

Implementation Plan for the Marine Scalefish Fishery Harvest Strategy

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1 Introduction and aim

South Australia's commercial Marine Scalefish Fishery (MSF) is a complex, multi-species, multi-stock, multi-gear and shared-access fishery that has recently undergone a large reform which included the implementation of quota-based management supported by a new Tiered Management Framework (TMF) (Appendix 1). Other commercial fisheries, the recreational fishery and Charter Boat Fishery share access to MSF fish stocks and have specified state-wide allocations for several stocks, which in some instances constitute a large component of the fishery. For all stocks, the Aboriginal traditional sector has a nominal 1% allocation¹.

A Harvest Strategy Framework (HSF) has been developed for the MSF. The aim of the framework is to establish robust, transparent, and defensible mechanisms to maintain MSF stocks at sustainable levels and ensure that management of the fishery is consistent with the *Fisheries Management Act 2007* and the [South Australian Harvest Strategy Policy](#). The HSF is an important section in the [Management Plan for the South Australian Commercial Marine Scalefish Fishery](#) ("the Management Plan"). The HSF defines the overarching goals and objectives, and reference points and decision rules to be applied to manage MSF stocks depending on the management tier (Appendix 1), and assessment category (Appendix 3).

The HSF in the Management Plan is accompanied by this Implementation Plan (IP). The IP outlines the specific details about how the harvest strategies are to be applied, including assessment approaches and decision rules for individual stocks. Details relevant to implementation of the HSF for individual stocks are summarised below. The arrangements described in this IP must be consistent with the arrangements described in the Management Plan.

Harvest strategies with formal decision rules are new to the MSF and some ongoing refinements are likely to be required at the stock level. For example, it is likely that there will be assessment refinements for several stocks as additional data are obtained and more robust assessment approaches are applied. To accommodate such changes and provide flexibility for efficient ongoing refinement of the application of the HSF to specific stocks, the IP sits outside the Management Plan.

2 Application and review

This IP is to be periodically updated as relevant new information becomes available regarding the scientific assessment and/or management of the MSF permitted species (e.g., improved stock assessment resulting in a change of assessment category, or a stock changes management tiers).

To amend this IP, changes should be provided to the Marine Scalefish Fishery Management Advisory Committee (MSFMAC) for consideration, with recommendations then provided to the Minister for Primary Industries and Regional Development or the Executive Director, Fisheries and Aquaculture, for approval, as appropriate.

Implementation of this IP cannot deviate from the HSF as provided in the Management Plan.

¹ Where the estimate of the recreational share for a particular stock is less than 1%, the Aboriginal traditional allocation has been set at half of the recreational share.

3 The Marine Scalefish Fishery Harvest Strategy Framework

The HSF describes the performance indicators for measuring the performance of the MSF stocks, and the use of these indicators and their associated reference points and decision rules for managing the MSF. The reference points are set to achieve preferred stock status (indicated by the target reference point) and to avoid undesirable outcomes (below the limit reference point).

The HSF reference points are:

- Target reference point (B_{TARG}) is 50% of the unfished biomass (B), or its proxy, denoted as B_{50} . The appropriate/corresponding fishing mortality reference point is F_{50} .
- Trigger Reference point (B_{TRIG}) is 40% of the unfished biomass, or its proxy (B_{40}).
- Limit reference point (B_{LIM}) is 20% of the unfished biomass, or its proxy, as the default value denoted as B_{20} . The appropriate/corresponding fishing mortality reference point is F_{LIM} .

The reference points above are the default values that are used unless alternative reference points are identified that are scientifically defensible to be more appropriate and are specified in this IP.

The stocks covered by this framework are those that are monitored and assessed, including Management Tier 1, Tier 2 and Tier 3 stocks of the TMF. Catches from the commercial sectors, as well as the recreational, Charter Boat and Aboriginal traditional sectors are included because, where data are available, all forms of fishing mortality need to be accounted for.

The HSF adopts a multi-category approach to deal with different levels of information and uncertainty in stock assessments. The different assessment categories reflect varying levels of uncertainty with stock status and identify ways to reduce the risks associated with this uncertainty.

Note the term 'stock[s]' is used throughout this document. In most cases 'stock' is consistent with the management unit. However, in some cases, the biological stock straddles multiple management units. Assessments are undertaken at the most appropriate level. Where necessary, Recommended Biological Catches (RBCs) would be distributed to management zones.

For many stocks in the MSF, it is not possible to estimate biomass and/or fishing mortality. For these stocks, empirical indicators are used together with proxies for the reference points.

Management Tier 1 stocks (i.e., Snapper, King George Whiting, Southern Garfish and Southern Calamari within specific management units; see Appendix 2) are to be maintained, on average, at the biomass target, B_{TARG} .

Management Tier 2 and Tier 3 stocks are to be maintained as close to the biomass target reference point (or proxy) as practicable.

All Management Tier 1, 2 and 3 stocks are to be maintained above their biomass limit reference point (B_{LIM}) at least 90 per cent of the time.

3.1 Assessment categories and decision rules

The HSF comprises six assessment categories (Table 1). Assessment Category 1 can be described as 'data-rich', Assessment Categories 2-4 are 'data-moderate', and Assessment Categories 5 and 6 are 'data-poor'. Stocks are allocated to a particular category based on data availability, and the quality and

type of assessment that is applicable to the stock. Not all categories are currently being used but have been included to accommodate species moving between Management Tiers and for a greater range of assessment methods to be used, should additional data become available.

The performance indicators for each stock may need to only consider commercial data if data on recreational catch and effort are not available or not sufficiently robust. However, catches from all relevant catching sectors should be included in the harvest strategy where possible and decision rules should consider each sector.

Table 1. Summary of assessment categories and assessment type.

Assessment Category	Assessment type
1	Robust integrated stock assessment model with fishery independent/dependent biomass indices
2	Integrated stock assessment model with fishery independent/dependent biomass indices – less certain or preliminary assessment
3	Biomass dynamic, surplus production models, stock reduction analysis
4	Empirical estimation of fishing mortality (size/age data), spawner biomass per recruit
5	Trends in standardised CPUE
6	Weight of evidence e.g., catch only methods, raw catch rates, species composition, risk assessments

There are two types of decision rules:

- **Management Tier 1 stocks:** An RBC is estimated. The RBC is the total catch that can be taken from the stock, as determined by the harvest strategy, and is shared between sectors (commercial, recreational, charter boat and Aboriginal traditional) based on the regional distribution of state-wide allocations. For those species with Individual Transferable Quota (ITQ) management arrangements implemented for a given fishing zone, a TACC/TARC will be set for relevant commercial sector/s annually and a corresponding quota unit value determined. For species in zones for which ITQs are not in place (e.g., West Coast King George Whiting) a commercial catch cap may be implemented.
- **Management Tier 2 and 3 stocks:** If the assessment of a fish stock indicates the biomass (or proxy) is declining and/or current fishing mortality is estimated to be greater than the fishing mortality to give F_{50} (as specified in the relevant assessment category), the decision rule would be triggered. If the decision rule is triggered, additional analyses and/or a species/sector-specific workshop are required from which management options are considered and monitoring and research needs identified and reported to the MSFMAC.

A “hockey stick decision rule” (Figure 1) applies to Assessment Category 1 and Assessment Category 2² stocks whereby fishing mortality (F) is reduced approximately linearly below the biomass trigger (B_{TRIG}) until it reaches the biomass limit (B_{LIM}) where F is zero. Apart from stocks assigned to Assessment Categories 1 and 2, and, for Southern Calamari (GSV/KI and SG), Category 5, all other stocks are currently assigned to Assessment Category 6.

² In some limited situations (e.g., where a stock assessment applies to only part of a stock), and where scientific evidence supports an alternative approach, a hockey stick decision rule may not be applied for this category.

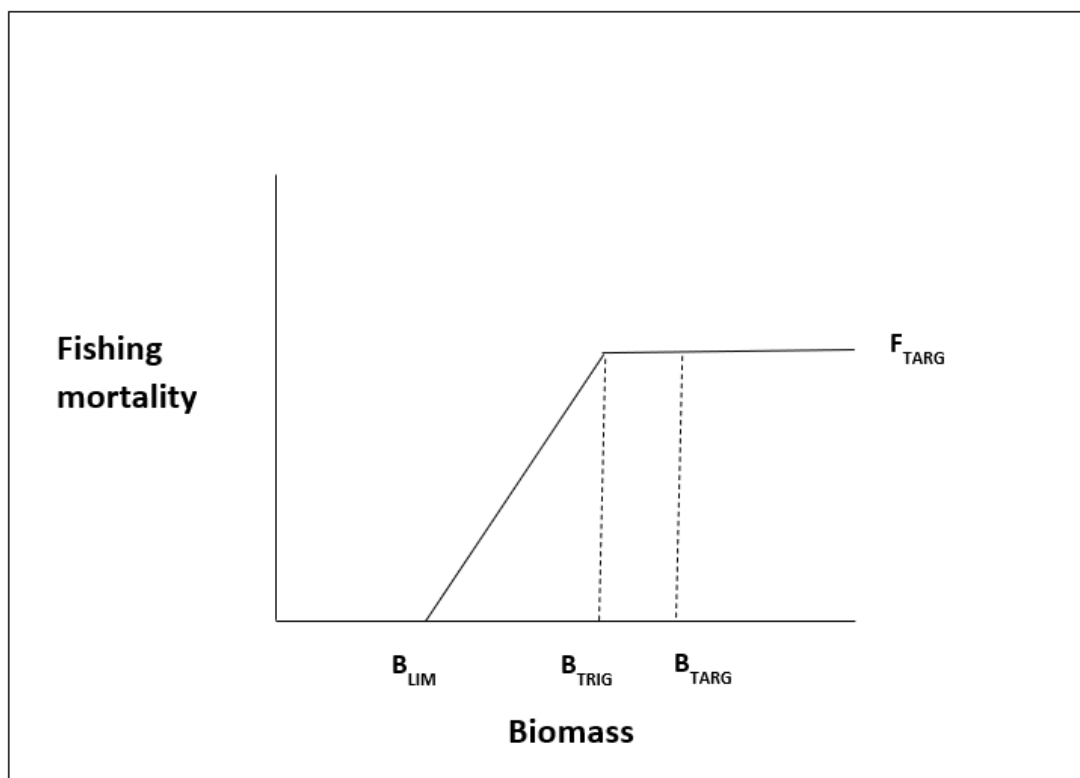


Figure 1. The “hockey stick” decision rule with associated reference points.

Table 2 below illustrates an example of use of the hockey stick decision rule to estimate RBCs. The example is based on a generic fish stock with a moderate life span with the integrated assessment giving an unfished biomass of 5000 tonnes (t) and a fishing mortality (F) at B_{TARG} of 0.2. The equivalent harvest fraction is 18.1%. The table shows RBCs for various current biomasses as a percentage of the unfished biomass – 60% of unfished biomass (B_{60}), B_{TARG} , B_{TRIG} , 30% of unfished biomass (B_{30}) and below B_{LIM} .

Table 2. An example of fishing mortality, harvest fraction and RBC values for corresponding biomass estimates and reference points.

Percentage of unfished biomass	Biomass (t)	Fishing mortality	Harvest fraction %	RBC (t)
B_{60} - 60%	3000	0.2	18.1	543
B_{TARG} - 50%	2500	0.2	18.1	453
B_{TRIG} - 40%	2000	0.2	18.1	362
B_{30} - 30%	1500	0.1	9.5	143
B_{LIM} - < 20%	1000	0	0	0

A weight-of-evidence approach is used in Assessment Category 6. It typically uses catch-only methods (e.g., Catch-MSY), raw catch rates and risk assessments. Catch-MSY is a commonly used data-poor method that gives estimates of maximum sustainable yield (MSY), essentially the RBC at the target biomass (B_{50}). However, the estimated depletion is highly uncertain and should be treated cautiously when used in isolation. That said, it may provide a broad indication of stock status that can be considered together with other methods. Further information regarding the application of the Catch-MSY method is available in Smith *et al.* 2021.

An example of a weight-of-evidence approach is provided as follows:

- Catch-MSY output may indicate an MSY of 300 t and suggest a stock is above its biomass limit reference point (B_{LIM}).

- The current catch is 200 t.
- Catch rates show an increasing trend.

Based on the above, the stock would be interpreted as being above the limit reference point and moving towards the target.

Further details on categories, decision rules and calculating RBCs is provided in Appendix 3.

3.2 Determining total catch and RBC

The HSF will be applied to determine an RBC for a Management Tier 1 stock in a given fishing zone. The RBC is considered to be the recommended total catch, less the buffer (if applicable; see Section 4), for a stock or fishing zone including catch of all extractive sectors.

A total allowable commercial catch (TACC) is the RBC (adjusted if applicable) less the regional distribution of state-wide allocations to the recreational, Charter Boat and Aboriginal traditional fisheries. If the RBC changes in response to application of the harvest strategy, the TACC/TARC is adjusted accordingly. For the other sectors, equivalent adjustments are made, if required, using existing or new management measures. Management arrangements for each fishing sector will be determined on a case-by-case basis, and aim to maintain all sectors at their regional share of the RBC.

The monitoring and stock assessment program needs to be commensurate with the scale and value of the MSF. Consequently, multi-year RBCs may be recommended. In addition, in some circumstances, if there is low risk to the stock, it may be appropriate to set a total allowable catch (TAC) and TACC/TARC that is different from that given by the decision rule. The HSF provides examples of when this might be considered which include: bycatch provisions, a minimum/maximum change rule, and step-up/step-down total catch.

Additionally, the HSF includes exceptional circumstances provisions to depart from or suspend the harvest strategy where credible information becomes available indicating that an RBC or resultant catch limit or other management arrangement derived from the HSF are not consistent with the objectives of the HSF.

Rebuilding depleted stocks

The Harvest Strategy states that for any stock or management unit that is classified as depleted, there should be a high probability of stock recovery to levels above the limit reference point, within specified timeframes related to the generation time of the species/stock. Depending on the stock and level of depletion, a rebuilding plan or strategy will be required. Further, an additional buffer may be applied to the RBC to ensure confidence that rebuilding will occur.

Transitional arrangements

Stocks below the biomass limit (B_{LIM}) – Apart from those stocks for which recovery management measures are already in place, stocks that are assessed to be below B_{LIM} when the HSF is implemented, will be subject to a two-year period of transitional arrangements. These will be identified in this IP (see Section 4). During this transitional period, the take of these stocks will not be reduced immediately to zero; however, management actions shall be directed to the rapid rebuilding of these stocks. These transitional arrangements will apply for no more than two years. The HSF will apply to all stocks in full following this transitional period, which means that fishing of species below B_{LIM} will then cease.

Stocks at or above B_{LIM} and below the biomass trigger (B_{TRIG}) – To support the transition to the HSF and accompanying new stock assessment methods, for stocks that are assessed to be at or above B_{LIM} yet below the biomass trigger (B_{TRIG}), a step-down approach may be applied to F, and resultant RBCs and TACCs derived from the HSF, for a period of three years from the commencement of this HSF.

4 Specific considerations for individual stocks.

The assessment category and decision rule (Appendix 3) currently applied to each stock are identified below. However, as previously noted, these are likely to change for some stocks as additional data are obtained and updated assessment approaches are adopted.

This IP also provides further detail for stock-specific harvest strategies that have been established following discussions between PIRSA, SARDI and stakeholders. These include:

- Buffers or discount factors are applied to the RBC to account for increased uncertainty at the lower stock categories. There is no buffer for Assessment Category 1 stocks, a 10% buffer is applied to Assessment Categories 2-4, and a 20% buffer to Assessment Categories 5 and 6. These buffers are default unless scientific evidence supports a more suitable value and this is specified in this IP.
- Reference periods are required for Assessment Category 5 and these may vary among stocks. For Category 5, it relates to the average catch and catch per unit effort (CPUE) during a period when the stock was considered close to the target biomass.
- Step up/step down total catch – this may be applied such that a total catch is increased or reduced over several years rather than in one year as determined by the RBC. The aim would be to minimise, for example, impacts on the fishery due to large episodic recruitment and provide the best means of managing this recruitment. However, the intent of the harvest strategy policy still needs to be met and risks to stock sustainability by adopting such an approach will be assessed on a case-by-case basis.
- Minimum/maximum change – to provide certainty and to minimise small changes in RBCs/TACs, a minimum and maximum change of 5% and 50%, respectively, are applied across all stocks unless specified otherwise in this IP.
- Bycatch provisions may be applied when the RBC is zero (i.e., stock is below the limit reference point) to account for incidental catches of a stock due to the multi-species nature of the MSF. This approach could be considered when the level of targeting can be reduced and the ability of fishers to avoid the stock is clear. Any incidental catch must not prevent stock rebuilding.

4.1 Management Tier 1 Stocks

Management Tier 1 stocks are managed at the fishing zone level via a TACC³, and, in most cases are unitised through ITQs. There is also a total allowable recreational catch (TARC) for the south east Snapper stock as outlined in Appendix 2.

The current harvest strategies including categories, assessment methods, key indicators, type of decision rule, are summarised in the tables below for each stock.

³ Or commercial catch cap in the case of King George Whiting in the West Coast Fishing Zone

King George Whiting

There are three Management Tier 1 stocks of King George Whiting - West Coast (WC), Spencer Gulf (SG), and Gulf St Vincent and Kangaroo Island (GSV/KI). Note the West Coast stock is Assessment Category 2 because of considerable uncertainty in the current assessment.

Table 3. Summary of current harvest strategies for Management Tier 1 King George Whiting stocks

Stock / Fishing Zone	Assessment Category	Assessment method	Buffer	Key indicator(s)	Decision rule
WC	2	Integrated stock assessment model	10%	F, B	Hockey stick
SG	1	Integrated stock assessment model	NA	F, B	Hockey stick
GSV/KI	1	Integrated stock assessment model	NA	F, B	Hockey stick

Snapper

There are three biological stocks of Snapper, SG/WC, GSV/KI and South East (part of Western Victoria (WV) stock). These stocks are spread across the four MSF fishing zones (management units). The SG/WC and GSV stocks are depleted, and the fisheries are closed. A rebuilding plan will be in place before these fisheries open. For the SG/WC and GSV/KI stocks, the Daily Egg Production Method (DEPM) has been used to provide an estimate of absolute abundance to inform the integrated assessment. Hydro acoustics and other alternative methods may be applied in future to provide these estimates.

For the SE stock, there is strong periodic recruitment from Victoria. Because the origin of recruitment is outside South Australia, and the fate of adult Snapper in the SE is uncertain, it is considered unnecessary to apply a buffer to this stock. Additionally, noting the application of a fixed harvest fraction for the SE stock, the 50% maximum change rule might not be applied in some circumstances (including where there are no sustainability concerns), where recommended by the MSFMAC.

Snapper stocks are characterised by large but variable episodic recruitment events. In such circumstances a step up/step down total catch may assist in managing this recruitment in conjunction with the hockey stick decision rule.

Table 4. Summary of current harvest strategies for Snapper stocks

Stock / Fishing Zone	Assessment Category	Assessment method	Buffer	Key indicator(s)	Decision rule
WC	1	Integrated stock assessment model	NA	F, B	Hockey stick
SG	1	Integrated stock assessment model	NA	F, B	Hockey stick
GSV/KI	1	Integrated stock assessment model	NA	F, B	Hockey stick
SE	2	Integrated stock assessment model	0%	F, B	Fixed harvest fraction

Southern Garfish

There are two Management Tier 1 stocks, SG and GSV/KI. The SG stock is classified as 'Recovering', however existing large spatial closures mitigate the need for precautionary buffers to be applied to support rebuilding.

Note there are two additional stocks, WC and SE, with negligible catches that have not been assigned a management tier.

Table 5. Summary of current harvest strategies for Management Tier 1 Southern Garfish stocks

Stock / Fishing Zone	Assessment Category	Assessment method	Buffer	Key indicator(s)	Decision rule
SG	1	Integrated stock assessment model	NA	F, B	Hockey stick
GSV/KI	1	Integrated stock assessment model	NA	F, B	Hockey stick

Southern Calamari

There are two Management Tier 1 stocks (SG and GSV/KI), and one Management Tier 2 stock (WC).

There is currently no formal assessment method, and the stocks are assessed using a weight-of-evidence approach. However, there is a current research project aimed at developing a more robust and cost-effective assessment approach.

Note, the WC stock has been assigned Management Tier 2. The SE stock has not been assigned a management tier due to negligible catches.

Table 6. Summary of current harvest strategies for Management Tier 1 Southern Calamari stocks

Stock / Fishing Zone	Assessment Category	Assessment method	Buffer	Key indicator(s)	Reference period	Decision rule
SG	5	CPUE standardisation	0%	Catch, catch rate	2009/10–2018/19	RBC adjusted proportionate to proxy for B (standardised CPUE)
GSV/KI	5	CPUE standardisation	0%	Catch, catch rate	2013/14–2017/18	RBC adjusted proportionate to proxy for B (standardised CPUE)

4.2 Management Tier 2 Stocks

Management Tier 2 stocks are managed without TACCs. Currently, all stocks are allocated to Assessment Category 6, the most data-poor category. However, it is anticipated that over the next few years some stocks will move to Assessment Category 5, as standardising CPUE becomes more common.

Table 7. Summary of current harvest strategies for Management Tier 2 stocks

Species	Stock / Fishing Zone	Assessment Category	Assessment method	Key indicator(s)	Reference period	Decision rule
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Yellowfin Whiting	SG	6	Weight of evidence, Catch MSY, Raw catch rates, Risk assessment	Catch, catch rate	NA	Where B (or proxy) is declining or F is estimated to be greater than fishing mortality to give F50, additional analysis and a species/sector specific workshop required from which management options are considered and monitoring and research needs identified and reported to the MSFMAC
Yellowfin Whiting	GSV/KI	6				
Blue Crab	WC	6				
Southern Calamari	WC	6				
WA Salmon	SG	6				
WA Salmon	GSV/KI	6				
Aust. Herring	SG	6				
Aust. Herring	GSV/KI	6				
Whaler sharks	SG	6				
Whaler sharks	WC	6				
Whaler sharks	GSV/KI	6				

4.3 Management Tier 3 Stocks

Management Tier 3 stocks are typically less targeted in the associated fishing zones and are managed with input controls. Similar to Management Tier 2 stocks they are currently allocated to HSF Category 6.

Table 8. Summary of current harvest strategies for Management Tier 3 stocks

Species	Stock / Fishing Zone	Assessment Category	Assessment method	Key indicator(s)	Reference period	Decision rule
Ocean jackets	SG	6	Weight of evidence, CatchMSY, Raw catch rates, Risk assessment	Catch, catch rate	NA	Where B (or proxy) is declining or F is estimated to be greater than fishing mortality to give F50, additional analysis and a species/sector specific workshop required from which management options are considered and monitoring and research needs identified and reported to the MSFMAC
Sand Crab	SG	6				
Wrasses	SG	6				
Yellow-eye Mullet	SG	6				
Leatherjackets	SG	6				
Leatherjackets	GSV/KI	6				
Snook	GSV/KI	6				
Snook	SG	6				

5 Assessment schedule

To support a monitoring and stock assessment program that is commensurate with the scale and value of the MSF, the frequency of MSF stock assessments is as follows:

- Management Tier 1 stocks with an integrated assessment model (i.e., other than Southern Calamari) are to be assessed on a triennial basis (every 3 years);
- Fishery independent monitoring of stocks, as required;
- Management Tier 2 and 3 stocks, and Southern Calamari will be assessed on an annual basis.

Changes from the above schedule may be recommended by the MSFMAC where there is an identified need, as approved by the Executive Director, Fisheries and Aquaculture, or Minister.

6 References

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7 Appendices

Appendix 1 - Tiered Management Framework

The TMF is a simple decision-making framework to guide the management strategy and science needs of species in the fishery. The TMF suggests a management tier for each of the main stocks/species in the fishery based on various scored criteria, including: stock status; their importance to the recreational, indigenous and commercial fishing sectors; target levels; and their vulnerability to over-fishing (Smart et al. 2022). Under the framework, Management Tier 1 stocks represent the top tier of management with TACCs which can be unitised with ITQs, and require quantitative analyses. Management Tier 2 and 3 stocks represent stocks that are managed without TACC's, and assessments undertaken using primarily fishery dependent information.

Stocks have only been assigned a Management Tier if average five-year annual commercial catches are greater than 5t.

Table 9. The Tiered Management Framework for the MSF (Smart et al. 2022).

Species	Zone	Tiered Management Indicators						Total Score		Tier
		Stock Status	Aboriginal/ Traditional Importance*	Commercial Importance	Management Need	Level of Commercial Targeting	Recreational Importance			
Southern Garfish	GSV/KI	3	1	3	3	3	3	16		Tier 1
Snapper	GSV/KI	3	1	3	3	3	3	16		Tier 1
Snapper	SG	3	1	2	3	3	3	15		Tier 1
Southern Garfish	SG	2	1	3	3	2	3	14		Tier 1
Snapper	SE	1	1	3	3	3	3	14		Tier 1
Southern Calamari	SG	1	1	3	3	3	3	14		Tier 1
King George Whiting	GSV/KI	1	1	2	3	3	3	13		Tier 1
King George Whiting	SG	1	1	2	3	3	3	13		Tier 1
Snapper	WC	3	1	1	3	3	2	13		Tier 1
Southern Calamari	GSV/KI	1	1	3	2	3	3	13		Tier 1
King George Whiting	WC	1	1	3	1	3	3	12		Tier 1
Blue Crab	WC	1	1	3	1	3	2	11		Tier 2
Southern Calamari	WC	1	1	1	2	3	3	11		Tier 2
Yellowfin Whiting	SG	1	1	3	2	2	2	11		Tier 2
Australian Herring	GSV/KI	1	1	1	3	1	3	10		Tier 2
Australian Herring	SG	1	1	1	3	1	3	10		Tier 2
Western Australian Salmon	GSV/KI	1	1	1	2	3	2	10		Tier 2
Western Australian Salmon	SG	1	1	1	2	3	2	10		Tier 2
Whaler Sharks	GSV/KI	1	1	1	2	3	1	9		Tier 2
Whaler Sharks	SG	1	1	1	2	3	1	9		Tier 2
Whaler Sharks	WC	1	1	1	2	3	1	9		Tier 2
Yellowfin Whiting	GSV/KI	1	1	1	2	2	2	9		Tier 2
Ocean Jacket	SG	1	1	1	1	3	1	8		Tier 3
Octopus	SG	1	1	1	1	3	1	8		Tier 3
Octopus	WC	1	1	1	1	3	1	8		Tier 3
Sand Crab	SG	1	1	1	1	3	1	8		Tier 3
Leather Jacket	GSV/KI	1	1	1	1	1	2	7		Tier 3
Leather Jacket	SG	1	1	1	1	1	2	7		Tier 3
Blue Throat Wrasse	SG	1	1	1	1	2	1	7		Tier 3
Snook	GSV/KI	1	1	1	1	1	2	7		Tier 3
Snook	SG	1	1	1	1	1	2	7		Tier 3
Yellow-Eye Mullet	SG	1	1	1	1	1	2	7		Tier 3

Appendix 2 – Management Tier 1 Stocks

Table 10. Management Tier 1 stocks in the MSF

Fishing Zone	King George Whiting	Snapper	Southern Calamari	Southern Garfish
West Coast	Tier 1 commercial catch cap	Tier 1 TACC / ITQ		
Spencer Gulf	Tier 1 TACC / ITQ	Tier 1 TACC / ITQ	Tier 1 TACC / ITQ	Tier 1 TACC / ITQ
Gulf St Vincent	Tier 1 TACC / ITQ	Tier 1 TACC / ITQ	Tier 1 TACC / ITQ	Tier 1 TACC / ITQ
South East		Tier 1 TAC (TARC/TACC) / ITQ		

Appendix 3 - Categories, Decision Rules and Calculating RBCs

A “hockey stick decision rule” applies to Assessment Category 1 and 2 stocks whereby the fishing mortality is reduced proportionate to the size of the biomass, below the biomass trigger (B_{TRIG}). The fishing mortality is:

- stable when the relative biomass (B/B_0) is above the trigger reference point (B_{TRIG}),
- reduced when B/B_0 falls below the trigger reference point (B_{TRIG}), and
- zero when B/B_0 falls below the limit reference point (B_{LIM})⁴

For other stocks (Categories 3-6), alternative model-based and empirical approaches are applied that are consistent with the above approach to reduce fishing mortality proportionate to the size of the biomass. In particular, Assessment Category 3 enables a “hockey stick” type decision rule to be adopted.

Assessment Category 1 – Robust integrated stock assessment

Applies to stocks with a robust quantitative integrated stock assessment that provides estimates of mature biomass, B , and fishing mortality, F . These assessments use a wide range of data inputs including fishery-dependent (e.g., catch per unit effort – CPUE) and fishery-independent (e.g., daily egg production method – DEPM) abundance indices or estimates, size and age composition, biological parameters, and commercial and recreational catch data.

The decision rule has the recommended fishing mortality declining below a trigger reference point (B_{TRIG}), termed a “hockey stick decision rule” (Figure 1).

The target reference point (B_{TARG}) is set at B_{50} .

The trigger reference point (B_{TRIG}) is set at B_{40}

The limit reference point (B_{LIM}) is set at B_{20}

The target fishing mortality (F_{TARG}) is set at F_{50} . F declines below the trigger reference (B_{TRIG}) point.

RBC calculation: the RBC is determined by applying the fishing mortality as determined by the decision rule to the estimated current biomass.

Assessment Category 2 – Integrated stock assessment model – less robust or preliminary assessment only

Similar assessment as in Category 1 but greater uncertainty in some data and/or conflicting signals, lack of stability in and/or poor model fits, and hence greater uncertainty. This may include integrated models where sensitivity analyses demonstrate influential model assumptions or data sources may influence conclusions. This category also applies to preliminary assessments, until such a time that an assessment is considered sufficient and further model development is not required.

RBC calculation: the decision rule (hockey stick) and calculation of the RBC is as per Assessment Category 1 but a buffer (i.e., 10%) is applied unless scientific evidence supports a more suitable value.

⁴ Pending applicable bycatch provisions, exceptional circumstances or transitional arrangements.

Assessment Category 3 – Aggregate production models

Surplus production or biomass dynamic models require catch and an index of abundance, usually CPUE. They provide estimates of F and B. Extensions include age-structured production models and delay-difference models. These require some biological information such as estimates of natural mortality, maturity- and length-at-age. Aggregate production models are generally more uncertain than integrated models and hence are assigned to a lower category.

RBC calculation: RBCs are calculated from the ratios of current F and B to F_{50} and B_{50} , respectively. A hockey stick decision rule for either F or harvest fraction can be applied between B_{TRIG} and B_{LIM} .

Assessment Category 4 – Empirical estimates of F and M and pre recruit analyses

This category requires data available on the age structure of catches (often snapshots) and some biological information including an estimate of natural mortality (M), and length, weight and fecundity at age. Fishing mortality (F) is estimated from the observed age structure. Yield per recruit analyses are used to estimate F values providing the biomass at the limit and target reference points, i.e., F_{20} and F_{50} .

RBC calculation: a similar decision rule is applied as for Categories 1 and 2, where F is reduced below F_{50} and the RBC is estimated from the ratio of F_{RBC} and estimated current fishing mortality (F_{CUR}), applied to the current catch.

Assessment Category 5 – Standardised CPUE

Standardised CPUE provides an index of abundance (as a proxy for B) estimated from catch and effort data by accounting for aspects of the fishery dynamics (such as area, gear, fisher, etc.) that influence CPUE. A reference period is selected from the catch and standardised CPUE time series to represent periods when the stock was thought to be close to the target biomass and thereby provide a proxy target reference point. Once the target reference point has been established, the limit standardised CPUE can be designated as a proportion (e.g., 40%) of the target standardised CPUE (analogous to the relationship $B_{LIM} = 0.4 B_{TARG}$).

RBC calculation: the RBC is calculated from the ratio of the difference in current average standardised CPUE and the limit standardised CPUE, and the difference between the target standardised CPUE and limit standardised CPUE applied to the target catch.

This is described by the following decision rule (after Little et al 2011):

$$RBC = C_{targ} * \max\left(0, \frac{\overline{CPUE} - CPUE_{lim}}{CPUE_{targ} - CPUE_{lim}}\right)$$

Where:

- $CPUE_{targ}$ is the target CPUE for the species,
- $CPUE_{lim}$ is the limit CPUE for the species = $0.4 * CPUE_{targ}$,
- $\overline{CPUE}$ is the average CPUE over the past m years; m will be stock specific and, in some circumstances, the last year,
- C_{targ} is a catch target derived from a period of historical catch that has been identified as a desirable target in terms of CPUE, catches and status of the fishery.

Assessment Category 6 – Weight of evidence methods

This category encompasses data-poor stocks for which the above assessment approaches cannot be undertaken and/or raw CPUE is not considered a reliable index of abundance. Methods used could include catch-only approaches (e.g. Catch-MSY, noting that depletion estimates from such approaches are highly uncertain), risk assessments, and simple triggers related to catches and catch composition.

RBC calculation: the RBC recommendation will take into account a number of these methods and the reasoning used must be well documented.

Note the decision rule for Management Tier 1 stocks will be different to that for Tier 2 and Tier 3 stocks.

Reference

Little, L. R., Wayte, S. E., Tuck, G. N., Smith, A. D. M., Klaer, N., Haddon, M., Punt, A. E., Thomson, R., Day, J., and Fuller, M. 2011. Development and evaluation of a cpue-based harvest control rule for the southern and eastern scalefish and shark fishery of Australia. – ICES Journal of Marine Science, 68: 1699–1705.