Vongole Harvest Strategy

June 2024

1. Introduction

The purpose of this harvest strategy is to ensure that the Vongole Fishery, in all three fishing zones (West Coast, Coffin Bay and Port River), is fished on a sustainable basis in accordance with the objects of the *Fisheries Management Act 2007*. This harvest strategy has been developed using the best available information. The harvest strategy will remain in place for a period of five years, after which time the document will be reviewed and updated, if required.

The harvest strategy covers the Coffin Bay Zone and West Coast Zone of the fishery. The Port River Zone of the fishery has not been incorporated as this Zone has not been fished for a number of years. Should the Port River Zone be reopened to fishing in the future the harvest strategy will be modified to incorporate this Zone.

The harvest strategy was developed by the Department of Primary Industries and Regions (PIRSA) Fisheries and Aquaculture in collaboration with the Vongole Fishermen's Association of South Australia (VFASA), with scientific advice to inform the harvest strategy provided by the South Australian Research and Development Institute (SARDI) and an independent scientific reviewer.

2. Framework for annual decision-making process

This harvest strategy provides a structured framework for decision making that pursues the ecologically sustainable development (ESD) objectives of the *Fisheries Management Act 2007*. This decision-making framework involves two main steps that will be followed each year prior to the start of the new fishing season on 1 July.

- Step 1: use the harvestable biomass estimate performance indicator to determine the current stock status of the Vongole Fishery within the respective zones of the fishery.
- Step 2: use reference points and decision rules within the decision-making matrices (Tables 2 and 3) and associated meta-rules in Section 8 to determine the Total Allowable Commercial Catches (TACCs) within the respective zones of the fishery.

The Vongole Fishery comprises three species Greys – *Katelysia scalarina*, Yellows – *K. rhytiphora* and Whites – *K. peronii*. The TACCs in the respective zones of the fishery pool all three species together, albeit the scientific advice provided by SARDI recommends harvestable biomass estimates for all three species individually by zone (Appendix A). All three species are pooled when setting the TACCs for the respective zones due partly to the significant costs associated with applying finer scale management. The risks associated with not applying TACCs on a species basis are recognised and the monitoring of harvestable biomass estimates by species enables any significant changes in individual species abundance within a zone, to be acted upon, if required. The meta-rules of the harvest strategy provide for a review should the species composition within an individual bay in either zone have a significant shift. Fishery Independent Surveys (FIS') are conducted biennially (i.e., every second year) in the Coffin Bay Zone and triennially (i.e., every third year) in the West Coast Zone. An independent review of the FIS design was undertaken by CSIRO in March 2022. The primary recommendation of the review was that the frequency and the design of the FIS' in both the Coffin Bay and West Coast Zones remain constant over time so that survey results within zones can be directly compared over time to provide a more informed assessment of stocks (Foster 2022).

The decision rules used in the decision-making matrix are based on results from the FIS', which are used to determine a harvestable biomass estimate for the respective zones of the fishery (Coffin Bay and West Coast). A decision rule framework has not yet been developed for the Port River. Should the Port River be reopened a decision-making matrix will be developed at this time.

Under the decision rules used in the decision-making matrix, for both the Coffin Bay Zone and West Coast Zone of the fishery, a specific response will be triggered in terms of a TACC setting based on the results of the performance indicator (Tables 2 and 3).

The resulting TACC derived from the decision rules will then be considered by the Minister or their delegate for the upcoming quota period and discussed with licence holders in the fishery as part of the PIRSA process of seeking advice from licence holders on the setting of the TACC for the upcoming quota period. Noting the Minister or their delegate has responsibility for determining the kilogram weight of a quota unit, in the respective zone of the fishery, for a quota period under the *Fisheries Management (Vongole Fishery) Regulations 2021*, which subsequently determines the TACCs.

3. Status of Australian Fish Stocks (SAFS)

A consistent national reporting framework for the status of fish stocks has been developed and applied in all jurisdictions across Australia. The reporting framework provides stock status classifications to assess whether the current abundance/biomass of fish in a stock is at an adequate level and whether the level of fishing pressure is adequately controlled through management measures or regulation (Piddocke et al 2020).

Biological reference points provide guidance on determining whether stock abundance/biomass is too low or fishing pressure is too high. The SAFS provides guidance on the definition of stock status classification and the management actions to be taken for each status (Table 1). The SAFS guidelines have been incorporated into the decision-making matrices for the respective zones in the Vongole Fishery (Tables 2 and 3).

Table 1: SAFS stock status classifications

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

4. Objectives

The harvest strategy has the following objectives:

Coffin Bay Zone

- To maintain a target Vongole harvestable biomass estimate at greater than the target reference point of 700 tonnes (t) and greater than the trigger reference point of 480 t.
- To ensure that the Vongole harvestable biomass estimate does not drop to or below the limit reference point of 250 t.

West Coast Zone

- To maintain a target Vongole harvestable biomass estimate at greater than the target reference point of 450 t and greater than the trigger reference point of 300 t.
- To ensure that the Vongole harvestable biomass relative biomass does not drop to or below the limit reference point of 150 t.

The application of the objectives achieves the following:

1. Maintains the stock at sustainable levels by setting appropriate annual TACCs.
    a. Sustainability of the Vongole Fishery.
    b. Providing management decisions responsive to changes in relative abundance of Vongole.
2. Improved business certainty and viability.
    a. Implement decision rules to provide greater certainty to the annual TACC decision making process for all stakeholders.
    b. TACC is only altered in years when fishery conditions have significantly changed such as a substantial rise or fall in relative biomass (estimated from the FIS').
    c. Facilitate structured industry input into the decision-making process.
3. Profitability
    a. TACCs can be set at a level that maximises returns for the fishery within biologically sustainable limits.

5. Biological performance indicators

To ensure that the Vongole resource is harvested within ecologically sustainable limits, performance of the fishery will be assessed annually. This assessment will be undertaken using FIS', which determine the harvestable biomass estimate biological performance indicator to inform TACC decision making.

The harvestable biomass estimate for Vongole in the respective zones of the fishery (Coffin Bay and West Coast) is the biological performance indicator used because it provides representative estimates of Vongole stock relative abundance/biomass, has been proven to be an accurate index of relative abundance/biomass and has a time series going back to 2009. The method for estimating harvestable biomass of legal-sized Vongole is described in Ferguson et al (2022). Since 2015, annual estimates of fishery independent relative biomass in Coffin Bay have been available every year, except 2019. However, FIS' have generally been undertaken in Coffin Bay biennially and the West Coast triennially.

While the number of transects and transect locations has varied over time, particularly in the Coffin Bay Zone, from the time of inception of this harvest strategy the FIS transect locations and numbers, and their sites within both the Coffin Bay and West Coast Zones of the fishery will remain constant. As outlined in the independent review of the FIS design undertaken by CSIRO, the survey design needs to be consistent in order for harvestable biomass estimates to be compared between years (Foster 2022).

Prior to the commencement of a FIS in either the Coffin Bay Zone or West Coast Zone, SARDI will liaise with the VFASA on the specifics of the FIS. Should as part of the consultation the Association request any additional sites be surveyed, in addition to the fixed set sites in either the Coffin Bay Zone or West Coast Zone, consideration will be given to the surveying of these sites by SARDI with the cost of any additional surveying covered by industry through the cost recovery process.

6. Reference points for biological performance indicators

The SAFS classifications (see Table 1) have been applied to the current status of the fishery relative to a target, trigger and limit relative biomass reference range, where ‘green’ and ‘blue’ is the target range or a ‘Sustainable’ stock status classification, ‘yellow’ is within the trigger range or ‘Depleting’ and ’red’ is below the trigger range or ‘Depleted’ (see Tables 2 and 3).

In this harvest strategy, reference points have been developed for the harvestable biomass estimate biological performance indicator within each zone of the fishery. The reference points for the harvestable biomass estimate biological performance indicator are based on advice provided by SARDI (Appendix A).

The SARDI advice states that when the harvestable biomass estimate is above the trigger reference point the TACC should be set at 7.5% of the harvestable biomass estimate and when between the limit and trigger reference point the TACC should be set at a more conservative level of 3% of the harvestable biomass estimate to facilitate stock rebuilding. The respective zone of the fishery is closed (TACC set at zero) should the harvestable biomass estimate be below the limit reference point (Appendix A).

Exploitation rates among similar bivalve fisheries are highly variable (e.g., 2.5% for the OHV Dutch Hand-Raked Cockle Fishery, Cappell 2019; 33% for the Thames Estuary Cockle Fishery, Hough and Andrews 2019). The Tasmanian Vongole Fishery in Anson Bay (*K. scalarina*), that uses similar methods to those described in this harvest strategy to obtain estimates of harvestable biomass, sets its TACC at 10% of the most recent biomass estimate, and has a biomass limit reference point of 40 t (Tarbath and Gardner 2015).

The SARDI advice also considers the application of a TACC at 6% of the harvestable biomass estimate between the target and trigger reference point when there is an absence of pre-recruits and the use of pre-recruit information (Appendix A). The application of management based on the presence and absence of pre-recruits has not been applied in this harvest strategy as further analysis needs to be undertaken to determine if trends exist between pre-recruits and harvestable Vongole (i.e., Vongole above the legal minimum length). Data will continue to be collected over the five-year period this harvest strategy is in place for and should a relationship between pre-recruits and harvestable Vongole be

identified consideration will be given to the application of pre-recruit information as a performance indicator in a subsequent harvest strategy.

The SARDI advice separates the reference points within the respective zones by the two main harvested species (Greys – *K. scalarina* and Yellows – *K. rhytiphora*). However, historically the TACCs set for the respective zones of the fishery have been set for all species combined (including Whites – *K. peronii*) because of how the fishery operates, and from a catch-cost-risk trade-off perspective (i.e., harvest strategy and associated monitoring reflective of value of the fishery). Therefore, when determining the target, trigger and limit reference points for the respective zones of the fishery the reference points derived by SARDI for the individual species have been added together to determine reference points for the respective zones on both species combined (Greys – *K. scalarina* and Yellows – *K. rhytiphora*) (see Table 1 of Appendix A).

While the harvest levels or bands differentiating the reference points which are used to determine the TACCs for the respective zones do not precisely match the SARDI advice they have been selected in order to incrementally step up/down the harvestable biomass estimate results (see Tables 2 and 3). Further, in consultation with licence holders in the fishery consideration has been given to the historical TACCs and harvestable biomass estimate results produced when undertaking FIS'. Of particular consideration was the position of licence holders that the TACCs have been historically set at 50 tonnes and 16 tonnes for the Coffin Bay and West Coast Zones, respectively, regardless of the harvestable biomass estimate results. This position in particular resulted in the target reference point for the Coffin Bay Zone being set at 700 t, as opposed to 885 t in the SARDI advice (Appendix A).

The scale of the harvestable biomass estimate increments between target and trigger and trigger and limit for the respective zones has been determined on the basis of the levels required to incrementally step out the TACC settings (see Tables 2 and 3). In the case of the West Coast Zone, harvestable biomass estimate bands have been staggered at 50 t steps. The Coffin Bay Zone has been staggered at 100 t steps where possible, while seeking to maintain combined species reference points consistent with the SARDI advice (Appendix A).

Target reference points

The target reference point will be reached in Coffin Bay when the harvestable biomass estimate is greater than 700 t and in the West Coast Zone when the harvestable biomass estimate is greater than 450 t.

Trigger reference points

The trigger reference point will be reached if the harvestable biomass estimate for Coffin Bay is 480 t or less and in the West Coast Zone when the harvestable biomass estimate is 300 t or less.

Limit reference points

A lower limit reference point will be breached in the Coffin Bay Zone when the harvestable biomass estimate is 250 t or less and in the West Coast Zone when the harvestable biomass estimate is 150 t or less.

Re-opening strategy

In the event that the closure of either the Coffin Bay Zone or West Coast Zone of the fishery, as a result of the harvestable biomass estimate, going below the limit reference point (Tables 2 and 3), these zones of the fishery can only be reopened following the completion of a FIS illustrating the harvestable biomass is above the limit reference point.

Following the demonstration that the harvestable biomass estimates are above the limit reference points for the respective zones of the fishery, as described in Tables 2 and 3 for Coffin Bay and the West Coast, respectively, and there is industry support for the re-opening of the fishery then approval for the re-opening of the respective zone of the fishery will be sought from the Minister or their delegate.

The re-opening of the fishery will involve the setting of a kilogram value for the unit for the respective zone, which will translate to the TACCs in the decision-making matrixes (see Tables 2 and 3).

Conducting additional Fishery Independent Surveys (FIS')

Under the current Service Level Agreement (SLA) with SARDI the Coffin Bay Zone is surveyed every second year and all three bays in the West Coast Zone are surveyed together every three years. The biological performance indicator, harvestable biomass estimate, is determined from the surveys in the respective zones of the fishery. The results of these performance indicators then guide the TACCs for the respective zones of the fishery under the decision rules in Tables 2 and 3 and meta-rules of the harvest strategy.

Should industry consider the results of the survey do not accurately reflect the status of the stock or are seeking to have a survey undertaken to re-open the fishery, either of which is outside the normal scheduled two-year and three-year cycles for the FIS' in Coffin Bay and the West Coast, respectively, a request from industry for additional surveys can be made. The cost of the additional surveys will be recovered from industry.

7. Decision rules for TACC setting

The decision rules used in this harvest strategy have been designed to provide clear guidance to the TACC setting process by defining how harvestable biomass estimates should be interpreted when setting the TACCs for the Coffin Bay Zone and West Coast Zone of the Vongole Fishery.

In both the Coffin Bay Zone and West Coast Zone a harvest fraction of 7.5% is applied when the stock is classified as sustainable and a harvest fraction of 3% is applied when the stock is classified as Depleting, to determine the TACCs (Tables 2 and 3).Where the harvestable biomass estimate is below the limit reference point and has a "Depleted" stock status classification the fishery in the respective zone will be closed.

The harvest strategy reduction from 7.5% to 3% at the trigger reference point has been applied to recover the stock quickly and bring it back to a sustainable stock status classification.

Table 2: Decision matrix for Coffin Bay Zone of the Vongole Fishery.

Stock Status	Harvestable Biomass estimate	Harvest Fraction application
Sustainable	> 800 tonnes	(850 t) 64 t
Sustainable	> 700 to 800 tonnes	(750 t) 56 t
Sustainable	> 600 to 700 tonnes	(650 t) 49 t
Sustainable	> 480 to 600 tonnes	(540 t) 40 t
Depleting	> 400 to 480 tonnes	(440 t) 13 t*
Depleting	> 300 to 400 tonnes	(350 t) 11 t*
Depleting	> 250 to 300 tonnes	(275 t) 8 t*
Depleted	250 tonnes or less	Closed

*3% harvest fraction of harvestable biomass estimate.

Table 3: Decision matrix for West Coast Zone of the Vongole Fishery.

Stock Status	Harvestable Biomass estimate	Harvest fraction application
Sustainable	> 450 tonnes	(475 t) 35 t
Sustainable	> 400 to 450 tonnes	(425 t) 32 t
Sustainable	> 350 to 400 tonnes	(375 t) 28 t
Sustainable	> 300 to 350 tonnes	(325 t) 24 t
Depleting	> 250 to 300 tonnes	(275 t) 8 t*
Depleting	> 200 to 250 tonnes	(225 t) 7 t*
Depleting	> 150 to 200 tonnes	(175 t) 5 t*
Depleted	150 tonnes or less	Closed

*3% harvest fraction of harvestable biomass estimate.

DECISION RULES

Dependant on the harvestable biomass estimate in Tables 2 and 3 the following rules apply:

DECISION RULE 1*

The upper maximum biologically acceptable TACC or any lower value can be taken (Column 3 of Tables 2 and 3).

8. Meta-rules

In addition, to the decision rules a series of meta-rules are applied when setting the TACCs for the respective zones of the fishery. These meta-rules are specific rules relating to the individual bays within the West Coast Zone of the fishery.

Table 4: Limit reference point by bay and species.

Location	Species common name	Limit reference point total species combined (tonnes)
Smoky Bay	Greys and Yellows	> 30 t
Streaky Bay	Greys and Yellows	> 100 t
Venus Bay	Greys and Yellows	> 25 t

1. If the most recent FIS harvestable biomass estimate in either Smoky Bay, Streaky Bay or Venus Bay for both Yellows and Greys combined is less than the limit reference point designated for these species (Column 3 of Table 4) the corresponding bay will be closed to fishing.

2. Should one, two or all three West Coast bays be closed to fishing, as a result of being below the corresponding limit reference point (Column 3 of Table 4) the bay or bays will remain closed to fishing until such time as a further FIS illustrating the harvestable biomass estimate is above the limit reference point (Column 3 of Table 4) is undertaken.

3. Should one or two of the three West Coast bays be closed to fishing under meta-rule one the TACCs for the bays remaining open to fishing will be determined by adding the TACCs in the bays opening to fishing by using the respective decision-making matrices (Tables 5, 6 and 7). Noting the SARDI advice will determine the harvestable biomass estimate for the respective bays within the West Coast Zone.

Table 5: Decision making matrix for Smoky Bay

Harvestable Biomass estimate	Harvest fraction application
90 tonnes and above	(90 t) 6.8 t
90 to 80 tonnes	(85 t) 6.4 t
80 to 70 tonnes	(75 t) 5.6 t
70 to 60 tonnes	(65 t) 4.9 t
60 to 50 tonnes	(55 t) 1.6 t*
50 to 40 tonnes	(45 t) 1.3 t*
40 to 30 tonnes	(35 t) 1 t*
Less than 30 tonnes	Closed

*3% harvest fraction of harvestable biomass estimate.

Table 6 – Decision making matrix for Streaky Bay

Harvestable Biomass estimate	Harvest fraction application
300 tonnes and above	(300 t) 22 t
300 to 250 tonnes	(275 t) 21 t
250 to 200 tonnes	(225 t) 17 t
200 to 150 tonnes	(175 t) 5 t*
150 to 100 tonnes	(125 t) 4 t*
Less than 100 tonnes	Closed

* 3% harvest fraction of harvestable biomass estimate.

Table 7 – Decision making matrix for Venus Bay

Harvestable Biomass estimate	Harvest fraction application
90 tonnes and above	(90 t) 7 t
90 to 80 tonnes	(85 t) 6.4 t
80 to 70 tonnes	(75 t) 5.6 t
70 to 60 tonnes	(65 t) 5 t
60 to 50 tonnes	(55 t) 4.1 t
50 to 40 tonnes	(45 t) 1.3 t*
40 to 25 tonnes	(35 t) 1 t*
Less than 25 tonnes	Closed

* 3% harvest fraction of harvestable biomass estimate.

4. Should there be a significant shift in species composition in an individual bay, in either Zone, a review will be undertaken by PIRSA and SARDI in collaboration with industry to assess if management action is required.
5. When reopening a zone, following a FIS determining a harvestable biomass estimate within a zone, the TACC should not be set higher than 40 t (i.e., based on 540 t harvestable biomass estimate) for the Coffin Bay Zone and 24 t (i.e., based on 325 t harvestable biomass estimate) for the West Coast Zone of the fishery.
6. The results of a FIS to determine a harvestable biomass estimate for the Coffin Bay Zone must have been published within 25 months of the TACC being determined. This meta-rule is to ensure that the FIS to determine the harvestable biomass estimate are undertaken within appropriate timeframes to utilise in the harvest strategy to subsequently determine the TACC. If the results of a FIS to determine a harvestable biomass estimate for the Coffin Bay Zone has not been published within 25 months of the TACC being determined, fishing will not be permitted in the Coffin Bay Zone of the fishery and procedures in the section on re-opening the fishery in the event of a closure will need to be followed.
7. The results of a FIS to determine a harvestable biomass estimate for the West Coast Zone must have been published within 37 months of the TACC being determined. This meta-rule is to ensure that the FIS to determine the harvestable biomass estimate are undertaken within appropriate timeframes to utilise in the harvest strategy to subsequently determine the TACC. If the results of a FIS to determine a harvestable biomass estimate for the West Coast Zone has not been published within 37 months of the TACC being determined, fishing will not be permitted in the West Coast Zone of the fishery and procedures in the section on re-opening the fishery in the event of a closure will need to be followed.

9. Review of the harvest strategy

The harvest strategy will remain in place for a period of five years, after which time the document will be reviewed and updated, if required. The review of the harvest strategy will consider the harvest fractions and reference points applied for the harvestable biomass estimate biological performance indicator within each zone. Further, consideration may also be given to the application of a pre-recruit biological performance indicator.

10. References

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ADVICE TO:	**PIRSA FISHERIES AND AQUACULTURE (PROF. GAVIN BEGG – EXECUTIVE DIRECTOR)**
FROM:	**DRs KATHERINE HELDT AND BEN STOBART (SARDI AQUATIC AND LIVESTOCK SCIENCES)**
SUBJECT:	**VONGOLE FISHERY – HARVEST STRATEGY DEVELOPMENT**
DATE:	**23 FEBRUARY 2023**

KEY ISSUES:

- The harvest strategy (HS) for the Coffin Bay and West Coast Vongole Fisheries is under review, and harvestable biomass and pre-recruit densities have been identified as the primary and secondary performance indicators, respectively.
- For each of the Coffin Bay and West Coast Fishing Zones, PIRSA Fisheries and Aquaculture have requested advice on: (1) appropriate trigger and limit reference points for the Harvestable Biomass Performance Indicator; (2) a sub-legal-sized density value to differentiate presence from absence of pre-recruits; and (3) the appropriateness of the 7.5% harvest fraction.
- This request, and the current approach to TACC setting, assumes a single stock. However, the most appropriate approach is to identify reference points and pre-recruit presence/absence, and to then apply harvest fractions, for each biological stock (*i.e.* by species and by bay). Thus, we recommend target, trigger and limit reference points for greys and yellows in Coffin Bay and each of the three West Coast bays. Whites are not included due to their small contribution to biomass, though we note they have historically been more abundant in Venus Bay.
- Target biomass for each species and location was estimated based on average biomass during years in which the stocks were “sustainable”. Biomass at contrasting stock status for Coffin Bay was used to identify an appropriate HS trigger reference point. This was 40% below the target biomass. The limit reference point, consistent with the literature, was set at 30% of the target.
- Recommended definitions for the presence of Vongole pre-recruits for species in Coffin Bay and the West Coast fishing areas are: (1) in Coffin Bay, the average density of sub-legal-sized greys **and** yellows is ≥20/m^2 and ≥10/m^2, respectively; and (2) in the West Coast, **each** of the Streaky, Smoky and Venus bays have an average density of sub-legal-sized greys **and** yellows that is ≥40/m^2 and ≥5/m^2, respectively.
- Where pre-recruits are present, and the stock is above the trigger reference point, a harvest fraction of 7.5% could be applied. However, when pre-recruits are absent, a lower harvest fraction of 6% (or less) may be more appropriate. When stocks are between the trigger and limit reference points, a 3% harvest fraction is recommended. The harvest fraction should be zero if the stock falls below the limit reference point.

BACKGROUND:

The Vongole Fishery (*Katelysia* spp.) consists of three fishing zones (Coffin Bay, West Coast and Port River), and three species are fished under a single zonal quota (yellows, *K. rhytiphora*; greys, *K. scalarina*; whites, *K. peronii*). Under the current management plan, the total allowable commercial catch (TACC) is determined as a fraction of the total harvestable biomass estimate obtained from fishery independent surveys (a sum of the biomass for three species at 80% confidence), up to a maximum of 7.5% (PIRSA 2013). Stock status is determined for all three species combined using a weight-of-evidence assessment for each fishing zone following the 2021 National Fishery Status Reporting Framework (NFSRF; Piddocke *et al*. 2021), since the current management plan does not provide a definition of stock status. The TACC does not specify the composition of the three species to be caught.

The harvest strategy (HS) for the Vongole Fishery is currently under review. The framework for the Pipi (*Donax deltoides*) HS (PIRSA 2022) is being utilised as a template to develop the Vongole HS. Vongole harvestable biomass and pre-recruit densities have been identified as the primary and secondary performance indicators (PI's), respectively. The most appropriate HS would be one that identifies, and then manages, on the basis of reference points, pre-recruit presence/absence, and harvest fractions for each relevant biological stock (i.e., by species and by bay) in the HS. The key risk of not having a HS that is species and area specific is that areas and/or species may become locally depleted (Karpov et al. 2000).

This Advice Note provides appropriate species-specific target, trigger and limit reference points for the harvestable biomass of relevant species to the Coffin Bay and the West Coast (Streaky, Smoky and Venus Bays) Fishing Zones, and provides values to identify pre-recruit presence/absence for each species at each of these locations. These were estimated using harvestable biomass estimates from 2013 to 2021 available for similar (but not identical) survey areas and size limits for the Coffin Bay and the West Coast Fishing Zones, and pre-recruit information available from 2009 onwards. In addition, the appropriateness of a 7.5% harvest fraction in the HS for Coffin Bay and the West Coast Fishing Zones is discussed.

RESULTS/DISCUSSION:

Primary PI - Harvestable biomass - target, trigger and limit reference points

Logical target, trigger and limit reference points can be derived where stock history provides contrasting status that can be used as a reference. Within the Coffin Bay and West Coast Vongole fisheries, the only historical changes in status for the period 2013 to 2021 have occurred in Coffin Bay, where stock status changed from "sustainable" in 2017 to "depleting" from 2018 to 2020, and then back to 'sustainable' for 2021 (Ferguson et al. 2022). While these stock statuses were applied to mixed-species biomass, the contrast in biomass between periods that had a "sustainable" and "depleting" stock status was used to identify appropriate percentage differences in biomass to set the HS trigger reference points for each species. While the "depleting" stock status from 2018 to 2020 was primarily related to decreases in *K. rhytiphora* abundance, a similar percentage difference in biomass was applied across all the Vongole species and bays.

Survey designs from 2013 to 2021/22 differed among years. Despite this variability, to enable the largest possible dataset, the best estimates of harvestable biomass from each year, derived using all transects sampled in that year, were used. This method allows for multiple years of data to be used, reflecting interannual variation in harvestable biomass estimates.

Average (± SE) harvestable biomass estimates were obtained for sustainable and depleting statuses. From 2021/22, harvestable biomass and stock status will be determined from a consistent survey design. Consequently, it may be necessary to reconsider the target, trigger and limit reference points, using the new and consistent data, at the next HS review.

For Coffin Bay, the average harvestable biomass estimate in sustainable years was 884 t ± 80, and during depleting years it was 541 t ± 3. The difference between these estimates is 39%. Based on these estimates, an appropriate species-specific trigger reference point could be set at 40% below the target reference point for each species. In addition, based on the literature, a suitable limit reference point could be 30% of the target (Sainsbury 2008; Keane 2021), given that Vongole recruitment is episodic and that stocks exhibit frequent fluctuations in productivity.

Thus, the proposed target for greys and yellows in Coffin Bay and the West Coast (Bays) was derived from the average biomass for these species and locations during "sustainable" years, with the proposed trigger set 40% below the target and the proposed limit set at 30% of the target (Table 1). Assigning reference points for whites is not possible because they contribute very little to legal biomass in recent years (Ferguson et al. 2022).

Table 1. Proposed species and location-specific target, trigger and limit reference values based on estimates of harvestable biomass for the Vongole Harvest Strategy. Note numbers rounded to the nearest 5.

Location	Species	Common name	Target (t)	Trigger(t)	Limit (t)
Coffin Bay	*K. scalarina*	Greys	145	90	45
	K. rhytiphora	Yellows	740	445	220
Smoky Bay	*K. scalarina*	Greys	65	40	20
	K. rhytiphora	Yellows	30	20	10
Streaky Bay	*K. scalarina*	Greys	215	130	65
	K. rhytiphora	Yellows	120	70	35
Venus Bay	*K. scalarina*	Greys	70	40	20
	K. rhytiphora	Yellows	20	10	5

Secondary PI - pre-recruits - presence/absence

Using a similar dataset as for harvestable biomass above, but from 2009 to 2021/22, years in which average pre-recruit densities were contrasting were identified (i.e. relatively high and/or a greater number of transects with high densities and the converse; see Appendix A for detail). Sensible boundaries were established between these contrasting densities to differentiate between presence and absence of pre-recruits (rounded up to the nearest 5 N/m2).

Coffin Bay

Pre-recruit presence occurs when the average density of sub-legal-sized greys is greater than 20 N/m2 and the average density of sub-legal-sized yellows is greater than 10 N/m2.

Pre-recruit absence occurs when the average density of sub-legal-sized greys is below 20 N/m2 or the average density of sub-legal-sized yellows is below 10 N/m2.

Thus, for example, pre-recruits would be considered present in Coffin Bay in 2020 and 2021 (Figure A2).

West Coast

Pre-recruit presence occurs when the average density of sub-legal-sized greys is greater than 40 N/m^2 **and** the average density of sub-legal-sized yellows is greater than 5 N/m^2 in **each** of the three surveyed bays.

Pre-recruit absence occurs when the average density of sub-legal-sized greys is below 40 N/m^2 **or** the average density of sub-legal-sized yellows is below 5 N/m^2 in **at least one** of the three surveyed bays.

Thus, for example, pre-recruits would be considered present on the West Coast in 2021 when all three bays exceeded the pre-recruit presence definition (Figure A4).

Table 2. Proposed species and location-specific average densities (N/m^2) at or above which pre-recruits would be considered "present" in the Vongole Harvest Strategy (rounded to the nearest 5).

Location	Species	Common name	Pre recruits present (N/m^2)
Coffin Bay	*K. scalarina*	Greys	≥20; and
	K. rhytiphora	Yellows	≥10
All West Coast Bays	*K. scalarina*	Greys	≥40; and
	K. rhytiphora	Yellows	≥5

Harvest Fraction

In 2013, the maximum of 7.5% harvest fraction of the harvestable biomass was considered appropriately conservative, while optimising the return from the resource (PIRSA 2013). Similar hand collection, bivalve fisheries around the world range between 1% and 30% in their harvest fractions (López-Rocha et al 2021). Vongole are characterised by low-level, episodic recruitment and therefore require conservative harvest fractions to maintain adequate spawning biomass during periods of low recruitment.

There is evidence to indicate that the 7.5% harvest fraction applied annually to Vongole in South Australia may be too high (see Appendix B). However, where pre-recruits are present and the stock is above the trigger reference point, a harvest fraction of 7.5% could still be applied. This approach of allowing higher catches when there is a presence of pre-recruits is consistent with the Pipi harvest strategy (PIRSA 2022). When pre-recruits are absent, a lower harvest fraction of 6% (or less) may be more appropriate (see Appendix B). When stocks are between the trigger and limit reference points, a more conservative harvest fraction of 3% (or less) is warranted (Tables 1, 2). The harvest fraction should be zero if the stock falls below the limit reference point. This conservative approach is recommended as Vongole have episodic recruitment.

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Appendix A. Pre-recruit densities

Coffin Bay

Most transects surveyed from 2009 to 2021 in Coffin Bay had relatively low vongole pre-recruit densities (N/m^2) interspersed with outlying higher density transects (yellows 0 - 2,350 N/m^2; greys 0 - 1,013 N/m^2; Figure A1). Pre-recruit densities for whites in Coffin Bay contribute little to the legal biomass in Coffin Bay (Ferguson 2022) and not discussed further.

In 2009, 2011, 2020 and 2021, for greys, there were >13 transects containing at least 100 N/m^2 while from 2013 to 2018 only 5 transects or less contained at least 100 N/m^2. These years coincided with relatively high and low average pre-recruit densities, respectively (Figure A2). Average pre-recruit density of yellows was also relatively high in 2013, 2020 and 2021, with > 10 transects containing at least 50 N/m^2 in these years). The proposed species pre-recruit density cut-off point of 20/m^2 for greys and 10/m^2 for yellows that in combination define pre-recruit presence was exceeded in 2020 and 2021 (Figure A2).

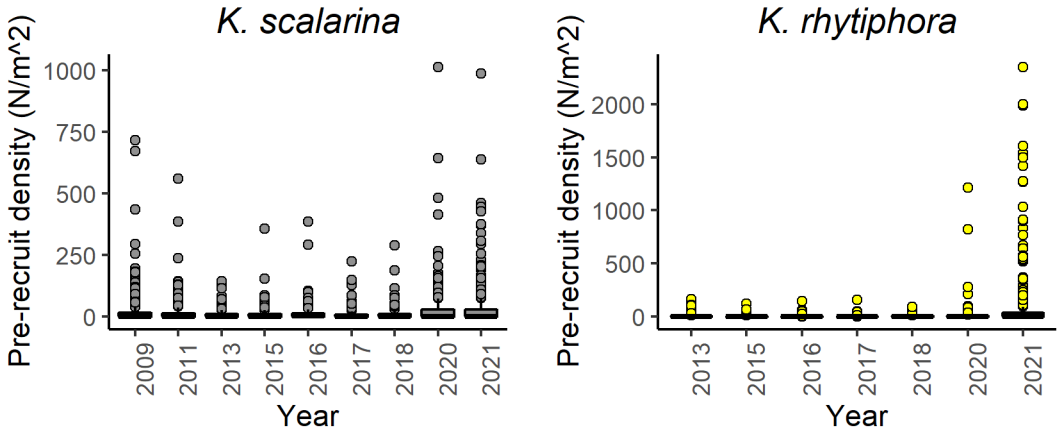

Figure A1. Pre-recruit densities (N/m^2) for greys (*K. scalarina*) and yellows (*K. rhytiphora*) in Coffin Bay from 2009 to 2021.

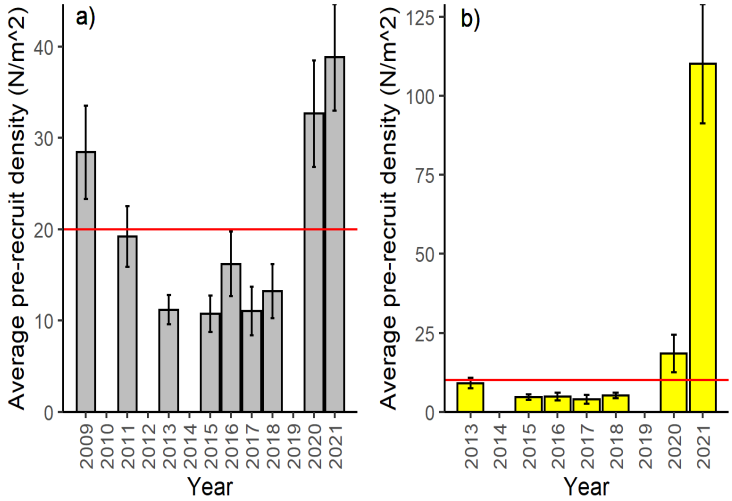

Figure A2: Average Vongole pre-recruit densities ± SE (N/m^2) for a) greys (*K. scalarina*); b) yellows (*K. rhytiphora*) in Coffin Bay. The solid red line is the proposed species-specific cut-off point at which pre-recruits could be considered "present" (above the line) if this criterion is met for both species. Data were not available for 2009 – 2011 for yellows due to MLL changes and the sampling method used. Note the axes vary among figures.

West Coast

The same principles as those used to determine Coffin Bay pre-recruit presence/absence were used for the West Coast. Most transects conducted from 2009 to 2021 on the West Coast also had relatively low pre-recruit densities interspersed with outlying higher density transects (greys 0 - 2,378 N/m^2; yellows 0 – 326 N/m^2; Figure A3). The average densities of pre-recruits varied among the three bays (Figure A4), and the number of transects with high densities of pre-recruits was not always aligned with average pre-recruit densities. For example, Smoky Bay only had grey pre-recruits in 7 transects in 2017 and 2021, while average pre-recruit densities were relatively high in 2015, 2017, and 2021. The proposed species-specific point defining pre-recruit presence in the West Coast was only exceeded once in 2021 when all three bays had densities above the proposed cut-off point of 40/m^2 for greys and 5/m^2 for yellows (Figure A4).

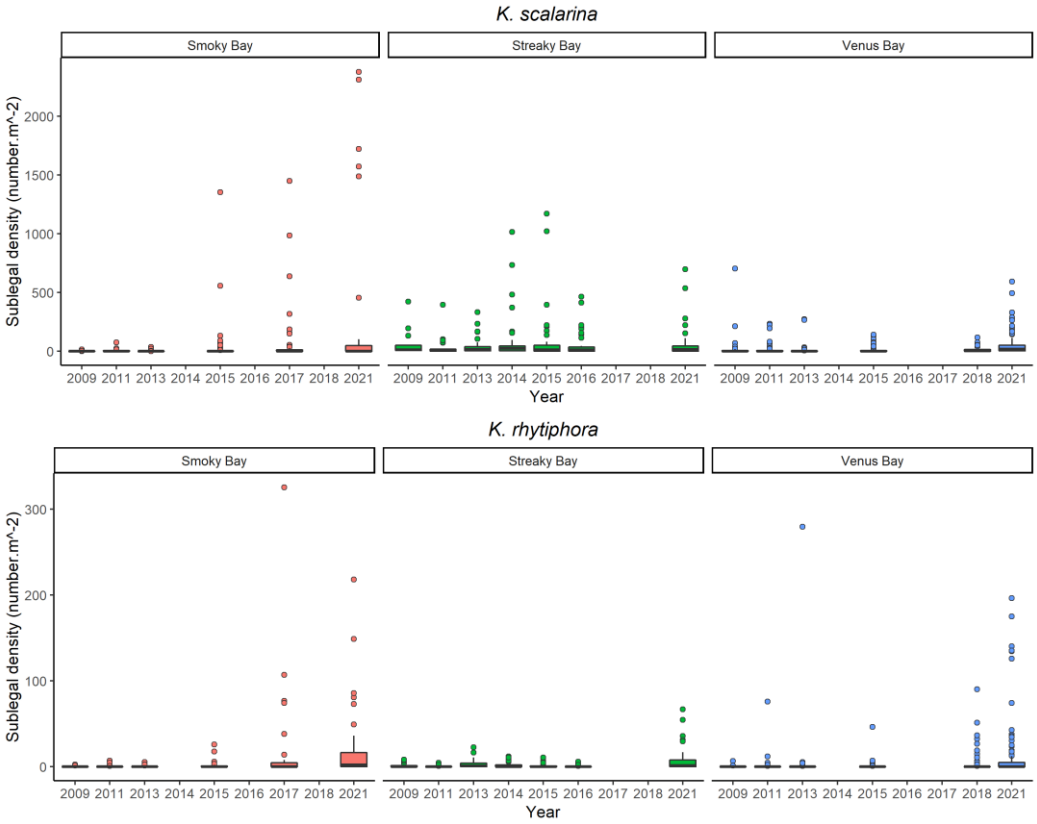

Figure A3. Pre-recruit densities (N/m2) for greys and yellows in Smoky Bay (pink), Streaky Bay (green), and Venus Bay (blue) from 2009 to 2021.

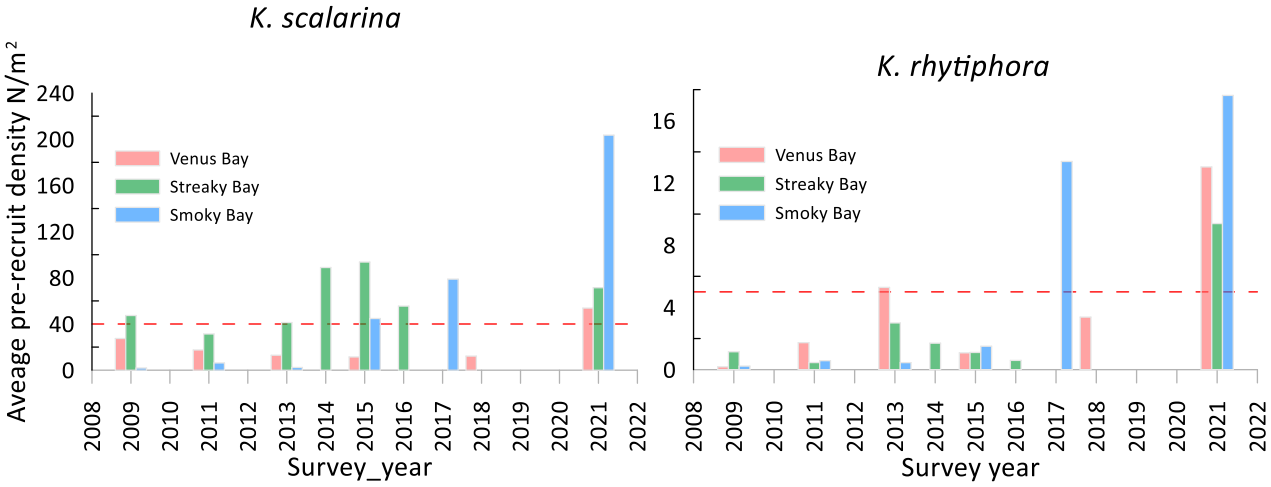

Figure A4. Average Vongole pre-recruit densities (N/m^2) for *K. scalarina* and *K. rhytiphora* in Smoky Bay (pink), Streaky Bay (green), and Venus Bay (blue). The red dashed line is the proposed species pre-recruit density cut-off point at which pre-recruits could be considered present (above the line) if this criterion is met for both species in each of the three bays.

Appendix B. Harvest Fraction

There is evidence to indicate that the 7.5% harvest fraction for Vongole may be too high, including:

1) in the three years prior to the depleting stock status in Coffin Bay in 2018/19, harvest fractions were below 7.5% (5.8 - 6.8%), yet stocks were declining, with long-term reductions in the abundance of legal and large sized Vongole and relatively low recruitment (Heldt et al. 2020). Strong recruitment events are rare, with only one clearly documented in the last thirteen years (2021; Ferguson et al. 2022) suggesting that a harvest fraction more conservative than 7.5% may be required to maintain adequate spawning biomass; and

2) more extreme temperatures are predicted in the future, and Vongole are sensitive to environmental stressors (e.g. die-offs in Port River and Streaky Bay related to heat and extreme tides). In combination with rare recruitment events, this makes Vongole stocks more vulnerable. For example, the South Australian Port River Fishery (*Katelysia* spp.) and the Tasmanian Anson Bay Fishery (*K. scalarina*) set respective TACCs at 10% of biomass estimates, and both fisheries were impacted by low levels of recruitment and environmental stressors. These two fisheries are depleted and have been closed for several years. Their rapid decline and closure suggest that the harvest fraction should be set conservatively.