SERAWG-01-09

First meeting of the Stock and Ecological Risk Assessment Working Group (SERAWG1)
25–29 March 2019, Yokohama, Japan

Preliminary categorisation of species into the SIOFA stock assessment framework

Relates to agenda item: 8 Working paper ☒ Info paper ☐

Delegation of Australia

Abstract

This paper describes a preliminary attempt to categorise SIOFA species within the tiered Stock assessment framework for bottom fisheries within the SIOFA Area (adopted at SC3, Annex J). Progress on this task has been limited because the categorisation of species into this framework requires a characterisation of available data, which is difficult due to the developmental nature of the SIOFA database and the lack of a robust SIOFA species list. Ultimately, categorisation into the framework and associated data characterisation should help the SC to formulate assessment options for the large number of species with which SIOFA bottom fisheries interact. As well as the level of data availability, assessment should be informed by the risks posed by fishing to various stocks. The consideration of the current risks to stocks as well as the desired (future) harvest strategy objectives should be used to drive data collection to enable the appropriate assessments to be applied.

Recommendations *(working papers only)*

It is recommended that the SC:

- **Note** that this work is ongoing and will be progressed as the SIOFA database and species list are refined and better data characterisation becomes possible.
- **Recommend** that this work is continued and supported as part of the SC workplan.

1. Purpose of paper

This paper describes a preliminary attempt to categorise SIOFA species within the tiered assessment framework for bottom fisheries in the SIOFA Area (adopted at SC3). This categorisation should help the SC to formulate assessment options for the large number of species with which SIOFA bottom fisheries interact. In the short-term it is likely that a number of low-information assessment approaches will need to be applied. Descriptions of low-information assessment approaches referred to herein are documented comprehensively elsewhere (e.g. Edwards 2015) and are not covered here in detail.

Eventually, the tier at which a stock is assessed should be informed by the risks to the stock and the desired harvest strategy objectives for the management of stocks. Harvest strategies that seek to maximise sustainable yield (or economic yield) may need to be based on stock assessment at more 'robust' tiers in the hierarchy. In the short- to medium- term, quantitatively informed and precautionary catch limits based on low-information stock assessment may be appropriate for stocks that are not thought to be heavily exploited. For stocks considered to be at higher risk from fishing, including low productivity stocks with high fishing mortality levels, more robust and quantitative assessment is required.

2. Rationale for a Tiered Assessment Framework

The SIOFA Scientific Committee may be requested to provide scientific advice on stock status (in relation to yet-to-be-defined harvest strategies containing target and/or limit reference points) and associated catch limits for a large number of demersal species, as well as advice on the impact of fishing on associated and dependent species with which these fisheries interact. The quantity, quality and suitability of data varies among species and over time and space. This variability influences the assessment approaches that can be applied and the parameters that can be estimated. This in turn will influence the scientific advice that the SIOFA SC can provide to the Meeting of the Parties.

To improve the efficiency of processes run by the SC, a tiered framework for prioritising stocks for assessment has been adopted. The framework is based on the parameters that can be estimated given the data available. A tiered framework will assist the SC to develop transparent decision rules for advice on recommended biological catches and potential buffers (e.g. 'discount factors') that may be applied to account for assessment uncertainty. The tiered levels consist of:

1. Full Benchmark Assessment that utilises catch data from fishery monitoring, ideally in combination with stock abundance from independent surveys, catch rates and biological data with the purpose of estimating depletion levels and fishing mortality rates;
2. Data Limited Assessment that may utilise catch only or simple indicators to track status (e.g. CPUE, size composition, Productivity-Susceptibility Analysis);
3. No assessment necessary.

Two subsets may apply after initial classification of stocks into tiers:

i. Research Assessment where new methods or data types are applied which may require substantive review of the methods by the SC; and

ii. Update Assessment where previous accepted assessments are updated with new data.

Given that many of the potential methods have not yet been tested in SIOFA's bottom fisheries, it is likely that subset i. Research Assessment would apply in most cases.

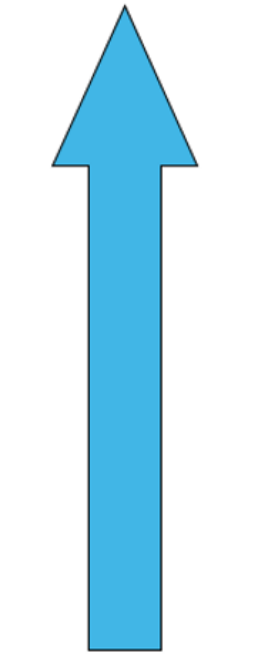
Discussion on harvest strategies—which may include target and limit reference points, buffers, discount factors and harvest control rules—are not included in this paper and will require significant development and testing.

As well as data availability, the choice of assessment method needs to be driven by:

- Consideration of the current level of risk to stocks and the level of risk that is acceptable. Precautionary fishing mortality limits (e.g. significantly less than FMSY) may be appropriate for a large number of species with which SIOFA demersal fisheries interact (particularly non-target but retained species) due to current exploitation patterns and the economics of fishing operations.
- The desired management and regulatory framework. The economics of the fisheries should influence the required level of monitoring and the implementation of harvest strategies. A fishery being fished at MSY may require more monitoring (and investment) than one with a low level of fishing mortality.
- A user-pays model whereby the cost for assessment and monitoring is borne by those seeking to exploit the resources, or indirectly exploiting the resources in the course of fishing for target or byproduct species
- Capacity. Situations may arise (commonly in RFMOs) where data are available but capacity and funding is often lacking.

Figure 1 demonstrates how information availability relates to a tiered framework. There may need to be a 'fuzzy' barrier between tiers 1 and 2 to account for assessment uncertainty.

Figure 1. Schematic showing increasing information needs for different tiers and assessment options



TIER	ASSESSMENT DETAILS
1	Robust assessment, C, E, CPUE, fishery-independent surveys
	Robust assessment, high level of data: C, E and additional data. *By* estimated by integrated assessment
	Robust assessment, low level of data: C, E, CPUE. *By* estimated by dynamic production model, robust egg production model
	Estimating F, M, and/or SBPR. Age data ± length, growth, reproduction data.
2	Estimating proxies. Empirical untested decision rules. CPUE, mean size, age data; depletion analysis, spatial surveys
	Estimating F. SAFE → biology, spatial overlap
	No estimate of *B*. Species-specific catch triggers; data = catch by species
	Triggers for groups of species, e.g. triggers may be C by group, E by group, spatial distribution of fishing activity, catch composition (fisheries have no fixed target species)

Adapted from Dichmont et al. 2013

3. Data requirements for non-standard stock assessment

Age-structured assessments, including those incorporating relative abundance indices such as CPUE and acoustic surveys, may eventually be possible for a small number of SIOFA species (which would likely be categorised as tier 1 if assessment diagnostics indicated 'robust' assessments), but the paucity of data means that alternative options may be required to assess numerous other species. These other species include target and non-target species. Table 1 demonstrates the data requirements for a number of low-information assessment approaches (see Edwards 2015 for additional detail). These approaches generally use a combination of fishery-dependent and fishery-independent data.

Table 1. Data requirements for low-information assessment methods

A - Fishery independent data

Method	Life history				Fishery			Status	
	Mortality	Growth	Maturity	Productivity	Selectivity	Catchability	Area	Depletion	Trajectory
Depletion Adjusted Catch Scalar				O				X	
Depletion Corrected Average Catch	X			X				X	
Depletion-Based Stock Reduction Analysis	X			X				X	
Catch-MSY				X				X	
Average-length	X	X			X				
Length-based SPR	X	X	X		X				
Swept area						X	X		
Productivity-Susceptibility Analysis, bSAFE				X	X	X	X		
Sustainability assessment (eSAFE)						O	X		
Non-parametric models									O
Time-series models									O
Production models				X		O		O	O
Delay-difference models	O	O	O	X	O	O		O	O

B - Empirical or fishery-dependent data

Method	Time series data		Current data		
	Catch	Abundance	Length	Survey	Effort
Depletion Adjusted Catch Scalar	X				
Depletion Corrected Average Catch	X				
Depletion-Based Stock Reduction Analysis	X				
Catch-MSY	X	O			
Average-length			X		
Length-based SPR			X		
Swept area				X	X
Productivity-Susceptibility Analysis, bSAFE					O (required for SAFE)
Sustainability assessment (eSAFE)				X	X
Non-parametric models	O	X			
Time-series models	O	X			
Production models	X	X			
Delay-difference models	X	X			

X = required data inputs
O = data that can be accommodated if available

Adapted from Edwards 2015

4. Categorisation of stocks into the Tiered Assessment Framework

The categorisation of species into the assessment framework requires characterisation of each 'fishery' and the available data. This should then allow categorisation of each stock into

Tier 1, 2 or 3. This cannot yet be done comprehensively due to the developmental nature of the SIOFA database and associated issues such as developing a comprehensive SIOFA species list.

In accordance with the accepted framework, prior to categorisation into Tier 1 or Tier 2 the SC may place some species into Tier 3 (No Assessment required) based on the presentation of sufficient evidence that existing measures provide adequate precaution (e.g. for species that rarely (if ever) interact with the SIOFA demersal fisheries).

Species/stocks should initially be subjected to semi-quantitative risk assessment methods such as Productivity-Susceptibility-Analyses and/or Sustainability Assessment for Fishing Effects (SAFE). These methods rank species/stocks into priority from high to low relative risk (or vulnerability), with SAFE also being capable of generating proxy estimates of fishing mortality[1]. This step should identify to the SC the species/stocks requiring immediate attention. It may be determined by the SC that stocks assessed to this level may not require further assessment (i.e. placed into tier 3) if the risks from fishing are assessed to be low, or if adequate management measures are in place to mitigate risks. Alternatively, species or stocks that are assessed as requiring additional attention may then be prioritised for other assessment approaches, for example those that may provide precautionary catch limits.

Categorisation into Tier 1 and Tier 2 of the framework will be based on the data available. Species/stocks with data suitable for estimation of current fishing mortality and depletion would generally be categorised into Tier 1. Species/stocks initially considered for Tier 1 may be subsequently classified for Tier 2 assessment if the Tier 1 assessment diagnostics fail to satisfy SC review. Species not placed into Tier 1 or Tier 3 categories by default are placed in Tier 2. To assess species at Tier 1 (and to a lesser degree Tier 2), full characterisation of the fishery's history, data, management arrangements, risks and other information is desirable. This would ideally be done on a species-by-species basis, but efficiencies could be made with grouping key species to be assessed at Tier 1 (or possibly Tier 2) for each of the main bottom fishing gears.

5. Next steps

It is possible (perhaps likely) that, even with a proper categorisation into the assessment framework and associated data characterisation and application of low-information assessment methods, these methods may be unable to output reliable metrics that can be used within a harvest strategy. The experience with orange roughy stock simulations in SIOFA (as well as SPRFMO) (e.g. Cordue 2018) suggest that despite reasonable confidence around catch histories and biological assumptions, there are still large uncertainties associated with assessment outputs.

An alternative may be to undertake simulation testing (akin to a Management Strategy Evaluation) to explore potential exploitation scenarios for a number of hypothetical stocks of differing productivities. Outputs from such testing could be used to set proxy, but

[1] Ecological risk assessment methods as currently applied to SIOFA teleosts and chondrichthyans cannot currently be used for providing management advice based on fishing mortality estimates due to a number of methodological limitations.

nonetheless quantitatively informed, catch limits for SIOFA demersal species. This work may also allow exploration of the validity of low-information assessment outputs for a number of species for which there is existing catch and other data. Australia intends to pursue this work during 2019 and 2020. Australia intends to continue the categorisation of SIOFA species into the assessment framework and associated data characterisation during 2019.

6. References

Cordue P 2018, Assessments of orange roughy stocks in SIOFA statistical areas 1, 2, 3a, and 3b, ISL Pty Ltd.

Dichmont et al 2016. Operationalising the risk-cost-catch trade-off. FRDC Project Number 2012-202.

Edwards, C 2015. Review of data-poor assessment methods for New Zealand fisheries, New Zealand Fisheries Assessment Report No 2015/27.