Harvest Strategy outputs, where Biomass is represented by the catch-weighted mean zonal score for the Target CPUE performance measure, and Fishing Mortality is represented by the catch-weighted mean score for the 4-year CPUE gradient score. The zone-wide proxy for biomass is 0.9, below the limit reference point of 1.0, while the proxy for fishing mortality is -1.1, and below the target reference point for sustainability [Mundy and McAllister 2020].

The above evidence indicates that stocks in the Tasmania Western Zone are likely to be depleted and that recruitment is likely to be impaired. The above evidence also indicates that 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 Tasmania Western Zone Fishery management unit is classified as a **depleted stock**.

Victoria Central Zone Fishery

Commercial catch per unit effort (CPUE) doubled from about 50 kg per hour in the early 1980s to around 100 kg per hour in the early 2000s, a pattern consistent throughout the state. The increase is thought to be at least partly due to changes in fishing practices that improved fishing efficiency [VFA 2017a]. Similar patterns have been observed during the same period in the other Australian Blacklip Abalone jurisdictions, and have been partially attributed to increased exploitable biomass. The introduction of a total allowable commercial catch (TACC) in the Victoria Central Zone in 1988 was expected to improve biomass and contribute to CPUE increases to some extent. The TACC was stable for more than a decade prior to the introduction of marine parks which reduced the available fishing grounds, probably because catch quotas were not linked to biomass trends at that time [Victorian Department of Natural Resources and Environment 1996].

Since the peak in the early 2000s CPUE has shown a declining trend, and by 2017–18 was almost one quarter lower at 74 kg per hour. Some of the smaller short-term fluctuations in CPUE during the past decade may be attributable to increases and decreases in abalone size limits. The abalone viral ganglioneuritis (AVG) outbreak west of Cape Otway contributed to a 50 t decline in catches and probably reduced catch rates to some extent. The TACC was reduced substantially from 620 t in 2006–07 to 285 t in 2010–11, following which it fluctuated between years by up to 8 per cent. The TACC has been set most recently at 252.6 t, which is a reduction of 18 per cent since 2015 [Dixon and Dichmont 2019a]. Trends in abundance estimated from fishery-independent survey (FIS) data were consistent with observed declines in CPUE, showing a major decline since 2003 of approximately 50–60 per cent in the relative abundance of sub-legal sized (pre-recruit) and legal-sized (recruit) abalone. Both of these FIS indices [A1] [Anon2] have been relatively stable since 2010. Although there are no prescribed reference points for these fishery-independent indicators of stock status, a draft harvest strategy specifies CPUE reference points with limits ranging from 40–50 kg per hour, thresholds from 60–70 kg per hour, and targets from 70–130 kg per hour among 11 of the 12 defined spatial management units (SMU) for which the Central Zone fishery is regulated [Dixon and Dichmont 2019a]. In the absence of recent catches, the Port Phillip Bay SMU was excluded. Current CPUE values in 2019 were between 53–103 kg per hour among the SMU, all above the limit reference points but with six below their respective thresholds and only one minor SMU above its target, in this instance of only 70 kg per hour [Dixon and Dichmont 2019a]. The stable, but relatively low, abundances observed in FIS indices indicate that the decline in biomass observed over two decades may have stabilised, but there is no evidence of recovery and commercial CPUE has decreased by 14 per cent during the past decade [VFA 2017a]. However, pre-recruit abundance levels are similar to those for recruits, implying that reasonable recruitment has been occurring at recent stock levels. The current challenge facing the fishery is ensuring that the spatial distribution of catch is aligned with catch targets that reflect the biological productivity of the resource and enable stocks to rebuild. The most recent assessment concluded that maintaining the TACC at current levels was likely to meet objectives for stabilising the biomass at its current level but unlikely to recover stocks to previous levels. The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. For the period 2009–2019 the biomass declined, but the stock is not yet considered to be recruitment impaired. Evidence based on the pre-recruit abundance index indicates that reasonable recruitment has been occurring at recent stock levels. [Dixon and Dichmont 2019a].

On the basis of the evidence provided above, the Victoria Central Zone Fishery

management unit is classified as a **depleting stock.**

Victoria Eastern Zone Fishery

The Eastern Zone management unit was not affected by abalone viral ganglioneuritis (AVG) but has experienced impacts from environmental and ecosystem changes such as increasing abundance of the Longspined Sea Urchin (*Centrostephanus rodgersii*). These urchins denude reefs of macro-algae, turning them into 'barrens' that are unsuitable for abalone, with significant areas of reef in the Eastern Zone having been affected by urchins in this manner over the past 20 years [Gorfine et al. 2012]. It is also likely that reproductive capacity has been reduced by habitat loss caused directly by the increased density of urchins [Bell 2020]. Industry has a history of stewardship and working with fishery managers to sustain the fishery, including active control of urchins at reefs near Mallacoota for the last eight years. The urchin range extension has led to an increased concentration of fishing effort on urchin-free reef areas, with an increased associated risk of localised depletion.

In common with other jurisdictions, improvements in fishing methods have also occurred in this management unit and are thought to have contributed to fishing efficiency-related increases in catch per unit effort (CPUE) from the mid-1990s to early 2000s. The introduction of a total allowable commercial catch (TACC) in the Victoria Eastern Zone in 1988 was expected to improve biomass and contribute to CPUE increases to some extent. The TACC was stable for more than a decade prior to the introduction of marine parks which reduced the available fishing grounds, probably because catch quotas were not linked to biomass trends at that time [Victorian Department of Natural Resources and Environment 1996].

The Eastern Zone catch was relatively stable from 1992 to 2002, ranging from 431 to 445 t per quota year before increasing to 480 t in 2003. Catch was maintained at this level until 2008 and has slowly declined thereafter. The 2018–19 catch quota (TACC) of 346.5 t was the lowest on record. Since 2012, there have been sequential reductions in the total catch harvested from the Eastern Zone. Standardised CPUE significantly increased from 1992 to 2011, before significantly declining over five years from 2011 to 2016, then increasing again from 2016 to 2019. The rate of increase among the seven defined spatial management units (SMU) for which the Eastern Zone fishery is regulated ranged from 6–19 per cent during this 4-year period [Dixon and Dichmont 2019b]. Current CPUE values in 2019 were 89–126 kg per hour among the SMU, well above the limit reference point of 50 kg per hour specified throughout the Eastern Zone, as well as SMU threshold and target reference points specified in a draft harvest strategy, that vary respectively between 70–80 kg per hour and 100–130 kg per hour [Dixon and Dichmont 2019b]. The increases in CPUE are likely to have resulted, at least in part, from ongoing reductions in catch since 2012, as well as from decreases in legal minimum length (LML) in some SMUs in recent years [Dixon and Dichmont 2019b].

In contrast with the CPUE trends, the fishery-independent survey indices showed that in 2015, pre-recruit abundance had declined by almost 70 per cent from historically high levels in 1995. From 1995–2015, the survey index of recruit abundance declined by 50 per cent and has since remained relatively steady [VFA 2017b].

For the periods 1995 to 2015 and 2012 to 2017, fishery independent and dependent performance measures respectively indicated that the biomass was declining, but not to the extent that the stock could be considered to have become depleted or recruitment impaired. In the last two years, both CPUE and recruit abundance have increased. Pre-recruit abundance has continued to decline and remains of concern, however it is reasonable to conclude that the status of the resource has stabilised and the likelihood of depletion to a level causing recruitment impairment in the near to medium term is low at the current precautionary TACC of 337.5 t [Dixon and Dichmont 2019b].

On the basis of the evidence provided above, the Victoria Eastern Zone Fishery management unit is classified as a **depleting stock**.

Victoria Western Zone Fishery

The Western Zone management unit has undergone significant changes over its recent history. Most notable was the impact of an outbreak of abalone viral ganglioneuritis (AVG) in 2006. Industry has worked with fishery managers since that time to respond to the disease outbreak, including development of a harvest strategy for the fishery that has been applied since 2016 (Sainsbury et al. 2019). Abalone mortalities due to the disease severely reduced the biomass and resulted in a major reduction in total allowable commercial catch (TACC) for this zone from 280 t in 2001–02 to 20 t in 2008–09. While some fishing occurred on uninfected reefs for a period immediately after the disease was first recognised, by 2008 most areas in the Western Zone had been impacted and were closed to fishing. These events complicate comparisons between recent and historical fishery-dependent and independent data.

Progression of the disease through the fishery had abated by 2009. This enabled fishers and researchers to conduct a structured fishing program [Mayfield et al. 2011], where divers were assigned precise fishing locations to gather information and assess the capacity of remaining stocks to support a viable commercial fishery. Since SAFS 2016, and in line with the Western Zone harvest strategy based on simulation modelling by Helidoniotis and Haddon [2014], the TACC has been increased to 70 t reflecting increases in estimates of exploitable biomass of Blacklip Abalone with shell lengths larger than a conservative legal minimum length (LML) of 130–135 mm. Recent TACCs have been set at around 10 per cent of the estimated biomass of legal-sized abalone [WADA 2020] to facilitate continued rebuilding.

Commercial catch per unit effort (CPUE) for the management unit increased by 73 per cent from 1979–2001. These increases likely reflect changes in the sophistication of management strategies, change in fishing practice and adoption of improved technology, which led to increased efficiency of the fleet. The introduction of a TACC in the Victoria Western Zone in 1988 was anticipated to improve biomass and is likely to have contributed to the CPUE increases to some extent. The TACC was stable for more than a decade prior to the introduction of marine parks, probably because catch quotas were not linked to biomass trends at that time [Victorian Department of Natural Resources and Environment 1996]. The CPUE from 2001–06 declined slightly, until the 2006 AVG outbreak caused substantial declines in catch and catch rate. In 2007, the highest average annual CPUE on record occurred, most likely due to fishing becoming restricted to disease-free areas [Gorfine et al. 2018] and some divers reverting to fishing at the LML of 120 mm prior to AVG spreading to reefs in the Portland region of the Western Zone. After normal fishing practices resumed in 2011 and divers were free to choose where to fish, CPUE increased rapidly until 2013. This increase was likely to have arisen from divers being able to target the more productive reefs again after structured fishing ended. Catch-per-unit-effort during the past two years has been 77 kg per hour, the same as the pre-disease average for the period 1992–93 to 2003–04, and comparable with the other two management units [Dixon and Dichmont 2019 a,b], despite the conservative LML of 130–135 mm.

The fishery-independent survey (FIS) data from 2003 onwards clearly show the impact of the AVG mortalities. Survey abundance indices for both pre-recruits and recruits showed 32 per cent and eight per cent less abundance respectively in 2018, compared with the pre-disease averages during 1995–2006 [VFA 2017c]. Since 2010 pre-recruit abundance has increased more than three-fold and recruit abundance has increased by 75 per cent since 2008 [VFA 2017c]. Despite the signs of recovery, the current mature biomass remains below the 2020 target reference point, but above the limit reference point, in the harvest strategy for the fishery but has declined for the last 3 years. Mature biomass is dominated by abalone below the LML, and so is also likely to be influenced by

variation in year-class strength. Recent declines in mature biomass follow a large increase in the biomass of under-sized abalone to 2016 and are more closely related to declines in legal-sized biomass in recent years whereby mature, but undersize abalone biomass remains more stable [WADA 2020].

The above evidence indicates that the biomass of the stock is unlikely to be depleted, and that recruitment is unlikely to be impaired. Abalone viral ganglioneuritis did not disrupt the fundamental breeding and juvenile recruitment processes.

Fishery-dependent and independent information indicate that the management unit has been stable since 2011, although at a lower biomass than pre-AVG. The recent stability of commercial CPUE under the higher LML of 130–135 mm, combined with stability of the fishery-independent pre-recruit and recruit survey indices, and biomass estimates derived from them, indicate that the current management arrangements are constraining fishing pressure sufficiently to avert declines in the productivity of the stock. Signs are now evident of an increase in pre-recruit abundance, indicating that the stock has been rebuilding despite progressive increases in TACC [VFA 2017c].

The harvest strategy details criteria on which to base SAFS assessments of the fishery during the rebuilding phase following AVG. These include provisions for both mature biomass, estimated from the fishery independent surveys, and harvest fractions of the available biomass. The mature biomass is currently above the performance indicator of 20 per cent of the unfished biomass and the harvest fraction has remained below 15 per cent, with both reference points from Helidoniotis and Haddon [2014], implying that the stock is unlikely to become recruitment impaired. Although the stock is not expected to be able to support pre-AVG catch levels in the short to medium term, 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 Victoria Western Zone Fishery management unit is classified as a **sustainable stock**.

Western Australia

Stock status for Blacklip Abalone in Western Australia is reported as **Negligible** due to very low historical catches by this jurisdiction. The Blacklip Abalone stock is not targeted by commercial fishers and not recorded by charter operators. There has been a very small amount of historical catch reported by the recreational sector, but this is misreporting of Brownlip Abalone catch.

BIOLOGY

Blacklip Abalone biology [Shepherd 1973, Officer 1999, Tarbath et al. 2001, Tarbath and Officer 2003]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Blacklip Abalone	20–50 years, 150–220 mm SL	~ 5 years, 80–130 mm SL

DISTRIBUTION

Distribution of reported commercial catch of Blacklip Abalone

TABLES

Fishing methods				
	New South Wales	South Australia	Tasmania	Victoria
Commercial				
Diving	✓	✓	✓	✓
Recreational				
Diving	✓	✓	✓	✓

Management Methods				
	New South Wales	South Australia	Tasmania	Victoria
Charter				
Bag limits				✓
Gear restrictions				✓
Licence				✓
Size limit				✓
Spatial closures				✓
Temporal closures				✓
Commercial				
Gear restrictions	✓			✓
Licence				✓

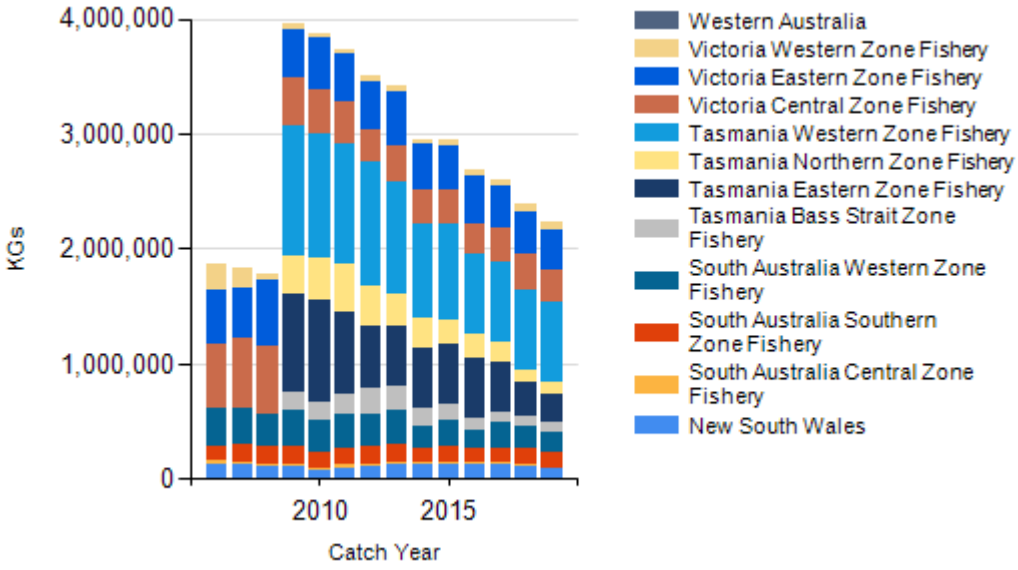
Limited entry	✓	✓	✓	✓
Limited entry (licensing)		✓		
Size limit	✓		✓	✓
Size limits		✓		
Spatial closures	✓	✓	✓	✓
Total allowable catch	✓	✓	✓	✓
Recreational				
Bag and possession limits	✓		✓	
Bag limits				✓
Bag/boat limits		✓		
Gear restrictions	✓			✓
Licence	✓			✓
Size limit	✓		✓	✓
Size limits		✓		
Spatial closures	✓			✓
Temporal closures				✓

Catch					
	New South Wales	South Australia	Tasmania	Victoria	Western Australia
Commercial	99.8431 t	300.043 t	1140.01 t	689 t	0 t
Indigenous	Unknown	Unknown	Unknown	Unknown	
Recreational	Unknown	0.1t	36 t	Unknown	

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*.

CATCH CHART



Commercial catch of Blacklip Abalone - note confidential catch not shown

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