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Live document on history of harvest strategies development in SIOFA and glossary

The SIOFA Secretariat

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Abstract

In 2024, the SIFOA WS2024-HSS "noted the usefulness of paper WSHSPA-2023-01 for tracking SIOFA's progress in developing harvest strategies. The Workshop recommended that the Secretariat regularly update this information and present it to future meetings and workshops where harvest strategies are to be discussed.
The following MoP11 meeting confirmed this tasking to the Secretariat, which created this paper as a live document to track the progress in SIOFA harvest strategies and presented it to SC10.
This paper contains both a history of harvest strategies as tasked by MoP11, as well as an introduction/glossary of the harvest strategy as suggested by some parties.

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Background

In 2024, the SIFOA WS2024-HSS “noted the usefulness of paper WSHSPA-2023-01 for tracking SIOFA’s progress in developing harvest strategies. The Workshop recommended that the Secretariat regularly update this information and present it to future meetings and workshops where harvest strategies are to be discussed.

The following MoP11 meeting confirmed this tasking to the Secretariat, which created this paper as a live document to track the progress in SIOFA harvest strategies and presented it to SC10.

Aims

This paper contains both a history of harvest strategies as tasked by MoP11, as well as an introduction/glossary of the harvest strategy as suggested by some parties.

Introduction

At MoP10, the Meeting of Parties endorsed the development of harvest strategies for selected SIOFA stocks and agreed to hold joint MoP-SC intersessional workshop to define management objectives (MoP10 report, paragraph 91).

Harvest strategies are an important tool that informs sustainable fisheries management decisions. They include the following elements (Tingley 2023):

- Management objectives that set the outcomes for the fish population and fishery.
- A monitoring program to collect data.
- Performance indicators of the fishery's status and population health, with associated reference points.
- Management actions using pre-defined rules that are based on the performance indicators.

This paper provides an introduction to harvest strategies and the associated management objectives.

Harvest strategies

Harvest strategies provide a more predictable approach than the traditional use of stock assessments to provide management advice. The effectiveness of harvest strategies relies on a set of agreed management objectives for the fishery and the stock, and then using management strategy evaluations (MSE, also known as management procedures, MP) to select the Harvest Control Rule (HCR) that is most likely to achieve these goals.

As the HCR is used to set the harvest rate (i.e., the annual catch limit), harvest strategies provide a structured framework for determining the scientific management advice. This approach allows managers to identify the most important management objectives, that are then used to determine the most effective HCR to meet these objectives. See https://ofp-sam.shinyapps.io/AMPLE-intro-hcr/_w_5d6010bd/tutorials/intro_hcr.html for an introductory tutorial on HCRs developed by SPC for the WCPFC using the AMPLE package. Other similar on-line apps include;

- WCPFC South Pacific Albacore (https://ofp-sam.shinyapps.io/spample/),
- New England Groundfish (https://jjesse.shinyapps.io/hcr_app/), and
- the MSE Game for EPO Bigeye tuna (https://valeromaspez.shinyapps.io/tunamse_epo_eng/).

Harvest strategies use a pre-agreed framework for making fisheries management decisions, and includes the following core elements:

i. A monitoring programme (e.g., CPUE, surveys, and/or age composition data).
ii. An approach to estimate stock status (e.g., a stock assessment).
iii. Reference points.
iv. An HCR evaluated using MSE.

MSE is a tool or procedure that uses simulation models to help compare the expected performance of different HCRs and guides the process of harvest strategy development (Figure 1).

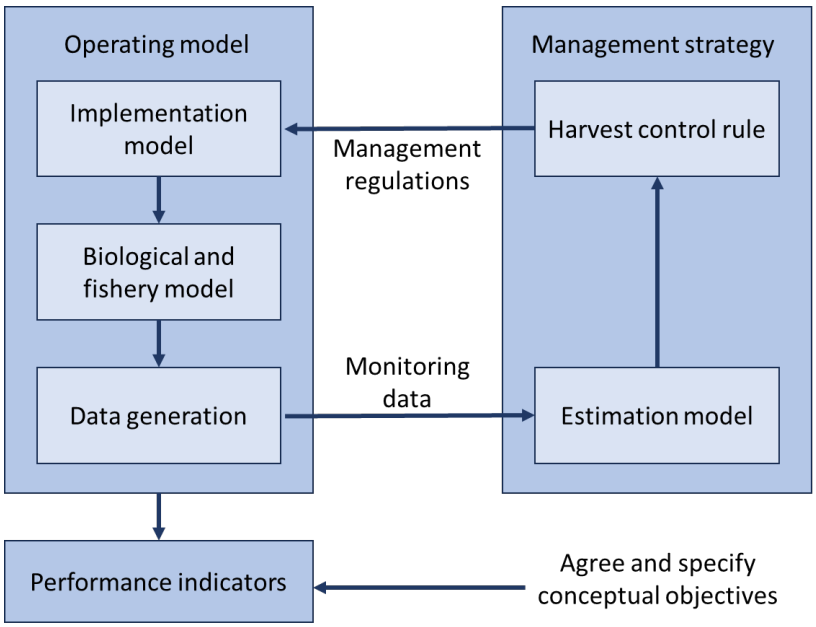

Figure 1: Conceptual overview of the management strategy evaluation modelling process (Figure 1 in Punt et al. 2016).

Reference points

Reference points is one of the main tools for the evaluation of an HCR. Usually there are three types: target reference points (TRP), limit reference points (LRP), and finally, trigger reference points that inform a management action (Figure 2).

TRPs define the ideal stock status. In a fishery, management actions should be designed to allow the stock to achieve this state over the medium or long term with a high degree of certainty. The stock is likely to fluctuate around the target due to natural variability and uncertainty but should not systematically deviate from it (e.g., be consistently either above or below the TRP).

The TRP is usually set to be the biomass that supports maximum sustainable yield (B_{MSY}) or a suitable proxy. Regional fisheries management organizations, such as SIOFA, are generally guided by a mandate to maintain populations at the level that can produce B_{MSY} and Article 4(d) of the SIOFA agreement states “the fishery resources shall be managed so that they are maintained at levels that are capable of producing the maximum sustainable yield, and depleted stocks of fishery resources are rebuilt to the said levels”.

In 2023, the MoP agreed interim TRPs of 40% B_0 for orange roughy and 50% B_0 for toothfish with a 50% probability of being above the target (MoP10 report, paragraphs 77-78).

Limit reference points set boundaries which are intended to constrain harvesting within safe biological limits within which the stock can produce MSY.

In 2023, the MoP agreed an interim LRP of 20% B0, with a 90% probability of being above the limit, for orange roughy and toothfish (MoP10 report, paragraphs 77-78).

Trigger reference points are stock status points where management action is required to help ensure that the fishery remains close to the TRP and avoids breaching the LRP. For example, management actions may adjust the catch limit as the current stock status fluctuates above or below the TRP by raising or lowering the catch limit to ensure the stock remains close to the TRP and away from the LRP. Trigger reference points are usually specified by the Harvest Control Rule (HCR) that is used to manage a fishery. Trigger reference points have not yet been defined for any SIOFA fisheries and would be determined as a part of the MSE and be part of the final harvest strategy.

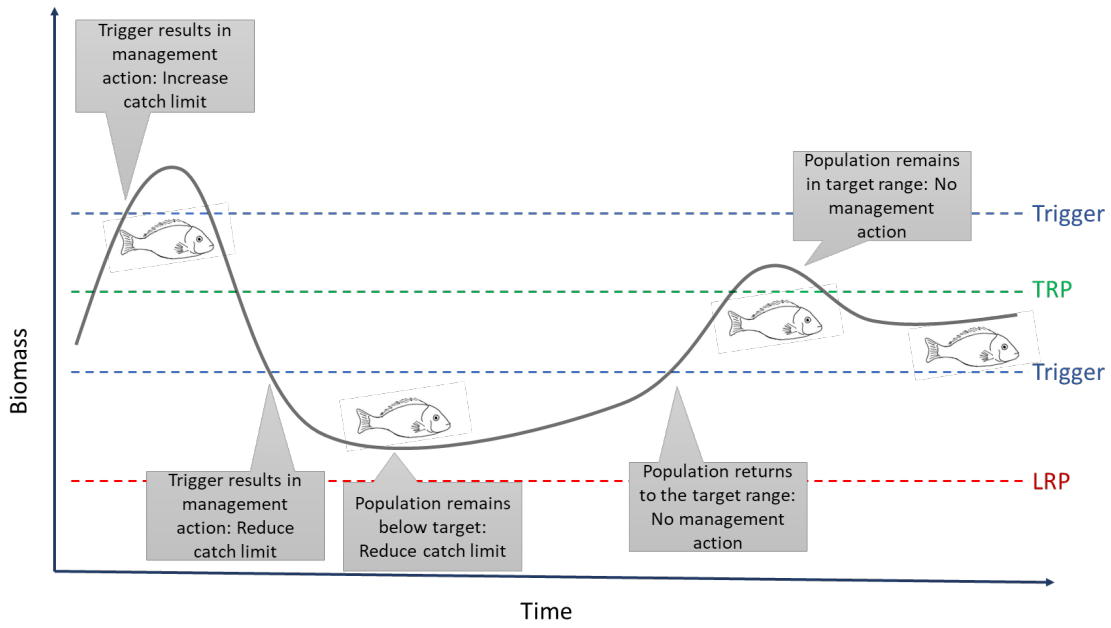

Figure 2: Example of a HCR and the effect of TRP, LRP, and trigger reference points with resulting management actions for a theoretical stock.

Timeline for the development of harvest strategies

In 2023, the MoP endorsed timeline for the development of harvest strategies (given in Annex 2 below, reproducing Annex G of the SC8 report).

The timeline encompassed six steps:

Step 1: Define management objectives.
Step 2: Determine appropriate fisheries monitoring regime.
Step 3 Develop candidate HCRs.
Step 4: Test HCRs with MSE.
Step 5: Implement the harvest strategy.
Step 6: Improve assessment and harvest strategy.

The first part of Step 1 is defining management objectives (e.g., biological and socio-economic), with the following components: proposing and selecting reference points (e.g., TRPs and LRPs); characterising uncertainties associated with the estimation of TRPs and LRPs; and specification of acceptable levels of risk.

Terms of reference for WSHSMO-2023

The Terms of Reference for the MoP Workshop on Harvest Strategy Management Objectives (WS2023-HSMO) were given in SIOFA Circular-2023/40 rev 1, and were:

The Terms of Reference for WS2023-HSMO are:

1) The aim of the workshop is for the MoP to agree on Management Objectives for the development of Harvest Strategies for selected SIOFA stocks (MoP10 report, paragraph 91).

2) To do so, WS2023-HSMO needs to develop management objective categories and, within these, preliminary management objectives in the development of harvest strategies.

3) The workshop will focus on management objectives for orange roughy and toothfish (MoP10 report, paragraph 76). In particular, WS2023-HSMO will have the following specific objectives for orange roughy and toothfish:
   a) Agree on specific management objectives for the development of harvest strategies for orange roughy and toothfish.
   b) Identify any other relevant management objectives, for example bycatch objectives, ecosystem objectives, and fishery impact objectives for harvest strategies for orange roughy and toothfish.

4) Identify potential responses to exceptional circumstances, such as dropout or breakout rules, in the implementation of harvest strategies (MoP10 report, paragraph 89), that should be considered by the Scientific Committee.

Management objectives

Management objectives identify the outcomes that managers want to achieve in a managed fishery and are also used to determine the measure of successful management of a target species. These are commonly grouped into five categories: status, safety, yield, abundance, and stability.

The five categories of management objectives

Status objectives

Status objectives are aimed at maintaining the stock at or near the target reference point (TRP).

The Scientific Committee had recommended a TRP ≈ B_{MSY} for orange roughy and alfonsino using a proxy of = 0.4×B_0 with a probability of being above the target at least 50% of the time, as this was a common surrogate used in other regions (SC8 report, paragraph 176). The Scientific Committee noted that proxies for MSY have been proposed for operationalising target reference points based on the assumption that the assessment methods would calculate depletion better than MSY, but that other equivalent operational targets may be appropriate depending on the assessment method used. The Scientific Committee also recommended a TRP = 0.5×B_0 for toothfish, with a probability of being above the target at least 50% of the time (SC8 report, paragraph 177), as this was the target used by CCAMLR in its decision rules for toothfish (Constable et al. 2000).

In 2023, MoP10 agreed that the interim TRP for orange roughy and alfonsino as a 50% probability of being above 40% B_0, and the interim TRP of 50% probability of being above 50% B_0 for toothfish (MoP10 report, paragraphs 77-78).

Safety objectives

Safety objectives are aimed at maximising the probability that the stock is above the limit reference point (LRP).

In 2023, MoP10 defined an interim LRP for orange roughy, alfonsino, and toothfish as a 90% probability of being above 20% B_0 (MoP10 report, paragraphs 77-78). The choice of the interim LRPs was based on advice from the SIOFA Scientific Committee (SC8 report, paragraphs 176-177).

Yield objectives

Yield objectives typically are aimed at maximising the catch (or sometimes effort) for a stock across regions and/or fishing gears.

Abundance objectives

Abundance objectives are aimed at maximising catch rates or other economic outcome to enhance fishery profitability. For example, high abundance usually leads to higher catch per unit effort and hence higher profitability of the catch.

Stability objectives

Stability objectives are aimed at maximising the stability of catches by minimising variability in catch from year to year, and hence reduce commercial uncertainty in annual catch limits.

Other objectives

Socio-economic, bycatch, and ecosystem objectives can be included within the categories above. Examples include:

- socio-economic objectives, e.g., requiring a minimum catch in order to ensure economic activity for a specific fleet.
- benthic impact objectives. E.g., restricting effort to ensure that the benthic footprint does not expand beyond an acceptable amount.
- Health and safety objectives, e.g., restricting vessel or other activities (vessel types, gear, locations and seasons) to ensure health and safety of vessel crew and operators.

These objectives can be included within the target species objectives, along with performance indicators, and included within the MSE to evaluate competing harvest control rules.

Examples of management objectives

Management objectives have usually been set at a high level, with the focus on outcomes from the application of performance indicators, monitoring strategy, and management strategy evaluations defining the specific management objectives for a stock. Hence, in practise, many fisheries management organisations specify high level management objectives with specific operational objectives that are encoded into the choice of performance indicators. Examples of the management objectives for WCPFC tuna species are given below, and Table 1 shows an example from the WCPFC for South Pacific albacore from Yao et al. (2019) with management objectives categorised as Biological, Economic, Ecosystem, and Social.

Table 1: Example of management objectives and performance indicators for the southern longline fishery (WCPFC14 Summary Report Attachment K) (source: Table 1 in Yao et al. 2019).

No.	Objective type	Objective Description	Performance Indicator (WP14)
1	Biological	Maintain ALB (and SWO, YFT and BET) biomass at or above levels that provide fishery sustainability throughout their range	Probability of SB/SB{F=0} > 0.2 as determined from MSE.
2	Economic	Maximise economic yield from the fishery	Predicted effort relative to E{MEY} (to take account of multi-species considerations, BET and other spp. may be calculated at the individual fishery level). B{MEY} and F{MEY} may also be considered at a single species level.

3	Economic	Maximise economic yield from the fishery	Average expected catch (may also be calculated at the assessment region level)
4	Economic	Maintain acceptable CPUE	Average deviation of predicted ALB CPUE from reference period levels
5	Economic	Taking Article 30 of the WCPFC convention into account: Maximise SIDS revenues from resource rents	Proxy: average value of SIDS/non-SIDS catch
6	Economic	Catch stability	Average annual variation in catch
7	Economic	Stability and continuity of market supply	Effort variation relative to reference period level (may also be calculated at the assessment region level)
8	Economic	Stability and continuity of market supply	Probability of and deviation from SB/SB{F=0} > 0.56 (ALB) in the short-, medium- and long-term as determined from MSE (may also be calculated at the assessment region level)
9	Social	Food security in developing states(import replacement)	As a proxy: average proportion of CCMs-catch to total catch for fisheries operating in specific regions
10	Social	Avoid adverse impacts on small scale fishers	• MSY of ALB, BET, YFT • Possible information on other competing fisheries targeting ALB (may also be calculated at the assessment region level) • Any additional information on other fisheries/species as possible
11	Ecosystem	Minimise by catch	Expected catch of other species
12	Economic	Optimise capacity	Vessel numbers targeting ALB
13	Social	Maintain/develop domestic fishery	Ratio of domestic catch to total catch
14	Social	Human resource development	Ratio of domestic catch to total catch

Fisheries monitoring regime

Fishery monitoring regimes are a key feature of harvest strategies and specify the programs for the scientific data collection and monitoring a stock in order to evaluate performance objectives and identify management actions to meet the management objectives. While these are not required for setting of management objectives, the choice of performance indicators and methods for evaluating harvest strategies will influence the scientific data monitoring program required. Similarly, cost and practicality of monitoring may impact the choice of performance indicators.

Haul and set catch and effort data, observer sampling for catch composition, otoliths, sex, length, and maturity are currently mandated in CMM-02 (2023).

Analyses of these data and otolith ageing for growth estimation and for age composition analyses, resource survey (e.g., acoustic surveys), and CPUE analyses are also carried out. These are not mandated in CMMs but have previously been a scheduled as Member and SIOFA activities and projects.

The current schedule for formal assessments for demersal stocks are defined in CMM-15 (2023) for orange roughy (every 3-5 years, CMM-15 (2023), paragraph 5), toothfish (annually, CMM-15 (2023), paragraph 30 & 47), and alfonsino (on a regular basis, CMM-15 (2023), paragraph 49).

Management strategy evaluation

Management strategy evaluation (MSE) is widely considered to be the most appropriate way to evaluate the trade-offs achieved by HCRs and to assess the consequences of uncertainty for achieving management goals. Butterworth et al. (2010) list three primary uses for MSE:

i. Development of the management strategy for a particular fishery,
ii. Evaluation of generic management strategies, and
iii. Identification of HCRs that will not work and should therefore be eliminated from further consideration.

The steps that should to be followed when conducting a MSE (Punt et al. 2016) are:

1. Identification of the management objectives and representation of these using performance indicators.
2. Identification of uncertainties (related to biology, the environment, the fishery and the management system) to which the HCR should be robust.
3. Development of operating models which provide a mathematical representation of the system to be managed. The operating models must represent the biological components of the system to be managed, the fishery which operates on the modelled population, how data are collected from the managed system and how they relate to the modelled population.
4. Selection of the parameters of the operating models and quantifying parameter uncertainty (ideally by fitting or 'conditioning' the operating models to data from the actual system under consideration).
5. Identification of candidate HCRs which could realistically be implemented.
6. Simulation of each HCR for the operating models.
7. Summary and interpretation of the performance indicators to evaluate the performance of each HCR —this may lead to refinement of the management objectives and informs the trade-offs among competing objectives.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2013-2015

Early MoP reports (2013-2015) did not specifically discuss reference points or harvest strategies when considering stock assessments. The only relevant comment found was in the MoP1 report (2013) that recorded an intervention by SIODFA, which noted that the objectives of SIODFA included an appropriate harvesting regime for targeted species.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2016

The SC1 (2016) noted the following

101: The Scientific Committee noted there is a requirement to follow the principles of the precautionary approach, whereby the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures (Article 4(c)). Some Members noted that the Scientific Committee could recommend a prohibition on deepwater gillnets that would not necessarily preclude their future use, but that if deepwater gillnet fishing occurred it would be on the basis of having a robust ecological risk assessment undertaken, an agreed harvest strategy with clear harvest control rules.

115: In discussing the management of bottom fishing in the SIOFA area (SC-01-07 (01), SC-01-07 (02), SC-01-INFO 26, SC-01-27) the Scientific Committee advises the MoP that there are several options for limiting fishing effort. Adopting effort control in SIOFA was considered prudent given the absence of quantitative assessments on the status of stocks in relation to biological reference points and an agreed harvest policy.

1. limiting fishing activity in bottom and mid-water fishing in any one year to their maximum effort in any one of the reference years (which would need to be defined). Limits could be defined as total days at sea in the Agreement Area and/or vessel numbers. The Scientific Committee did not have a substantive discussion on the most appropriate effort measure.
2. prohibiting vessels from undertaken bottom fishing in the Area outside their historical bottom fishing footprint. The term 'bottom fishing footprint' means a map of the spatial extent and distribution of historical bottom fishing in the Area of all vessels flagged to a particular Contracting Party, CNCP or PFE over expressed as grid blocks of 20 minute resolution over a reference period (which would need to be defined).

116: The Scientific Committee advised that Option 1 would not necessarily constrain the spatial distribution of effort. Option 2 would not constrain total effort but would constrain the spatial distribution of effort which may assist the MoP with ensuring that impacts on VMEs is minimised by preventing fishing activities from expanding into new areas. The MoP may wish to consider both options if it chooses to manage effort in terms of total effort and its spatial distribution. The MoP is advised that Scientific Committee did not discuss the implications of effort creep due to increases in fishing power of vessels on these options. The Scientific Committee did not discuss the definition of reference periods for limiting effort, suggesting this be investigated intersessionally and advice provided in future if required.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2017

No discussions of harvest strategies or reference points were recorded. However, the SC2 report (2017) noted (Annex M, the SIOFA Scientific Committee Operational Work Plan 2016-2019) that the determination of biological reference points and associated development of harvest strategies was a priority. This work was included in the workplan of the SAWG, which was tasked with assisting with review of methods and outputs used for stock assessments and provide advice to the Scientific Committee on a harvest strategy and fisheries reference points for SIOFA fisheries.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2018

The SC3 (2018) noted the following:

192: The SC recalled paragraph 6a of CMM 2016/01 that actions the SIOFA Scientific Committee to provide advice and recommendations to the Meeting of the Parties on the status of stocks of principal deep-sea fishery resources targeted, and, to the extent possible, taken as bycatch and caught incidentally in these deep-sea fisheries, including straddling fishery resources by 2019.

193: Dr Nishida, Chairperson of the SAWG, presented the report of the first meeting of the SAWG (SC-03-07.1.1(03)). The main areas of discussion centred around:

- A tiered assessment framework for SIOFA fisheries
- Stock assessment for seven orange roughy sub-regions
- Future work, including that planned for alfonsino, Patagonian toothfish and other species.

194: The SAWG Chairperson presented the discussion and outcomes regarding the SAWG's consideration of a tiered assessment framework for SIOFA fisheries (based on SAWG(2018)-01-INF06). Such a framework will provide direction for future work of the SC/SAWG and may increase the efficiency of the SC/SAWG's considerations given the large number of species with which SIOFA fisheries interact. It was noted that the quantity, quality and suitability of data will vary among species over space and time and that this variability is likely to influence the parameters that can be estimated, and the associated uncertainties. The tiered framework for prioritising stocks for status assessment was proposed based on the parameters that can be estimated given the data available. Such a tiered framework may eventually assist the SAWG and SC with developing 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 recommended tiered levels consist of:

- Tier 1 Benchmark assessments that utilise 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.
- Tier 2 Data limited assessments that may utilise catch-only or simple indicators to track status (e.g. CPUE, size composition, Productivity-Susceptibility Analysis).
- Tier 3 No assessment necessary.

195: This tiered framework is not equivalent to those applied in some management approaches, where the tiers have been established to guide the application of harvest control rules and generate effort or quota outputs. Examples of these types of tiered frameworks were presented in papers SAWG(2018)-01-INF06, SAWG(2018)-01-INF07 and SAWG(2018)-01-INF11.

226: The SC agreed that that the outputs of the SAWG and stock assessment [for orange roughy] could be used to provide advice. The SC noted that since the MoP had not provided any instruction on its preferred reference points for this stock, advice on status would not be made but instead the estimates and the ranges around these estimates would be presented.

227: Management Strategy Evaluation (MSE) was discussed and it was noted that MSE could be undertaken to test different harvest strategies for SIOFA stocks.

In the Scientific Committee's 2018 report (2018, Annex L), the Scientific Committee noted that determination of biological reference points and associated development of harvest strategies for alfonsino, orange roughy, and toothfish had not been addressed.

The MoP5 (2018) noted the following

51: In clarifying the request in CMM2018/01 paragraph 6a, the Meeting of the Parties requested the Scientific Committee provide advice on the status of stocks in relation to MSY until species/stock/fisheries specific reference points are adopted by the Meeting of the Parties.

52: Noting the advice from the SC03 (234) requesting further direction from the Meeting of the Parties on the establishment of reference points, the Meeting of the Parties requests the Scientific Committee by the end of SC04 to provide advice on candidate target (TRP) and limit reference points (LRP) for SIOFA orange roughy, alfonsino and toothfish. The LRPs should be related to the resilience of the species concerned and to a risk of recruitment failure or collapse. The range of TRPs on which advice is requested would range from Bmsy to 50% of the unfished biomass B0. The advice requested should address implications of the use of the various reference points.

53: The Scientific Committee (SC04) is requested to develop a framework and a work plan for the establishment of harvest strategies for key SIOFA stocks. Such a plan should include to the extent possible: management objectives, reference points, monitoring strategy, HCR, MSE and any other elements the Scientific Committee might consider appropriate. The Scientific Committee is also requested to facilitate a scientists-fisheries manager dialogue dedicated to the key concepts of harvest strategies.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2019

The SC4 (2019) noted the following

173: The Chair reminded the SC that the MoP had requested that the SC provide advice on candidate target (TRP) and limit reference points (LRP) for orange roughy, alfonsino and toothfish and develop a framework and a work plan for the establishment of harvest strategies for key SIOFA stocks (MoP5 report, paras 52 – 53).

174: The SC agreed that scientific work was required to inform SC advice on TRPs and LRPs. The SC requests the SERAWG to form a group of key interested parties to work intersessionally with a consultant to draft a technical working paper for submission to the next SERAWG meeting;

- to develop a generic approach for determining reference points for current and future stocks;
- that candidate reference points should take into account the level of data uncertainty in stocks, noting the data-limited nature of some fisheries/stocks;
- that for straddling stocks consistent reference points should be applied across the stock.

175: The SC recommends that the MoP consider including six elements when developing harvest strategies, and the SC begin work to populate those elements: (i) operational objectives, (ii) reference points, (iii) an acceptable level of risk of breaching reference points, (iv) a monitoring strategy, (v) decision rules for achieving reference points, and (vi) a process for evaluating harvest strategies.

178: The SC agreed to a work plan to progress this work (Annex X). The work plan includes scientists – fishery managers – stakeholders dialogues to discuss the key concepts of harvest strategies.

The SC4 report (2019, Annex X) provided a work plan for the development of target and limit reference points and a harvest strategy framework:

> The focus is initially the three key species (orange roughy + alfonsino + Patagonian toothfish)
>
> - To implement this task a consultant (expert) needs to be hired because specialised knowledge and skills are required.
> - The consultant should propose plausible candidates for target (TRP) and limit (LRP) reference points and harvest strategies considering life history, biology, ecology and availability of data of three species and also by considering linkage between the reference points and harvest strategies. The consultant should consider other SC advice, paras 174-175.
> - A dialog involving scientists, managers and stakeholders should be facilitated to develop a shared understanding of the key concepts and elements of harvest strategies.
> - As there needs to be a common understanding and also decision points, the work is planned over two years.
>
> In terms of the harvest strategy development, the consultant shall incorporate the following elements of harvest strategies. Initially, information describing these elements needs to be provided and relevant decisions by the MoP facilitated.
>
> - operational objectives;
> - Reference points;
> - acceptable level of risk of breaching reference points;
> - monitoring strategy;
> - decision rules for achieving reference points; and
> - a process for evaluating harvest strategies.

In 2019, MoP6 (2019) allocated funding to assist with the development of target and limit reference points and harvest strategies.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2020

The SC5 (2020) report noted the following

171: No papers were provided for this agenda item [*Agenda item 7.9 Harvest strategies*]. The SC agreed to progress this work, in line with the agreed work plan (SC4 Report, Annex X) and reflected in the SC Operational work plan, noting the MoP6 had approved funding for this work in 2020 (MoP6 Report, Annex Q, EUR 15,000 in 2020, of a requested EUR 30,000 across two years).

No relevant comments on reference points or harvest strategies were found in the MoP7 (2020) report.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2021

Paper SC-06-24 (Butterworth et al. 2021) was a SIOFA consultancy that reported on the development of harvest strategies for key target species in the SIOFA area. This paper provided the following summary:

> The Terms of Reference for this contract ask for evaluations of use of harvest strategies, and target and limit reference points, by other fishery organisations, and then for recommendations for adoption of similar approaches by SIOFA. Those practices in a number of such organisations are summarised, as are the assessments available for the three major species under harvest in the SIOFA area: alfonsino, orange roughy and Patagonian toothfish. However, for the other main species of commercial interest in this area, because only limited information is currently available, assessments (and hence reference points, and harvest strategies based on those) are not yet possible; hence, a process to move towards developing and then improving these assessments needs to be agreed. This process must include further data collection in particular, especially of catch and effort information.
>
> For alfonsino, orange roughy and Patagonian toothfish, the alternative merits of three different approaches need to be considered:
>
> 1. Maintaining catches at present levels (unless there is evidence of a marked downward trend in the resource) until sufficient further data become available for meaningful improvements to the existing assessments.
> 2. Implementing an Fstatus-quo harvesting strategy, which varies catches up or down in proportion to the results from continued collection of some measure or index of abundance.
> 3. Implementing a harvest strategy based primarily on some multiple of a proxy value of FMSY, where this in turn is based on a proxy value for a BMSY reference point whose value is informed by the most recent assessment of the resource.
>
> The choice amongst these for each of the three species separately will come down primarily to the trade-off between likely greater stability of catch limits over time under the first approach, against possibly larger catches in the short term at least under the second and third.
>
> For the other main, but data-poor, species in the SIOFA area, only the first approach is viable at this time, but needs to be augmented by one or more precautionary provisions. For example, the SAFE methodology might be applied to obtain some

indication of whether the current catch is leading to an appreciable reduction in abundance – if so, necessitating a reduction in the present catch.

The SC6 (2021) noted the following

117: The report on the development of harvest strategies for key target species in the SIOFA Area (SC-06-24; also presented at SERAWG3 as SERAWG-03-10) was taken as read. The report included a summary of the use of harvest strategies, and target and limit reference points used by other fishery organisations, a summary of the assessments available for the three major species under harvest in the SIOFA Area (alfonsino, orange roughy and Patagonian toothfish), possible harvest strategy approaches for the aforementioned three major species and the pros and cons of each, and possible ways to move towards developing assessments for the other major species and consequently reference points and harvest strategies based on those assessments.

122: The SC NOTED that for most other SIOFA species that are data limited, assessments and consequently reference points and harvest strategies are not yet possible to develop.

123: For these SIOFA species, the SC NOTED that approach i. could be the most viable at this time, but that this would need to be augmented by one or more precautionary provisions to check whether catches were sustainable and take corrective action in the event that there were persuasive indications to the contrary. The SERAWG NOTED that this approach could be implemented, for example, by application of risk assessment across a broad suite of species using, for example, the SAFE methodology. However, unless the spatial and temporal scale of the fishery is well known, this may not be possible and other options would need to be investigated.

124: The SC RECOMMENDS that the MoP note that an important associated priority is further data collection, especially more and better catch and effort information and the associated analyses of these data through space and time.

125: The SC SUGGESTS that:

- The utility and specifics of the three alternative approaches, as they may apply in each case, be examined before a decision on the best approach is determined.
- The MoP considers interim reference points for orange roughy and alfonsino as follows: Target = BMSY using a proxy of = 0.4*B0, and a Limit = 0.2*B0 (common surrogates used in other regions). These interim reference points could be considered for SC reporting purposes and would not necessarily be appropriate for management purposes.
- With respect to toothfish, the MoP consider that CMM 2020/15 has an objective to “ensure collaborative and complementary arrangements are in place for D. eleginoides between SIOFA and the CCAMLR”. Accordingly, when setting reference points for toothfish, SIOFA consider the reference points adopted by CCAMLR: Target = 0.5*B0, and Limit = 0.2*B0
- The MoP consider fishing fleet behaviour and fish stock structure in the development of harvest strategies for each species.

126: The SC RECOMMENDS that the MoP:

- Undertake analyses to determine the applicability and trade-offs between the three proposed harvest strategy approaches for each of the three species concerned, to provide

an objective basis to underpin final decision making. For some approaches this will require consideration of appropriate reference points.

The MoP8 (2021) noted the following

130: France Territories supported the continuation of the work on harvest strategies by implementing analyses to assess the effectiveness and risks associated with the three strategies proposed in the Scientific Committee report. In view of the little knowledge on the sustainability of harvesting levels for the main species, France Territories supported the implementation of the precautionary principle when choosing the reference points. Regarding toothfish, France Territories supported the adoption of management objectives and reference points as adopted by CCAMLR.

131: Australia welcomed the significant consultant report exploring the potential development of harvest strategies in SIOFA and stated that it continues to be a strong advocate of harvest strategies as a best practice in fisheries management in order to achieve SIOFA's objectives. Australia could support the proposed interim reference points on orange roughy, alfonsino, and toothfish, but recognised that further consideration may be needed within the Scientific Committee and amongst CCPs and so Australia did not advocate for a decision on reference points at this MoP. Australia supported the recommendation on further work to examine the applicability of the three proposed harvest strategy approaches, and work to develop objectives for these fisheries.

132: The Cook Islands expressed its support for the development of a harvest strategy process, noting that, while some of the issues need broader consideration, the work done so far by the Scientific Committee is a good step forward. The Cook Islands noted that, for all three stocks concerned, the scientific information available make the development of an efficient, well-balanced, and carefully thought out harvest strategy challenging, and suggested that it may be necessary to consider simpler approaches in the interim.

133: The European Union welcomed the work done to progress the harvest strategy approaches and suggested that a roadmap be developed and the work be progressed further in the intersessional period before the Scientific Committee meeting to enable it to make recommendations in time for the next Meeting of the Parties.

134: The European Union highlighted the need for enhanced cooperation between scientists and managers when developing harvest strategy approaches.

135: The Meeting of the Parties requested the Scientific Committee to develop a roadmap for developing harvest strategies at the seventh Scientific Committee meeting and, as recommended in paragraph 126 of the SC6 report, consider analyses to determine the applicability and trade-offs between the three proposed harvest approaches for orange roughy, alfonsino, and toothfish.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2022

Report SC-07-INFO-24 (Butterworth 2022) was a SIOFA consultancy that reported on a roadmap for the development of harvest Strategies for SIOFA. This report provided the following summary:

The Consultants past experience with conducting assessments of and/or providing management advice for SIOFA fish stocks has indicated that a key problem has been the lack of background information on the data available and how they relate to the way the fishery operates. That missing information is a key input to the assessment process, and its ability to provide reliable results. The International Whaling Commission's "harvest strategy roadmap" is reviewed. Their first step for any stock of a "pre-assessment" process to compile the data to be used in the harvest strategy analyses and how they should be interpreted, is suggested to be an essential component of any similar SIOFA roadmap. This process should be put into practice by the appointment, for any stock for which a harvest strategy is to be developed, of a Technical Sub-Committee which would meet separately from the SIOFA Scientific Committee and report back to it. This Sub-Committee would include persons with the relevant expertise about the stock to provide this missing information and to develop ToR's for the basis on which the harvest strategy development should proceed. Overview comments are provided about the process that would then follow. An important decision to be made is whether the harvest strategy for a specific stock is to be based on the "best assessment plus harvest control rule" approach or on Management Strategy Evaluation (MSE). A table is provided summarising the details associated with this "Technical Sub-Committee" pre-assessment component of a harvest strategy development roadmap.

Table 2: Elements of the initial stage of a recommended harvest strategy roadmap for SIOFA, focussing on the suggested pre-assessment process (Table 1 from Butterworth 2022).

Step 1	The Scientific Committee selects a stock for the potential development of a harvest strategy. Note that at any one time, probably no more than two stocks should be in process towards such development (this in the light of likely resource limitations in terms of "person-power")
Step 2	The Scientific Committee appoints a Technical Sub-Committee to initiate the harvest strategy development process for that stock through what is termed a "Pre-assessment". In broad terms, the role of that Sub-Committee is to oversee the compilation of the data to be used in that process and to comment on how they are to be interpreted in developing stock assessment models and the basic hypotheses on which those models are to be based (this may extend beyond single interpretations of components of that information, and include alternatives for which sensitivities will need to be investigated).
Step 3	The Technical Sub-Committee is to comprise of persons with the appropriate expertise to advise on the data available for the stock and how they are to be interpreted. They are to be drawn both from Scientific Committee members and from outside persons with relevant expertise.
Step 4	At the start of the process, the Scientific Committee should appoint likely analysts, but at that stage "preliminarily", i.e., for participation in the activities of the Technical Sub-Committee only.
Step 5	A primary role of the Technical Sub-Committee is to report back to the Scientific Committee when they consider that the pre-assessment process has been successfully completed to the stage that they would be prepared to recommend to the Scientific Committee that the quantitative assessment analyses by the analysts previously "provisionally" appointed can commence
Step 6	The Technical Sub-Committee must also advise the Scientific Committee on: a) Likely timelines for completion of the harvest strategy development. b) If pertinent, broad indications of likely appropriate values for target and limit reference points. c) ToR for the analysts who will be developing the harvest strategy. d) Whether to aim for a "best assessment plus harvest control rule approach" or for a full MSE harvest strategy, with the addition of further details desirably specified immediately for whichever option is preferred.
Step 7	The Scientific Committee then considers the recommendations/advice provided by the Technical Sub-Committee, and decides whether the harvest strategy development for the stock under consideration is to proceed, together with specifying the ToR for the analysts.

The SC7 (2022) noted the following

124. The SC ENDORSED the recommendation in SC-07-INFO-12 rev 1 (Butterworth 2022):

- to specify a pre-assessment process involving the appointment of a Technical Sub-Committee to oversee the collection of relevant data and to provide the interpretations of those data that are necessary before the assessment of and harvest strategy development for any stock can proceed.
- that subsequent harvest strategy development would be highly dependent on the reports from such Technical Sub-Committees, so it would be premature at this time to get into more details about the later stages of a harvest strategy roadmap for SIOFA.

125. As the next steps, the SC RECOMMENDED:

- that the Secretariat work intersessionally to prepare as much information as possible for understanding the data available on the alfonsino, orange roughy and toothfish fisheries and any potential trends in the data.
- that a two-day harvest strategy pre-assessment workshop be held in 2023 prior to SC8, with the participation of scientists, managers, industry representatives, and observers, to:
  i. discuss the planning and implementation of the harvest strategy development roadmap.
  ii. interpret the data.
  iii. identify data gaps for informing a stock assessment.
  iv. discuss which stocks are to be assessed.
- That the outcomes of the workshop be presented to the SC and its working groups for further discussion.

126: The SC encouraged CCPs to conduct characterisations of their alfonsino, orange roughy and toothfish fisheries, and to present this information to the abovementioned workshop.

170: With regard to the development of a harvest strategy roadmap, the SC RECOMMENDED the MoP:

- ENDORSE the specification a pre-assessment process involving the appointment of a Technical Sub-Committee to oversee the collection of relevant data and to provide the interpretations of those data that are necessary before the assessment of and harvest strategy development for any stock can proceed.
- NOTE that subsequent harvest strategy development would be highly dependent on the reports from such Technical Sub-Committees so it would be premature at this time to get into more details about the later stages of a harvest strategy roadmap for SIOFA.
- task the Secretariat to work intersessionally to prepare as much information as possible for understanding the data available on the alfonsino, orange roughy and toothfish fisheries and any potential trends in the data.
- ENDORSE that a two-day harvest strategy pre-assessment workshop be held, with the participation of scientists, managers, industry representatives, and observers, to:
  i. discuss the planning and implementation of the harvest strategy development roadmap.
  ii. interpret the data collected intersessionally.
  iii. identify data gaps for informing a stock assessment.
  iv. discuss which stocks are to be assessed.
  v. develop identification guides to assist the recording of species by the vessel crew and observers.
- that the outcomes of the workshop be presented to the SC and its working groups for further discussion.

The MoP9 (2022) noted the following

130: The Meeting of the Parties ENDORSED the recommendations in paragraph 170 of the SC7 report regarding the development of a harvest strategy roadmap.

131: The Meeting of the Parties AGREED that the holding of the harvest strategy preassessment workshop, as well as other workshops, should be done in a hybrid format to enable maximum participation, including by observers.

268: The Meeting of the Parties AGREED that the joint MoP-SC workshop on harvest strategy pre-assessment will take place from 17 to 18 March 2023, the workshop on deepwater sharks in the SIOFA Area will take place from 20 to 21 March 2023, and the eighth meeting of the SC will take place from 22 to 31 March 2023, in Tenerife, Spain.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2023

The joint MoP-SC WSHSPA-2023 (2023) noted the following

15. The Workshop noted the benefit of continued discussion between managers and scientists and recommended the MoP consider establishing a process for regular dialogue between the MoP and the SC for the development of harvest strategies.

17. The Workshop recommended that the SC provide advice to the MoP on approaches to improved data collection and monitoring programmes that could be considered as a part of a harvest strategy framework.

21. The Workshop agreed that for the management objectives, biological objectives should be considered initially in the development of harvest strategies, but also noted that this did not preclude the inclusion of socio-economic objectives either at the same time or once the harvest strategy process was more developed.

31. The Workshop recommended that the SC be requested to provide advice to the MoP of additional SIOFA species that would be amenable to the development of monitoring programs and harvest strategies.

32. The Workshop recommended that the MoP consider recommending the development of harvest strategies for orange roughy and toothfish as a first step, but also consider the development of harvest strategies for alfonsino and other important SIOFA species based on advice from the SC.

37. The Workshop recommended that the MoP adopt interim reference points as follows.

i. Stock-specific interim reference points:

(a) Orange roughy (all assessment units) and Alfonsino (all stocks): Target = BMSY using a proxy of = 0.4*B0, and a Limit = 0.2*B0 (common surrogates used in other regions) with a probability of being above the target of at least 50% of the time, and a probability of being above the limit of at least 90% of the time.

(b) Toothfish (all management units): Target = 0.5*B0, and Limit = 0.2*B0 with a probability of being above the target of at least 50% of the time, and a probability of being above the limit of at least 90% of the time.

ii. Candidate Harvest Control Rules (HCRs) as interim management for the above stocks and as management for all other stocks:

(a) Maintaining catches at present levels (unless there is evidence of a marked downward trend in the resource) until sufficient further informative data become available for meaningful improvements to the existing assessments.

(b) Implementing an Fstatus-quo harvesting strategy, which varies catches up or down in proportion to the results from continued collection of some measure or index of abundance.

(c) Implementing a harvest strategy based primarily on some multiple of a proxy value of FMSY or BMSY.

38. The Workshop discussed the development of rebuilding plans and recommended that the SC provide advice to the MoP on generic rules for stock rebuilding plans, taking as reference some of the well-developed fishing regimes around the world, that could be considered for inclusion into harvest strategies.

41. The Workshop recommended that the MoP consider additional objectives such as bycatch, fisheries impacts, benthic impacts, etc., as part of its harvest strategies, and that the SC provide advice to the MoP based on the objectives set by the MoP.

42. The Workshop recommended that the SC conduct a review, and compile and summarise the proxies used by other jurisdictions for the main species caught in the SIOFA Area.

43. The Workshop recommended the following process for the setting of management objectives:

i. As a first step, the Meeting of the Parties (MoP) propose potential management objectives in generic terms and, if possible, specific for each species and their stocks.

ii. The SC develop potential performance indices based on the management objectives proposed by the MoP.

iii. The SC identifies any objectives that are incompatible with each other and where trade-offs would need to be considered.

iv. The MoP considers the performance indices recommended by the SC, and identifies those to adopt, and which should be excluded or further refined by the SC.

45. The Workshop recommended the SC consider a wide range of options for stock monitoring programmes; prepare a table (e.g., Table 2), with the scientific uncertainty, relative costs, and applicability by stock/fishery of the various options; and present this to the MoP for the MoP to decide on the appropriate monitoring programme for each stock.

48. The Workshop recommended that the MoP request the SC evaluate the different stock assessment options, based on the level of data available, for all species that were potential candidates for harvest strategies.

53. The Workshop recommended that the MoP request the SC provides advice on appropriate monitoring programmes that could be used to monitor each stock that was a potential candidate for harvest strategies.

54. The Workshop recommended that the MoP decide on the appropriate monitoring programme for each stock based on advice on potential options that would be prepared by the SC.

55. The Workshop recommended that the MoP request the SC determine potential performance indicators for each of the management objectives once the MoP has decided on the management objectives.

56. The Workshop developed an approach to the development of harvest strategies and the timeline for the implementation of pre-assessments, assessments, management objectives and implementation of harvest strategies (see Table 3).

57. The Workshop recommended that the SC, at its 2023 meeting, consider adopting the framework of advice with specific reference to data-limited stocks. The SC should also consider potential candidate interim Harvest Control Rules (HCR) for data-limited stocks.

58. The Workshop recommended that the SC, at its 2026 meeting, aim to formally propose final Harvest Strategies to the MoP. If adopted by the MoP in 2026, the Harvest Strategy could be used to formulating its scientific advice in 2027.

59. The Workshop requested the MoP and SC consider and further refine the above proposed timeline given in Table 3.

60. The Workshop requested that CCPs consider the timeline and provide advice to the SC and MoP on contributions they are intending to make to facilitate the development of harvest strategies.

61. The Workshop reaffirmed the importance of regular dialogue between the MoP and the SC to ensure smooth and timely progress in accordance with the timeline, and requested the MoP and the SC to consider how frequently and in what format the SC and MoP should hold such dialogues when refining the above timeline.

62. The Workshop recommended that a one or two-day joint MoP-SC workshop on harvest strategy pre-assessment be held in 2024 immediately preceding SC9 to further the discussion between MoP and SC on the development of harvest strategies. The Workshop recommended that the SC, at its meeting in 2023, develop draft objectives and terms of reference for that workshop for consideration at MoP10.

63. The Workshop noted that the SC could hold species-specific pre-assessment meetings in the intersessional period and recommended that the SC develop a pre-assessment summary and make it available for the joint MoP-SC workshop in 2024.

65. The Workshop recommended that the MoP consider an agenda item on harvest strategies at its annual meeting this year and consider, as part of that, inviting SPC or some other experts to give an overview of harvest strategies and appropriate software tools, including a demonstration of the SPC AMPLE Shiny App or other similar HCR tool.

67. The Workshop recommended that the MoP consider requesting the SC develop interim ad-hoc harvest control rules that could be used for managing stocks, including for example, harvest control rules that adjust catch limits based on trends in CPUE or other stock status indicators.

The SC8 (2023) noted the following

166. The SC endorsed the recommendation in paragraph 15 of the Workshop report that the MoP consider establishing a process for regular dialogue between the MoP and the SC for the development of harvest strategies, held in conjunction with either the MoP or SC meetings.

171. The SC endorsed the recommendation in paragraph 31 of the Workshop report that the MoP request the advice of the SC on additional SIOFA species that would be amenable to the development of monitoring programmes and harvest strategies.

173. The SC endorsed the recommendations in paragraph 32 of the Workshop report that the MoP consider recommending the development of harvest strategies for orange roughy and toothfish as a first step, but also consider the development of harvest strategies for alfonsino and other primary SIOFA species.

176. The SC recommended that the MoP adopt interim stock-specific reference points for orange roughy (all assessment units) and alfonsino (all stocks) as follows (with B0 denoting pre-exploitation spawning stock biomass): Target = BMSY using a proxy of = 0.4*B0, and a Limit = 0.2*B0 (common surrogates used in other regions) with a probability of being above the target at least 50% of the time, and a probability of being above the limit of at least 90% of the time. The SC recommended that the MoP note that the proxies for MSY have been proposed for operationalising target reference points based on the assumption that the assessment methods would calculate depletion better than MSY, but that other equivalent operational targets may be appropriate depending on the assessment method used.

177. The SC recommended that the MoP adopt interim stock-specific reference points for toothfish (all management units) as follows (with B0 denoting pre-exploitation spawning stock biomass): Target = 0.5*B0, and Limit = 0.2*B0 with a probability of being above the target at least 50% of the time, and a probability of being above the limit of at least 90% of the time. The SC noted that the toothfish stocks in Williams Ridge and Del Cano Rise are likely to be part of a straddling stock with toothfish in the CCAMLR area and recommended that the MoP note the need to ensure alignment with the CCAMLR decision rules when operationalising the above interim reference points.

178. The SC recommended that the MoP adopt the following candidate Harvest Control Rules (HCRs) as interim management for the above stocks and as management for all other stocks:

a. Maintain catches at present levels (unless there is evidence of a marked downward trend in the resource) until sufficient further informative data becomes available for meaningful improvements to the existing assessments. Where not previously defined for specific stocks, the SC recommends the present level be defined as the average (mean) of the 5 year period 2018–2022. For orange roughy, SC7 agreed that recent levels referred to the average of the last six years of that assessment (2015–2020).

b. Implementing an Fstatus-quo harvest strategy, which varies catches up or down in proportion to the results from continued collection of some measure or index of abundance.

c. Implementing a harvest strategy based primarily on some multiple of a proxy value of FMSY or BMSY, while noting that other proxies or proxy values may be appropriate for some stocks, for instance those in the CCAMLR decision rules for toothfish.

179. Regarding paragraph 38 of the Workshop report, the SC recommended that the MoP request that SC9 hold discussions on the development of generalised approaches for stock maintenance and rebuilding approaches (if needed) and present the outcomes of its discussions to MoP11.

180. The SC endorsed the recommendation in paragraph 41 of the Workshop report that the MoP consider additional objectives such as bycatch, fisheries impacts, benthic impacts, etc., as part of its harvest strategies, and that the SC be requested to provide advice to the MoP based on the objectives set by the MoP.

182. The SC endorsed the process for the setting of management objectives recommended in paragraph 43 of the Workshop as follows:

i. As a first step, the Meeting of the Parties (MoP) proposes potential management objectives in generic terms and, if possible, specific for each species and their stocks.

ii. The SC develops potential performance indices based on the management objectives proposed by the MoP.

iii. The SC identifies any objectives that are incompatible with each other and where trade-offs would need to be considered.

iv. The MoP considers the performance indices recommended by the SC, and identifies those to adopt, and which should be excluded or further refined by the SC.

183. The SC endorsed the recommendation in paragraph 45 of the Workshop report that the SC consider a wide range of options for stock monitoring programmes; prepare a table (e.g., as shown in Table 2), with the scientific uncertainty, relative costs, and applicability by stock/fishery of the various options; and present this to the MoP for the MoP to decide on the appropriate monitoring programme for each stock.

184. The SC recommended that the MoP note that Table 2 is only an example that has been included for illustration purposes and that the specific rows and species will likely differ following the SC's discussions and scientific evaluations at SC9.

185. The SC endorsed the recommendation in paragraph 48 of the Workshop report that the MoP request the SC evaluate the different stock assessment options, based on the level of data available, for all species that were potential candidates for harvest strategies.

186. The SC endorsed the recommendation in paragraph 55 of the Workshop report that the MoP request the SC determine potential performance indicators for each of the management objectives once the MoP has decided on the management objectives.

187. Regarding paragraph 56 of the Workshop report, the SC endorsed the approach for the development of harvest strategies and the timeline for the implementation of pre-assessments, assessments, management objectives and implementation of harvest strategies proposed by the Workshop (Annex G). The SC noted that ecosystem considerations under Step 1.1 Specify management objectives could include bycatch and benthic impacts. The SC noted that Step 4.2. Adopt appropriate harvest strategy and Step 5.1. Implement management changes based on HCR should happen in the same year and recommended that the MoP begin preparations, which may take several years, for Step 5.1., to minimize the delay between the two steps.

188. The SC endorsed the recommendation in paragraph 58 of the Workshop report that the SC, at its 2026 meeting, aim to formally propose final Harvest Strategies to the MoP. The SC noted that if adopted by the MoP in 2026, the Harvest Strategy could be used for formulating the SC's scientific advice from 2027.

189. Regarding paragraph 59 of the Workshop report, the SC noted that the proposed timeline for the implementation of pre-assessments, assessments, management objectives and implementation of harvest strategies should include responses to exceptional circumstances, such as dropout or breakout rules as mentioned in paragraph 51 of the Workshop report, and recommended that the MoP consider what such responses might be.

193. Regarding paragraphs 61 and 62 of the Workshop report, the SC noted the importance of regular dialogue between the MoP and the SC to ensure smooth and timely progress in accordance with the timeline, and endorsed the recommendation that a one or two-day joint MoP-SC workshop on harvest strategy pre-assessment be held in 2024. As for the timing, the SC requested that the MoP consider whether the workshop should be held immediately preceding SC9 or immediately preceding MoP11, noting that the latter may facilitate greater participation by managers.

194. The SC developed draft objectives and Terms of Reference for the joint MoP-SC workshop on harvest strategy pre-assessment and recommended that the MoP consider them for adoption (Annex H).

196. The SC endorsed the recommendation in paragraph 65 of the Workshop report that the MoP consider an agenda item on harvest strategies at its annual meeting this year and consider, as part of that, inviting the Pacific Community (SPC) or other experts to give an overview of harvest strategies and appropriate software tools (such as the SPC AMPLE Shiny App or other similar HCR tool). The SC believed that such a demonstration could be beneficial for the MoP and tasked SC Chair to liaise with the MoP Chair about this matter.

197. The SC endorsed the recommendation in paragraph 67 of the Workshop report that the MoP consider requesting the SC to develop interim ad-hoc harvest control rules that could be used for managing stocks, including for example, harvest control rules that adjust any future catch limits based on trends in CPUE or other stock status indicators.

The MoP10 (2023) noted the following

73. The MoP ENDORSED the recommendation in paragraph 166 of the SC8 report to establish a process for regular dialogue between the MoP and the SC for the development of harvest strategies, held in conjunction with either the MoP or SC meetings.

75. The MoP ENDORSED the recommendation in paragraph 171 of the SC8 report and REQUESTED the advice of the SC on additional SIOFA species that would be amenable to the development of monitoring programmes and harvest strategies.

76. The MoP NOTED the recommendations in paragraph 173 of the SC8 report and AGREED to develop harvest strategies for orange roughy and toothfish as a first step, and then subsequently consider developing harvest strategies for alfonsino and other primary SIOFA species. The MoP REQUESTED the SC to continue to work to develop harvest strategies in conjunction with workshops held with the MoP.

77. The MoP ENDORSED the recommendations in paragraph 176 of the SC8 report regarding interim stock-specific reference points for orange roughy and alfonsino.

78. The MoP ENDORSED the recommendations in paragraph 177 of the SC8 report regarding interim reference points for toothfish.

79. The MoP ENDORSED the recommendations in paragraph 178 of the SC8 report regarding candidate Harvest Control Rules for interim management, notably:

a. Maintain catches at present levels (unless there is evidence of a marked downward trend in the resource) until sufficient further informative data becomes available for meaningful improvements to the existing assessments. Where not previously defined for specific stocks, the SC

recommends the present level be defined as the average (mean) of the 5 year period 2018–2022. For orange roughy, SC7 agreed that recent levels referred to the average of the last six years of that assessment (2015–2020).

b. Implementing an Fstatus-quo harvest strategy, which varies catches up or down in proportion to the results from continued collection of some measure or index of abundance.

c. Implementing a harvest strategy based primarily on some multiple of a proxy value of FMSY or BMSY, while noting that other proxies or proxy values may be appropriate for some stocks, for instance those in the CCAMLR decision rules for toothfish.

80. The MoP NOTED paragraph 179 of the SC8 report and REQUESTED that SC9 hold discussions on the development of generalised approaches for stock maintenance and rebuilding approaches (if needed) and present the outcomes of its discussions to MoP11.

81. The MoP ENDORSED the recommendations in paragraph 180 of the SC8 report that the MoP consider additional objectives such as bycatch, fisheries impacts, benthic impacts, etc., as part of its harvest strategies. The MoP REQUESTED that the SC provide advice based on the objectives set by the MoP.

82. The MoP ENDORSED the recommendations in paragraph 182 of the SC8 report regarding the process for the setting of management objectives.

83. The MoP ENDORSED the recommendation in paragraph 183 of the SC8 report that the SC consider a wide range of options for stock monitoring programmes; prepare a table (e.g., as shown in Table 2 of the SC8 Report), with the scientific uncertainty, relative costs, and applicability by stock/fishery of the various options; and present this to the MoP for the MoP to decide on the appropriate monitoring programme for each stock.

84. As recommended in paragraph 184 of the SC8 report, the MoP NOTED that Table 2 of the SC8 Report is only an example that has been included for illustration purposes and that the specific rows and species will likely differ following the SC's discussions and scientific evaluations at SC9.

85. The MoP NOTED the recommendation in paragraph 185 of the SC8 report and REQUESTED the SC evaluate the different stock assessment options, based on the level of data available, for all species that are potential candidates for harvest strategies.

86. The MoP NOTED the recommendations in paragraph 186 of the SC8 report and REQUESTED the SC determine potential performance indicators for each of the management objectives once the MoP has decided on the management objectives.

87. The MoP ENDORSED the recommendations in paragraph 187 of the SC8 report regarding the approach for the development of harvest strategies and the timeline for the implementation of preassessments, assessments, management objectives and implementation of harvest strategies proposed by the Workshop (SC8 Report, Annex G).

88. The MoP ENDORSED the recommendations in paragraph 188 of the SC8 report regarding the timeline for the proposal, adoption and use of final Harvest Strategies.

89. The MoP ENDORSED the recommendation in paragraph 189 of the SC8 report regarding the inclusion of responses to exceptional circumstances, such as dropout or breakout rules, in the proposed timeline for the implementation of pre-assessments, assessments, management objectives and implementation of harvest strategies and AGREED to consider what such responses might be.

90. The MoP ENDORSED the recommendation in paragraph 193 of the SC8 report to hold a joint MoP-SC workshop on harvest strategy pre-assessment in 2024 and discussed the duration and timing of the meeting under agenda item 15.

91. The MoP AGREED to hold a joint MoP-SC intersessional workshop to define management objectives, based on which the SC would develop its scientific advice. The MoP REQUESTED the Chair and the SC to draft the agenda and Terms of Reference for the intersessional workshop. The MoP discussed the timing of the meeting under agenda item 15.

92. The MoP NOTED paragraph 194 of the SC8 report and adopted the draft objectives and Terms of Reference for the joint MoP-SC workshop on harvest strategy pre-assessment (SC8 Report, Annex H).

93. The MoP ENDORSED the recommendation in paragraph 196 of the SC8 report and AGREED to have an agenda item on harvest strategies at its next annual meeting and invite the Pacific Community (SPC) or other experts to give an overview of harvest strategies and appropriate software tools (such as the SPC AMPLE Shiny App or other similar HCR tool) at the next MoP-SC joint meeting. The MoP TASKED the Secretariat to make the necessary arrangements.

94. The MoP NOTED paragraph 197 of the SC8 report and REQUESTED the SC to develop interim ad-hoc harvest control rules that could be used for managing stocks, including for example, harvest control rules that adjust any future catch limits based on trends in CPUE or other stock status indicators.

95. The MoP noted paragraph 199 of the SC8 report and AGREED that, for the primary SIOFA target species, CCPs should include in their national reports nominal CPUE data for these species, to enable the identification of potential trends in years when no assessment is being undertaken.

96. The MoP NOTED paragraph 201 of the SC8 report and ENDORSED a stock assessment schedule whereby only one of the three main SIOFA target stocks are subject to a stock assessment in any given year and other species are subject to a stock assessment, as required, in years where no stock assessment of the three main SIOFA target stocks is being conducted.

97. The MoP NOTED paragraph 202 of the SC8 report and held further discussions under agenda item 9.

98. The MoP NOTED paragraph 203 of the SC8 report and considered it alongside the related recommendation of the Compliance Committee under agenda item 5.1.

The joint MoP-SC WS2023-HSMO (2023) noted the following

18. The Workshop agreed that the definitions of the quantitative terms that it has used for describing probabilities (e.g., ‘very likely’) are tentative and requested the SC develop a formal set of definitions for these terms.

Probability Description

> 99 % Virtually Certain

> 90 % Very Likely

> 60 % Likely

40–60 % About as Likely as Not

< 40 % Unlikely

< 10 % Very Unlikely

< 1 % Exceptionally Unlikely

23. The Workshop recommended that the SC and the MoP consider and further refine the potential management objectives and performance indicators in Table 1.

28. The Workshop recommended that the SC and the MoP consider and further refine the potential management objectives and performance indicators in Table 2.

30. The Workshop requested the SC hold further discussions on the development of breakout rules. The Workshop noted that the following examples of exceptional circumstances, derived from the WCPFC (WCPFC Commission report ANNEX IV, Attachment G. Interim Skipjack Tuna Management Procedure, WCPFC 19th Regular Session 2022), could be considered and refined at future meetings.

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2024

The SC9 (2024) noted the following

131. The SC recommended the MoP note that it has considered the potential management objectives and performance indicators for orange roughy that were drafted by the WS2023-HSMO and further refined the performance indicators as described in Annex H.

135. The SC recommended that the MoP note that the development of breakout rules would be a key part of the development of harvest strategies, and that criteria would be developed as part of this process.

138. The SC recommended the MoP note that it has considered the potential management objectives and performance indicators for toothfish that were drafted by the WS2023-HSMO and further refined them as described in Annex I.

147. The SC recommended that the MoP note that it had updated the timeline by adding the implementation status of each task (Annex K).

150. The SC recommended that the MoP note the proposed draft agenda in Annex L.

152. The SC recommended that document WSHSPA-2023-01, the workplan and projects for the development of harvest strategies from SC9, and the harvest strategy development timetable (Annex K) be submitted to the workshop. In addition, the SC recommended that a timetable be included with the circular on the agenda with the tasks of the workshop and the anticipated inputs from the SC and the MoP highlighted.

The joint MoP-SC WS2024-HSS (2024) noted the following

13. The Workshop noted the usefulness of paper WSHSPA-2023-01 for tracking SIOFA's progress in developing harvest strategies. The Workshop recommended that the Secretariat regularly update this information and present it to future meetings and workshops where harvest strategies are to be discussed.

20. The Workshop recommended that the MSE initially evaluate alternative sensitivity choices of 50-60-70% probability of being at or above a TRP of 30-40-50% B0 for orange roughy.

21. The Workshop recommended that the MoP adopt the management objectives and performance indicators for orange roughy described in Annex B.

24. The Workshop recommended that the MSE initially evaluate alternative sensitivity choices of 50-60-70% probability of being at or above a TRP of 40-50-60% B0 for toothfish.

25. The Workshop recommended that the MoP adopt the management objectives and performance indicators for toothfish described in Annex C.

26. The Workshop recommended that the MoP task the SC to provide advice on determining a total allowable catch (TAC) for toothfish and on determining a TAC and/or total allowable effort (TAE) for orange roughy, as well as potential provisions to allow a degree of flexibility, such as allowable unders/overs/carry-overs, or multi-year limits.

27. The Workshop recommended that the MoP task the SC to consider how effort management and effort creep would be included in the MSE for orange roughy.

28. The Workshop recommended that the MoP develop a framework for deciding allocations based on catch history, among other factors, and to advance this work in parallel with the development of harvest strategies.

31. The Workshop reaffirmed that harvest strategy development work should first focus on toothfish and orange roughy, and that harvest strategies for alfonsino and other SIOFA species could be developed thereafter, as was agreed by MoP10 and SC9.

34. The Workshop recommended that the MoP note the updated harvest strategy development timeline (Annex D).

The MoP11 (2024) noted the following

145. The MoP NOTED paragraph 13 of the WS2024-HSS Conveners report regarding the usefulness of paper WSHSPA-2023-01 for tracking SIOFA's progress in developing harvest strategies and TASKED the Secretariat to regularly update this information and present it to future meetings and workshops where harvest strategies are to be discussed.

146. The MoP ENDORSED the recommendation in paragraph 20 of the WS2024-HSS Conveners report that the management strategy evaluation (MSE) initially evaluate alternative sensitivity choices of 50-60-70% probability of being at or above a target reference point (TRP) of 30-40-50% B0 for orange roughy.

147. The MoP NOTED the recommendation in paragraph 21 of the WS2024-HSS Conveners report and ADOPTED the management objectives and performance indicators for orange roughy (Annex N).

148. The MoP ENDORSED the recommendation in paragraph 24 of the WS2024-HSS Conveners report that the MSE initially evaluate alternative sensitivity choices of 50-60-70% probability of being at or above a TRP of 40-50-60% B0 for toothfish.

149. The MoP NOTED the recommendation in paragraph 25 of the WS2024-HSS Conveners report and ADOPTED the management objectives and performance indicators for toothfish (Annex O).

150. The MoP NOTED the recommendation in paragraph 26 of the WS2024-HSS Conveners report and TASKED the SC to provide advice on determining a total allowable catch (TAC) for toothfish and on determining a TAC and/or total allowable effort (TAE) for orange roughy, as well as potential provisions to allow a degree of flexibility, such as allowable unders/overs/carry-overs, or multi-year limits.

151. The MoP NOTED the recommendation in paragraph 27 of the WS2024-HSS Conveners report and TASKED the SC to consider how effort management and effort creep would be included in the MSE for orange roughy.

152. The MoP ENDORSED the recommendation in paragraph 28 of the WS2024-HSS Conveners report that the MoP develop a framework for deciding allocations based on catch history, among other factors, and to advance this work in parallel with the development of harvest strategies.

153. The MoP welcomed the offer from the Cook Islands to develop a paper, in collaboration with other CCPs, for MoP12 to help advance work to develop an allocation framework in SIOFA.

154. The MoP NOTED paragraph 31 of the WS2024-HSS Conveners report and NOTED that the Workshop reaffirmed that harvest strategy development work should first focus on toothfish and orange roughy, and that harvest strategies for alfonsino and other SIOFA species could be developed thereafter, as was agreed by MoP10 and SC9.

155. The MoP NOTED the recommendation in paragraph 34 of the WS2024-HSS Conveners report and NOTED the updated harvest strategy development timeline (Annex D, WS2024-HSS Conveners report).

Harvest strategies and timeline for the implementation of pre-assessments, assessments, management objectives and implementation (WS2024-HSS Annex D)

(Additional columns have been added to the timeline, originally developed by the Harvest Strategy Pre-Assessment Workshop, to record the implementation status of each step for orange roughy and Patagonian toothfish.)

Steps	**SC**			**MoP**		
Steps		**ORY**	**TOP**		**ORY**	**TOP**
Step 1				1. Specify management objectives:	☐	☐

Steps	SC			MoP		
Steps		**ORY**	**TOP**		**ORY**	**TOP**
Define management objectives				➢ biological (including ecosystem considerations) e.g., ensuring long-term sustainability and productivity; recovering heavily depleted stocks ➢ socio-economic e.g., maintaining reasonable stability in catches for the industry		
	2. Propose reference points based on management objectives: limit reference points (B_{lim} and/or F_{lim}), and target reference points (B_{TARGET} and/or F_{TARGET})	☒	☒			
				3. Select reference points	☐	☐
	4. Characterise the sources and values of uncertainties associated with the estimation of reference points (target and limit)	☒	☒			
				5. Specify acceptable levels of risk to be used in evaluating possible consequences of management actions, and time horizons for fishing mortality adjustments to avoid stock collapse, breaching limit reference point or achieve the target reference.	☐	☐
<u>Step 2</u> **Determine appropriate fisheries**	1. Identify data collection and monitoring activities required to reliably evaluate resource	☐	☐			

Steps	SC			MoP		
Steps		**ORY**	**TOP**		**ORY**	**TOP**
monitoring regime	status with respect to reference points					
				2. Implement data collection and monitoring programme to deliver consistent, high-quality data into the future.	☐	☐
	3. Determine how frequently to monitor (survey and/or assessments)	☐	☐			
Step 3 **Develop candidate Harvest Control Rules**	1. Propose candidate Harvest Control Rules (HCR): actions for controlling fishing mortality (F) or adjusting catch (and/or effort for orange roughy) with respect to pre-defined, stock-specific, precautionary reference points for both biomass (B) and fishing mortality (F) were possible.	☐	☒			
				2. Select HCR	☐	☐
	3. Conditions for Re-Evaluating Reference Points and HCR	☐	☐			
Step 4 **Test HCR with MSE**	1. Test HCR and compare expected performance of harvest strategies	☐	☐			
				2. Adopt appropriate harvest strategy	☐	☐
Step 5				1. Implement management changes based on HCR	☐	☐

Steps	SC			MoP		
Steps		**ORY**	**TOP**		**ORY**	**TOP**
Implement Harvest Strategy	2. Monitor (survey and/or assessment) and assess stock(s)	☐	☐			
	3. Determine stock status relative to reference points	☐	☐			
				4. Determine if Harvest Strategy delivers the objectives	☐	☐
Step 6 **Improve assessment and harvest strategy**	1. Review reference points and HCR if needed	☐	☐			
	2. Define research requirements to improve the quantification and evaluation of uncertainty (i.e., risk analysis), as well as methodological developments required to reduce uncertainty.	☐	☐			

Summary of recommendations and decisions from the Scientific Committee and Meeting of parties for 2025

The First Scientific Committee Workshop to progress the SIOFA Precautionary Approach and Management Projects (WS2025-PAM) noted the following

33. The Workshop noted that, as many of SIOFA's stocks have low levels of information or data , the project should focus on development of BRPs under PAM2024-02 that would be suitable for low information stocks rather than those that may be applied in high information stock assessments.

35. The Workshop noted that the SAFE methodology may be a potential assessment methodology that should be considered under PAM2024-02 but also noted that this required adequate spatial distribution information, and that this may not be the case for many SIOFA fisheries.

38. The Workshop noted that often the target reference points like the higher biomass levels are the ones that are often either hardest to achieve or are, in some examples from other jurisdictions, not defined. They noted that the definition of the limit reference point was critical to ensure the stock remained sustainable, while also achieving the long-term objective (i.e., the target reference point) of ensuring the maximum yield.

39. The Workshop noted that it would be useful to hold additional workshops to allow consultation with CCPs, the fishing industry, and observers, before finalising the report for project PAM2024-01.

40. The Workshop recommended that additional PAM workshops should be held, including joint workshops with the MoP along with technical ad-hoc meetings with experts from the SC and MoP, to ensure that the work was appropriately developed and fully considered by the SC and MoP.
45. The Workshop recommended that the development of BRPs and HCRs should be evaluated with consideration to their robustness to the effect of climate change on stock productivity and distribution. Further, the Workshop recommended that the precautionary approach framework should include consideration of the value of monitoring of, for example, age and length distributions, spatial distribution, etc, for evidence of changes in productivity or spatial distribution that would indicate if climate change effects would impact the scientific advice for managers.
46. The Workshop recommended that 'breakout' or 'stopping' rules developed for the HCRs include guidelines for management if such climate change effects on spatial distribution or productivity that would affect the management advice were detected.
47. The Workshop noted that the development of models to predict changes in productivity and distribution that may happen as a consequence of climate change was a very challenging task, and would not be possible within the current project
48. The Workshop noted that assumptions of the spatial distribution of stocks (for example for Orange Roughy and alfonsino) should be considered in the HCR evaluation. Further, the Workshop noted that some SIOFA stocks may cross the boundaries of the SIOFA Area, and that management strategies would need to be robust to cases where stocks partially reside in areas outside SIOFA.
49. The Workshop noted that the SC may wish to consider development of future projects to address uncertainties in the stock structure of key SIOFA stocks including consideration of cost-effective methods for collecting additional data (for example genetic sampling and age information).

The SC10 (2025) noted the following

179. The SC recommended that additional PAM workshops be held, including joint workshops with the MoP along with technical ad-hoc meetings with experts from the SC and MoP, to ensure that the work was appropriately developed and fully considered by the SC and MoP.
180. The SC recommended that the development of BRPs and harvest control rules (HCRs) should be evaluated with consideration to their robustness to the effect of climate change on stock productivity and distribution. Further, the SC recommended that the precautionary approach framework should include consideration of the value of monitoring of, for example, age and length distributions, spatial distribution, etc, for evidence of changes in productivity or spatial distribution that would indicate if climate change effects would impact the scientific advice for managers.
181. The SC recommended that exceptional circumstance rules be developed for the HCRs include guidelines for management if such climate change effects on spatial distribution or productivity that would affect the management advice were detected.

The MoP12 (2025) noted the following

131. The MoP NOTED the SC's recommendation, in paragraph 179 of the SC10 report, for holding additional PAM workshops, including joint workshops with the MoP along with technical ad-hoc meetings with experts from the SC and MoP, to ensure that the work would be appropriately developed and fully considered by the SC and MoP. The MoP discussed this matter further as part of the SC work plan under agenda item 5.1.12.
132. The MoP NOTED the SC's recommendations, in paragraph 180 of the SC10 report, that:
a. the development of biological reference points (BRPs) and harvest control rules (HCRs) should be evaluated with consideration to their robustness to the effect of climate change on stock productivity and distribution.
b. the precautionary approach framework should include consideration of the value of monitoring of, for example, age and length distributions, spatial distribution, etc., for evidence of changes in productivity or spatial distribution that would indicate if climate change effects would impact the scientific advice for managers.
133. The MoP NOTED the SC's recommendation, in paragraph 181 of the SC10 report, that

exceptional circumstance rules be developed for the HCRs and that these include guidelines for management if climate change effects on spatial distribution or productivity that would affect the management advice were detected.

The Second Scientific Committee Workshop to progress the SIOFA Precautionary Approach and Management Projects (WS2025-PAM2) noted the following

20. The Workshop endorsed the overall three-component architecture as appropriate for SIOFA's diverse fisheries portfolio, spanning well-studied high-value stocks to data-poor, low-value fisheries, and recommended proceeding with the proposed Framework Architecture.
24. The Workshop endorsed the three-tier classification (high, medium, low information) as practical for SIOFA's circumstances, while noting the potential addition of a fourth tier for stocks with zero or near-zero available information. The Workshop recommended that the SC develop clear, objective criteria for classifying stocks between information categories, with provision for regular review as data availability changes.
28. The Workshop endorsed the Three-Zone Stock Status System, subject to further refinement of the naming and definition of each zone.
29. The Workshop recommended that:
a. priority should be given to determining limit reference points (LRP) for the main SIOFA species as listed in Annex 1 of CMM 17(2024)
b. default biological reference points be established for other and low-information stocks, where possible, with provision for adding stock-specific reference points as data improves.
30. The Workshop endorsed Management Procedures as the default management approach for the main SIOFA species, recognising their value for providing predictable, science-based decision-making, and considered the three-tier approach (quantitative model-based, simplified empirical, qualitative knowledge-based) to be appropriate for SIOFA's diverse circumstances.
31. The Workshop recommended applying a progressive approach to implementation, prioritising:
a. Stocks whose status warrants immediate attention
b. Primary species of highest economic or ecological importance
c. Stocks where SIOFA has existing management infrastructure
33. The Workshop endorsed the risk equivalency principle ensuring all stocks face similar conservation risk levels through appropriate precautionary buffers and reference points adjusted for uncertainty levels.
34. The Workshop recommended that Technical Guidelines be developed concurrently with Framework finalisation, addressing:
a. Stock assessment methodologies for each information tier
b. Reference point calculation methods
c. Management Procedure design and testing protocols
d. Performance monitoring requirements
e. Specification of how precautionary buffers and reference points will be adjusted based on information availability and assessment uncertainty
f. Additional guidance for how to use the scientific information to categorise stocks
49. The Workshop recommended that the consultants ensure full integration between the framework development (PAM-2024-01) and the biological reference points (PAM-2024-02) and harvest strategies (PAM-2024-03) projects.

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