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Southern Indian Ocean Fisheries Agreement
Accord relatif aux Pêches dans le Sud de l'Océan Indien

Development of the SIOFA Precautionary Approach Framework (PAF) (SIOFA PAM-2024-01) Final Project Report

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**Funded by
the European Union**

1 Introduction

Project PAM-2024-01 was commissioned by the Southern Indian Ocean Fisheries Agreement (SIOFA) to develop a Precautionary Approach to Management (PAM) Framework — a structured, evidence-based system for translating the precautionary approach into operational fisheries management. This requirement arises from Article 4(c) of the SIOFA Agreement, which mandates the application of the precautionary approach consistent with the 1995 UN Fish Stocks Agreement (UNFSA) and the FAO Code of Conduct for Responsible Fisheries, and from specific recommendations in the SIOFA Performance Review. The Meeting of the Parties' functions under Article 10 — reviewing stock status, evaluating ecosystem impacts, and adopting conservation and management measures — require a robust technical foundation that this Framework is designed to provide.

The terms of reference for the project required the development of two documents: (1) a Conceptual Framework; and (2) Technical Guidelines. These are presented as Attachments 1 and 2 to this report respectively. The complete terms of reference are reproduced at Annex 1. The project was funded by the European Union.

This report documents the methods used to develop the Framework, summarises the resulting documents, records the consultation and review process undertaken, and identifies the manner in which feedback from the Scientific Committee at SC-11 has been addressed in the final versions.

2 Methods

Development of the Framework was qualitative, combining systematic review, comparative analysis, and iterative structured consultation.

Framework review and development

- The consultants conducted a comprehensive review of international precautionary approach and harvest strategy frameworks, including NAFO's precautionary approach framework, ICES advice rules, FAO technical guidelines, and domestic frameworks from Australia, Canada, and New Zealand. While these provided conceptual precedent and practical reference points, none was directly transferable to SIOFA's specific context.
- The central challenge is SIOFA's fishery portfolio, which spans species with relatively high data availability (such as orange roughy, where stock assessments have been undertaken) through to species for which very limited biological information is available. Most international frameworks treat data-limited stocks as edge cases, with primary architecture designed for data-rich species. This Framework deliberately inverts that assumption: SIOFA's data-limited stocks are the operational norm, and the Framework is designed accordingly, with substantive guidance for low- and zero-information stocks rather than relegating them to generic fallback provisions.

Development proceeded through four elements:

- Institutional and fishery context analysis: an analysis of SIOFA's legal framework, institutional arrangements, and fishery portfolio established the requirements and constraints the Framework must meet. This included a review of existing SC and MoP decisions and the strategic and technical direction established through those processes, to ensure the Framework is consistent with SIOFA's existing governance architecture and builds on rather than cuts across it.

- Literature and framework review: international literature and comparable frameworks were reviewed to identify established approaches to applying a precautionary approach, and in particular to management procedures, across different data environments.
- Architecture development: the three-component architecture — Information Classification System, Three-Zone Stock Status System, and tiered Management Procedures — was developed as an integrated system rather than three separate instruments.
- Technical Guidelines: the Technical Guidelines were developed to operationalise each component, drawing on a range of technical literature (cited within the documents) and on outputs from PAM-2024-02 and PAM-2024-03 where available. Novel guidance was developed for low- and zero-information stocks where no adequate international precedent was found.

Consultation and review process

The development involved extensive structured consultation throughout the project:

- Proposed methods were shared with the Scientific Committee Advisory Panel, and an initial virtual workshop (WS2025-PAM, February 2025) was held to develop and test the approach. Preliminary methods and outcomes were subsequently presented to the 10th Meeting of the Scientific Committee (SC-10, March 2025).
- A second virtual workshop (WS2025-PAM2, August 2025) provided further feedback on the developing framework, which was incorporated into subsequent drafts.
- A draft report was submitted to the SIOFA Secretariat on 25 December 2025. The submission was accompanied by a letter identifying the progress to that date, the issues considered, and providing a detailed response to each area of feedback received from the workshops and advisory processes. This letter and response document are provided at Attachment 3.
- Expert reviewer feedback was received from the PAM-2024-04 review panel (Dr Anne-Elise Nieblas, Dr Sylvain Bonhommeau, and Dr Nathan Walker) following their review of the draft report. This feedback was reviewed and incorporated ahead of submission to SC-11, with a detailed account of how each item was addressed provided at Attachment 5.
- The final documents, together with the SC working paper [SC-11-31](#), were presented to the 11th Meeting of the Scientific Committee (SC-11, Fremantle, Australia, March 2026). SC-11 considered the documents, raised three matters requiring further attention, and adopted a set of recommendations on the Framework and its implementation pathway.

Outputs were coordinated throughout with companion projects PAM-2024-02 (Biological Reference Points, Drs Hoyle and Mormede) and PAM-2024-03 (Harvest Control Rules and MSE, Drs Mormede and Hoyle).

3 Results

The project has delivered two documents as contractually required.

PAM-2024-01 Conceptual Framework (Attachment 1)

The Conceptual Framework establishes the policy architecture of SIOFA's Precautionary Approach. Part I sets out the legal basis for the Framework, its relationship to the Agreement, to CMMS, and to the Technical Guidelines, and the principles that should guide management decisions — including

substantive provisions addressing SIOFA's obligations towards developing States and SIDS under Article 13.4 of the Agreement. Part II describes the three-component framework architecture and its integration. Part III addresses the Information Classification System, establishing four categories — High, Medium, Low, and Zero Information — based on the quality, quantity, and breadth of available data. Part IV describes the Three-Zone Stock Status System (Healthy, Under Watch, and Critical), establishing reference-point-based zones that trigger specific management responses. Part V sets out the Management Procedure system, including the three-tier structure (Tier 1: full quantitative; Tier 2: simplified empirical; Tier 3: qualitative/knowledge-based), alternative management approaches for stocks where formal Management Procedures are not yet feasible, and provisions for periodic review.

PAM-2024-01 Technical Guidelines (Attachment 2)

The Technical Guidelines operationalise each component of the Conceptual Framework. They provide detailed guidance on applying the Information Classification System, including a novel operational checklist that translates classification criteria into assessable indicators, designed to support consistent, evidence-based classification while retaining the expert judgement essential for a portfolio as diverse as SIOFA's.

The guidelines address the Three-Zone Stock Status System, including methods for establishing reference points across information tiers and interim default reference points where stock-specific values cannot be determined. Guidance on Management Procedure development covers all three tiers, with particular depth for Tier 3 — where the literature review found no existing framework with sufficient guidance for SIOFA's context. This section is accordingly novel.

The guidelines also address stocks not currently under formal Management Procedures, limiting the situations to which this can apply to truly minimal fisheries, fisheries pending management procedure development or fisheries for which even a Tier 3 qualitative management procedure is not possible. It establishes seven mandatory elements for alternative management approaches that maintain risk equivalency with the Management Procedure system, and performance monitoring requirements to ensure these approaches remain temporary and drive progress towards full Management Procedures.

4 Discussion

Key issues identified in SC-11-31

Three matters were identified in the SC-11 paper as requiring the Scientific Committee's guidance before the Framework is finalised.

Implementation scope and progressive application

Article 4 of the Agreement could bring upwards of 100 species within the Framework's scope. Applying the Framework uniformly and immediately across this entire portfolio would be neither realistic nor efficient. The Framework recommends that the Meeting of the Parties explicitly determine which species the Framework initially applies to, and progressively 'opt in' others using objective trigger rules. A three-group structure is proposed: Primary Species specified in CMM 17 Annex 1; other Primary Species; and Secondary Species. Trigger rules could include thresholds such as sustained catch trends, Productivity-Susceptibility Analysis risk classifications, or IUCN listing changes — the same information that would inform information classification and zone assignment when a species is later brought fully into the Framework. The SC is invited to consider whether the scope should be addressed within the Framework itself or through a separate MoP Resolution.

Operational checklists for information classification

Threshold values in the classification checklist — for example, what constitutes an adequate time series — cannot be fixed uniformly across species, given the fundamental differences in life history. Five years of squid catch data has a very different scientific value to five years of orange roughy data. The Scientific Committee is invited to consider the checklists and advise on an appropriate review process before they are applied to any specific stock.

Treatment of low- and zero-information stocks

The substantive treatment of low- and zero-information stocks is a defining and genuinely novel feature of this Framework. For SIOFA, data-limited stocks are the operational norm rather than the exception, and the Framework addresses them accordingly. The Tier 3 Management Procedure guidance and the alternative management approach provisions are novel in international practice, and the Scientific Committee and advisory panel are encouraged to give them particular scrutiny — both because they have not been benchmarked against established international frameworks, and because their successful implementation is central to SIOFA's ability to manage its full fishery portfolio sustainably.

Linkages with PAM-2024-02 and PAM-2024-03

The PAM-2024-01 Framework is designed to be read and implemented alongside the outputs of the two companion projects. Outputs from PAM-2024-02 inform the Technical Guidelines' reference point guidance, particularly interim default reference points and the tiered reference point framework. Harvest control rule structures from PAM-2024-03 are reflected in the Tier 1 and Tier 2 Management Procedure guidance.

This integration means the PAM-2024-01 documents are necessarily sensitive to the final status of their companion outputs. Any aspects of PAM-2024-02 or PAM-2024-03 that are revised, not accepted, or subject to further development following SC-11 would need to be reflected in corresponding updates to the Technical Guidelines and, if the changes are substantive, the Conceptual Framework.

Matters arising from SC-11 and how they have been addressed

Three additional matters were raised during SC-11's consideration of the draft Framework. The SC-11 meeting report documents these discussions at paragraphs 144–149. In consultation with the delegations concerned, the documents submitted as part of this final report address all three matters.

Developing States and small island developing States (Article 13.4)

Seychelles and the Cook Islands, as SIDS, noted that the draft Framework did not specifically comment on SIDS issues or Article 13 of the Agreement. The SC also noted that the MoP is developing a capacity-building programme for developing States, and recommended that the consultants draw an explicit link between that programme and the SIOFA-PAM work. In response, both the Conceptual Framework and Technical Guidelines in their final versions include substantive treatment of SIOFA's obligations under Article 13.4. The Conceptual Framework establishes that these obligations require the interests of developing State CCPs to be taken into account at every step of the Framework's development and application — not satisfied by a statement of intent — and identifies three concrete ways the Framework advances them: through its explanatory depth and accessibility, which is deliberately designed so that technically demanding provisions do not create participation barriers inconsistent with Article 13.4; through the requirement that developing State CCPs be actively engaged in stock classification and management procedure development,

particularly for low and zero information stocks where their practitioner knowledge may be the most substantive available information; and through the expectation that the MoP consider how Framework implementation connects to SIOFA's broader capacity development programme, so that technical progress does not outpace the ability of all CCPs to participate. The Technical Guidelines reinforce this at the operational level, and include a direction that they be read in conjunction with any capacity development and technical assistance programme established by SIOFA pursuant to Article 13.4.

Recovery plans

The SC noted a practical challenge with the rebuilding framework: if a stock falls into the Critical zone, SIOFA may lose the ability to obtain monitoring data from commercial fishing activity, yet a recovery plan would require significant ongoing data collection from alternative sources. The SC noted its support for the rebuilding framework while flagging that this constraint would need to be carefully managed. The final documents address this by providing for the SC to determine a minimum catch level necessary to maintain adequate data flow from the fishery — ensuring that the rebuilding framework does not require catches to be reduced to zero or near-zero where doing so would eliminate the information needed to monitor recovery. This approach preserves the integrity of the rebuilding objective while maintaining the observational capacity on which evidence-based management depends.

Historical catch history for alternative management

The SC noted that the Tier 3 Management Procedure guidance in the Technical Guidelines suggested catch limits based on the mean of the last 5 years of catches, and flagged that this may not be appropriate for early-stage fisheries where catch levels and catch rates tend to be elevated at the start of a fishery before subsequently declining. The final Technical Guidelines address this by revising Table 8 to make clear that where historical catches are used as the basis for a Tier 3 catch limit, the reference period should be one considered representative of sustainable fishing rather than peak early-stage catches, and that the SC retains discretion to determine the appropriate reference period and precautionary factor for each fishery.

Expert reviewer feedback

Final comments from the PAM-2024-04 expert review panel — Dr Anne-Elise Nieblas and Dr Sylvain Bonhommeau — were received and incorporated ahead of submission to SC-11. A detailed account of how each item of expert reviewer feedback was addressed — and, where relevant, the reasons why specific recommendations were not incorporated — is provided at Attachment 5.

SC-11 recommendations on the Framework

At SC-11, the Scientific Committee adopted the following recommendations relating to Project PAM-2024-01 and the implementation of the Framework. These are reproduced here for completeness; they represent the SC's advice to the MoP, not recommendations of the project consultants.

- The SC recommended that the MoP note that the work provided under projects PAM-2024-01, PAM-2024-02, and PAM-2024-03 provides a strong scientific basis for advancing a precautionary approach to fisheries management within SIOFA.
- The SC suggested that the MoP Chair invite the PAM-2024-01 consultants to present an overview of the Precautionary Approach Framework at MoP-13.
- The SC recommended that the MoP adopt the SIOFA Precautionary Approach Framework.

- The SC developed an indicative workplan for the adoption of management procedures (Annex F of the SC-11 Report).
- The SC recommended that the MoP endorse the indicative workplan for the adoption of management procedures; develop a detailed workplan with clear tasks, timelines, and responsibilities; and regularly update the workplan, including with input from the SC.
- The SC requested that the MoP provide advice on the level of resourcing envisaged for the development and adoption of management procedures, noting that a shift to a management procedure-based approach may allow reallocation of resources previously directed to stock assessment work.
- The SC recommended that the MoP endorse the holding of a two-day workshop on SIOFA-PAM-related work in late 2026 or early 2027, and a one-day MoP–SC joint workshop in late April or early May 2027 to consider outcomes and provide preliminary advice to the MoP and CCPs.
- The SC recommended that the MoP note that the SC intends to delay the implementation of management procedure-related work for 12 months, and that the SC will identify key parts of any consultancy starting in 2027–2028 if required

5 Conclusions

The PAM-2024-01 Conceptual Framework and Technical Guidelines are complete as contractually required and ready for consideration through SIOFA’s governance processes. Together they provide a structured, evidence-based basis for SIOFA to apply the precautionary approach consistently across its full fishery portfolio — from data-rich species assessed through formal stock assessment to zero-information species currently managed under interim measures.

At SC-11, the Scientific Committee noted the high quality and comprehensiveness of the work, adopted a suite of recommendations on the Framework and its implementation pathway, and identified three matters for attention in the finalisation of the project report. Those matters have been addressed in the versions submitted as part of this final report.

The Framework is ready for thorough evaluation by the Scientific Committee. Its implementation will require a sustained multi-year effort across the workstreams identified in the indicative workplan developed by SC-11.

6 Acknowledgments

The authors acknowledge the support and contributions of the participants in workshops WS2025-PAM, WS2025-PAM2, and WS2025-PAM3; the SC Chairperson and the SIOFA Secretariat for their ongoing coordination and guidance throughout the project; Drs Mormede and Hoyle (PAM-2024-02 and PAM-2024-03 Consultants) for their close collaboration and willingness to coordinate across projects; the SIOFA-PAM Expert Review Panel — Dr Anne-Elise Nieblas, Dr Sylvain Bonhommeau, and Dr Nathan Walker — for their thorough and constructive engagement; and the SIOFA-PAM Project Advisory Panels for their guidance. The project was funded by the European Union, whose support for the development of the SIOFA-PAM project concept and this work is gratefully acknowledged.

7 References

Included in the relevant attachments

8 Annexes

1. Project TOR

9. Attachments¹

- A. Precautionary Approach Conceptual Framework (PAM-2024-01)
- B. Technical Guidelines (PAM-2024-01)
- C. Letter of 25 December 2025 — draft report submission, progress documentation, and detailed response to workshop and advisory feedback
- D. Author response to expert reviewer (PAM-2024-04) feedback

¹ The attachments to this report are discrete documents submitted as part of the final project deliverable. Each attachment contains its own annexes, which use numerical designators (Annex 1, Annex 1, etc.) to avoid confusion with the lettered annexes of this report. The attachments are presented here as a single combined document at the request of the SIOFA Secretariat

Annex 1 – Terms of Reference for the project

Project title: Development of the SIOFA Precautionary Approach Framework

Project Code: PAM-2024-01

Terms of Reference

Introduction

The SIOFA Precautionary Approach and Management (SIOFA-PAM) programme will further enhance the scientific advice of the SIOFA Scientific Committee (SC) for the SIOFA Meeting of the Parties (MoP), in particular towards ensuring the sustainable management of fish stocks and the environmental impacts associated with fishing.

The SIOFA-PAM programme has three main projects that focus on development of a framework to ensure the sustainable management of fish stocks and managing the environmental impacts associated with fishing activities within the SIOFA Area. These aim to guide, inform, and enhance resource protection and to improve sustainable resource management measures, especially in the context of the information-limited fisheries. A fourth project provides for expert review and advice across the three main projects.

The specific projects of SIOFA-PAM will be to:

PAM-2024-01: Develop the SIOFA Precautionary Approach Framework. This project involves establishing a framework for high, medium, and lower information stocks to apply the precautionary approach within the SIOFA Area. This framework will provide guidelines and principles to help ensure that fisheries management decisions are made in a precautionary manner using the best scientific evidence available, consistent with the Objectives (Article 2) and General Principles (Article 4) of the SIOFA Agreement (SIOFA, 2006).

PAM-2024-02: Determine Biological Reference Points (BRPs) for key SIOFA fish stocks. This project focuses on developing and scientifically evaluating BRPs for the key fish stocks within the SIOFA Area, based on the best available scientific data and methods.

PAM-2024-03: Develop harvest strategies for key SIOFA fish stocks. Building upon previous workshops and ongoing efforts by the SC and MoP, this project aims to develop formal harvest strategies for key fish stocks.

PAM-2024-04: Expert Review Panel for the Development of the SIOFA Precautionary Approach and Management. Provide external expert review and advice to the project teams and SIOFA for the work and outcomes of the three main projects.

Collectively, these projects will provide the SC with the information required for it to advise the MoP on management approaches and actions to achieve sustainable exploitation rates while considering socio-economic factors and ecosystem impacts.

This project (PAM-2024-01) will develop a Precautionary Approach Framework (PAF) that will enable SIOFA to meet the objectives of Articles 2 (Objectives) and 4 (General principles) of the SIOFA Agreement.

The PAF will be approached in a structured way by first developing a conceptual framework, and second, developing the operational guidelines used to implement the conceptual framework. The PAF will ultimately provide a fisheries precautionary approach framework that is designed to help ensure sustainably managed fisheries within the SIOFA Area.

This project will directly address the recommendations of the SIOFA Performance Review Panel (Recommendations 1 and 10) regarding the adoption of harvest strategies and the development of a decision-making framework for the provision of scientific advice.

Methods

The framework will describe the overarching principles and concepts that the PAF will aim to achieve, informed by international best practice. The framework will also include the operational guidelines to guide the implementation of the framework. The PAF will need to be consistent with the other projects within the SIOFA-PAM programme, other processes being developed by SIOFA (such as bottom fishing footprint, exploratory fisheries, etc), and the Southern Indian Ocean Fisheries Agreement and its Conservation and Management Measures (CMMs).

The PAF will consider and evaluate different frameworks and approaches that may be applied in the SIOFA Area and describe the principles and operational guidelines for low, medium, or higher information stocks. The PAF should describe the roles of CCPs to the Agreement, the Scientific Committee, the Meeting of the Parties, and the SIOFA Secretariat as a part of the PAF operational guidelines.

The PAF will take into consideration other Regional Fisheries Management Organizations (RFMOs) Precautionary Approach Frameworks, as well as any SC and MoP requirements.

As a part of this project, the consultants will present preliminary methods, draft reports and results developed during the project to an Expert Panel (see Project PAM-2024-04) and a project Advisory Panel for review, as well engage in project workshops when developing the outputs. Interim and final results will be submitted and presented to SC in 2025 and 2026 respectively.

Project objectives

1. Provide a fisheries precautionary approach framework (PAF) designed to help ensure sustainable fisheries within the SIOFA Area, including examining different Precautionary Approach frameworks and summarizing these findings identifying the advantages and disadvantages of the different approaches.
2. Provide the operational guidelines for the implementation of the PAF, including considering stock-specific situations and data-limited approaches.
3. Revise and update any reports and outputs based on the reviews from the Expert Panel, the Advisory Panel, the feedback from project Workshops, and the SIOFA Scientific Committee.

Relevant SIOFA information

1. SIOFA data (provided by the SIOFA Secretariat upon request)
2. SIOFA spatial data layers. Available at:

https://github.com/SIOFASecretariat/SIOFA_SC_Spatial_layers

3. SIOFA reporting templates. Available at:
https://github.com/SIOFASecretariat/SIOFA_Reporting_templates
4. SIOFA reports:
 - a. SIOFA SC, SC Working Group, and National Reports. Scientific Committee Meeting | SIOFA (<https://siofa.org/>)
 - b. SIOFA MoP reports. Meeting of the Parties | SIOFA (<https://siofa.org/>)
 - c. SIOFA technical and scientific reports (public reports and abstracts of restricted reports are available from <https://siofa.org/>, and full restricted reports will be made available by the SIOFA Secretariat to the project consultant upon request and after the approval of relevant CCPs.
5. SIOFA Agreement (SIOFA, 2006). <https://siofa.org/sites/default/files/documents/SIOFA-Agreement-Digital-ENG.pdf>

Key project indicators

1. Follow the project timeline as detailed in this agreement, including the submission of deliverables.
2. Collect any necessary data as early as possible, e.g. by submitting a data request to the SIOFA Secretariat.
3. Attend the project initialisation meeting with the project Expert Panel (composed by external experts) and Advisory Panel (composed by members of the SIOFA Scientific Committee and the SIOFA Secretariat) to discuss the project setup and development. Further engage, as requested, with the Advisory Panel that will assist the consultant(s) to access and interpret reports, data, and to provide advice on relevant analyses for the project.
4. Present preliminary results during the project, as required, to the project Expert Panel and the project Advisory Panel, and respond and revise any project outputs based on their review.
5. Provide regular (i.e. every 2-3 months), proactive updates to the Project Coordinator and the Advisory Panel throughout the project, in particular informing promptly of any unforeseen delay or variation to the project.
6. Submit deliverables on time and appropriately formatted, as required. Each deliverable will be going through a SIOFA review to ensure that it meets the quality targets and the project objectives as set out in the Terms of Reference.
7. Appropriately acknowledge the project funding source (i.e. EU), with appropriate corresponding logos in prominent positions, within each deliverable.
8. Take into reasonable account the outcomes of the SIOFA review or any comments made by meeting attendees, when revising the deliverables.

Deliverables

Attend (virtually) the project Advisory Panel meetings for Project PAM-2024-01. Additional attendance may be required at the project Advisory Group meetings for the closely related projects PAM-2024-02 and PAM-2024-03

Produce support materials and engage in discussions during 2 planned SIOFA Workshops (virtual) to be organized during the project timeline (tentatively Jan/Feb 2025 and Nov/Dec 2025).

Presentation of methods and results to the SIOFA SC annual meetings (March 2025 and 2026)

A Draft Report that addresses the project objectives and tasks as laid out in this contract. Revise and update the Draft Report based on review by the project Expert Panel, Advisory Group, and the SIOFA Scientific Committee. The report should follow the guidelines and format available at https://github.com/SIOFASecretariat/SIOFA_Reporting_templates. In particular, the report should include a concise (max 300 words) summary, and should detail the methods,

the outcomes, conclusions, and concise recommendations. The Draft Report will also be submitted to the SIOFA Scientific Committee.

- A Final Report that follows the guidelines and format available at https://github.com/SIOFASecretariat/SIOFA_Reporting_templates and includes any final review comments from the SIOFA Scientific Committee on the final Draft Report. The Final Report will also be submitted to the SIOFA Scientific Committee.

Provide all the information collected as a part of this project to the SIOFA Secretariat (including that sourced from the Secretariat) before the final payment of the contract. Such information includes electronic data files, analysis code, biological samples, and other relevant data where applicable.

Presentations of reports to the Scientific Committee may be given virtually and travel to the meetings is not obligatory. All project meetings will take place virtually. No additional travel costs will be paid.

Acceptance of Draft and Final Reports

1. Draft and Final Reports must be submitted in English to the Project Coordinator at the SIOFA Secretariat.
2. Draft and Final Reports will be reviewed using the procedures outlined in paper MOP-09-12 (Annex B), see also: https://github.com/SIOFASecretariat/SIOFA_Reporting_templates/tree/main/SC%20reports/Review%20template%20for%20consultant%20reports.
3. Payment of contract milestones will be subject to acceptance of the submitted reports by SIOFA.

Intellectual property clause and confidentiality

The Consultant shall submit all the information collected to the SIOFA Secretariat (including that sourced from the Secretariat) before the final payment of the contract is made to the consultant.

Such information includes electronic data files, analysis codes, biological samples, and other relevant data if applicable. Any arrangements for ownership, storage, or disposal of physical samples shall be agreed by SIOFA as a part of the contract. All Intellectual Property generated as a part of this contract shall become the property of SIOFA unless otherwise excluded in the proposal and agreed by SIOFA in the contract.

The Consultant shall not release confidential data provided for conducting this study to any persons nor any organizations, other than SIOFA Secretariat.

The Consultant shall delete all the confidential data upon the completion of the contract.

Work timeline and payment schedule

The funds for this project, budgeted under the SIOFA-PAM EU Grant (<https://siofa.org/eu-grants>), allow for a maximum total budget of 50,000 Euro (including all costs and any travel related expenses).

The consultant shall follow the timeline described in Table 1 below.

Table 1: Timeline for payments, milestones, and report submission

Milestone	Date	Activities
Initiation of contract	30 September 2024	First instalment payment (30% of the total contract sum)

Milestone	Date	Activities
Presentation of preliminary results	18–27 March 2025	Presentation of preliminary methods and results to the SC10 meeting (virtual)
Delivery of draft report	31 December 2025	Second instalment payment (30% of the total contract sum) upon satisfactory submission of draft report, in a format suitable for submission to SC, to the Project Coordinator.
Presentation of final results	March 2026	Presentation of final results to the SC11 meeting (virtual)
Delivery of final report	1 April 2026	Submission of final report in a format suitable for submission to SC and submission of all project information to the project coordinator. Final instalment payment (40% of the total contract sum) on acceptance of the final report by the advisory panel and the final submission of project information

Submission of applications

1. A current CV that summarises the applicant(s) relevant educational background and professional experience.
2. A brief proposal (indicatively 3-4 pages) outlining the proposed methods and analyses, including a description of how the objectives of the ToR will be achieved.
3. Any proposed exclusions to the intellectual property clause or variations to the work timeline and payment schedule.
4. The proposed consultancy price (including all consultant expenses and project related costs), noting that the available budget for this work indicated in Section 7.
5. Identification of any project risks and associated mitigation and management required to successfully complete the project.
6. A statement that identifies any perceived, potential, or actual conflicts of interest of the applicant(s), including those described in paragraph 4 of the SIOFA recruitment procedure (see Section 12), and
7. Any additional relevant information the applicant(s) wish to submit.

The applicants must have appropriate experience and knowledge of similar work in their portfolio.

Applications must be submitted to the SIOFA Science Officer Marco Milardi (marco.milardi@siofa.org, CC secretariat@siofa.org). Only those applications received before 12:00 PM (9:00 AM UTC) on Sunday the 8th of September 2024, Reunion Island time, will be considered.

Evaluation criteria for the selection of candidates

An evaluation panel, the SIOFA Secretariat, and the Chair and Vice-Chair of the SIOFA Scientific Committee will select one successful applicant for this contract. The selection criteria will include the following:

- Adequate submission of information to allow the panel to evaluate the candidate
- Evaluation of the proposal from the candidate, including the proposed contract price
- Ability to undertake and complete the analyses or work required in this ToR
- The candidate's agreement with confidentiality provisions required for the project
- Acceptable conflict of interest statement
- Agreement with the data submission and intellectual property terms required in this ToR, and
- Financial and resourcing considerations.

Conflicts of interest. Paragraph 4 of SIOFA's Recruitment Procedure

To ensure that situations relating to potential and actual conflict of interests are avoided, persons falling into the following categories may not normally be considered for SIOFA consultancy: (i). any person designated as a designated representative or alternate representative of a CCP to the Meeting of Parties (MOP) as per Rule 3.1 of the Rules of Procedure, and to the SC and any other subsidiary bodies of the MOP, as per Rule 21.3 of the Rules of Procedure; (ii). Any person fulfilling the function of Chair or Vice-Chair of the MOP or Chair or Vice-Chair of a SIOFA subsidiary body or working group; (iii). Any person acting as a member of a delegation involved in the SIOFA decision-making process resulting in recommendations and/or approval for the SIOFA work requiring the engagement of a consultant; and (iv). Individuals who were SIOFA Secretariat staff members at the time when the recommendations and/or approval for the SIOFA works were adopted or who are members of immediate family (e.g., spouse or partner, father, mother, son, daughter, brother, or sister) of any Secretariat staff member or of the persons identified in 4 (i), (ii), and (iii).

Contacts

Project Coordinator – SIOFA Science Officer (Marco Milardi, marco.milardi@siofa.org)

Administration – SIOFA Executive Secretary (Thierry Clot, thierry.clot@siofa.org)

Attachment A - Development of a SIOFA Precautionary Approach Framework - Conceptual Framework



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Executive Summary

This Precautionary Approach Framework (the Framework) provides a structured approach for the Southern Indian Ocean Fisheries Agreement (SIOFA) to implement its obligations to apply a precautionary approach, as is required under international law. It is designed to assist SIOFA to facilitate the long-term conservation and sustainable use of fishery resources within the Agreement Area.

SIOFA operates in a uniquely complex management environment among regional fisheries management organisations (RFMOs), overseeing a wide diversity of fisheries, many of which are data-limited or poorly understood. This diversity, combined with significant scientific uncertainty and ecological variability, underscores the need for a robust precautionary approach.

This Framework will enable management decisions to account for uncertainty and avoid potentially irreversible impacts, particularly in cases where data are insufficient to support full stock assessments. It will reduce the risk of overexploitation, help preserve ecosystem function, and support greater long-term stability and resilience to SIOFA fishery resources and the ecosystems in which they live.

This Framework is aligned with international best practices, particularly the UN Fish Stocks Agreement and FAO guidelines, which promote proactive management, science-based decision-making, and adaptive governance. SIOFA's relatively recent establishment (2012) offers a strategic opportunity to embed these principles from the outset.

This Precautionary Approach Framework operates through three interconnected components that work together to ensure sustainable fisheries management. First, an **Information Classification System** categorizes each stock as high, medium, low information or zero information based on data availability and assessment capability, ensuring that management approaches are appropriately matched to what is known about each fishery. Second, a **Three-Zone Stock Status System** classifies stocks into Healthy, Under Watch, or Critical zones based on their biological condition relative to scientifically-established reference points, providing clear signals about exploitation status and management urgency. Third, **management procedures** serve as the primary implementation tool, establishing pre-agreed, science-based decision rules that automatically adjust fishing opportunities based on stock status and information level, ensuring consistent and transparent management responses. These components are supported by robust monitoring systems, regular performance reviews, and adaptive management processes that allow the framework to evolve with improving knowledge and changing conditions. Together, these elements create a comprehensive system that maintains equivalent levels of conservation risk across all SIOFA stocks, regardless of their data richness or economic importance.

Critically, this Framework is designed to accommodate and facilitate improving scientific understanding. It creates structured pathways for stocks to graduate from lower to higher information categories as data collection improves and analytical capabilities advance. This future-orientated design recognises that fisheries science is not static, today's data-limited stocks may, through systematic research and monitoring, become tomorrow's well-assessed populations. The

Framework therefore avoids locking stocks into perpetual data-poor status, instead providing clear mechanisms for graduation that reward investment in better science whilst maintaining rigorous precautionary standards at all information levels. Similarly, the tiered management procedure approach can incorporate methodological advances without requiring fundamental restructuring, ensuring the Framework remains relevant as analytical methods evolve and computational capabilities expand.

This framework positions SIOFA to fulfil its mandate effectively, promoting responsible stewardship of Southern Indian Ocean fisheries.

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Version History

Version	Date	Author	Description of Changes
1.0	2026 - MM - DD	Meeting of the Parties	Initial adoption

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1 Part I: Foundation

1.1 What is a Precautionary Approach Framework?

A precautionary approach framework in fisheries management is a comprehensive decision-making system designed to address scientific uncertainty and natural variability while ensuring the long-term sustainability of fish stocks and fisheries. At its core, this framework establishes a structured methodology that enables the Meeting of the Parties (MoP) to make decisions consistently, based on a fishery's performance and the information available to guide its management.

Beyond reference points and control rules, a precautionary approach framework includes robust monitoring strategies to collect relevant data, assessment processes to evaluate fishery performance against objectives, and performance indicators that provide clear signals about stock status and management effectiveness. This systematic approach ensures that management responses are both predictable and scientifically defensible, providing greater certainty and planning.

1.2 Why have a Precautionary Approach Framework?

The implementation of a precautionary approach framework addresses several critical challenges inherent in modern fisheries management. Foremost among these is the need to manage fishing pressure, natural variability and scientific uncertainty effectively. Fish populations are subject to complex ecological dynamics, environmental fluctuations, and measurement uncertainties that can mask true population trends. A precautionary framework provides a systematic method for incorporating these uncertainties into management decisions, ensuring that uncertainty translates into management for sustainability rather than increased risk-taking.

A Precautionary Approach Framework can enhance the sustainability and profitability of fisheries by preventing overfishing before stocks become severely depleted and in ensuring management attention is directed where it is needed. Establishing clear limits and associated management response provides a scientific and technical basis for rebuilding depleted stocks in a timely manner where needed, and in managing stocks out of biologically unsafe levels. This proactive approach is far more cost-effective than reactive management, which often requires more severe restrictions and longer recovery periods once stocks have collapsed.

From an operational perspective, precautionary approach frameworks reduce the time needed to make management decisions by pre-establishing decision rules and response protocols. This streamlined approach eliminates lengthy debates about appropriate management responses during stock assessments, as the framework provides clear guidance on what actions should be taken given specific stock conditions. The predictability of this approach also allows stakeholders in the fishery to better anticipate management changes and plan accordingly.

This Framework accounts for risk systematically by explicitly defining acceptable levels of risk to meet management objectives. This transparent approach to risk management ensures that stakeholders understand the probability of different outcomes and the rationale behind management decisions.

Finally, implementing a precautionary approach framework aligns fisheries management with international best practices and standards required by certification agencies and international management authorities. This alignment is increasingly important for market access and maintaining social licence to operate, particularly as consumers and retailers demand evidence of sustainable fishing practices. The framework demonstrates a commitment to responsible stewardship that extends beyond compliance with minimum legal requirements to embrace global standards for sustainable fisheries management.

Globally, there are numerous examples of precautionary approach frameworks, sometimes called harvest strategy frameworks, from which SIOFA has taken inspiration. Internationally, these include the Northwest Atlantic Fishery Organization's (NAFO) precautionary approach framework (NAFO 2024b; 2024a), International Council for the Exploration of the Sea (ICES) advice (Lassen et al. 2012), and FAO technical guidance (Food and Agriculture Organization of the United Nations 1996), which provide comprehensive models for implementation. There are less detailed examples contained in International Commission for the Conservation of Atlantic Tunas (ICCAT) (Recommendation 15-07 2015a; Resolution 15-12 2015b) and Indian Ocean Tuna Commission (IOTC) resolutions that demonstrate regional adaptation of the precautionary approach (Resolution 12/01 2012). The Inter-American Tropical Tuna Commission (IATTC) and the International Pacific Halibut Commission (IPHC) have also discussed developing precautionary approach frameworks, indicating the growing recognition of their importance across fisheries management organizations (2010; Hicks et al. 2025).

Domestically, Canada, New Zealand, and Australia all have established frameworks that have provided relevant inspiration for the SIOFA framework, offering practical insights into national-level implementation of precautionary management approaches (Ministry for Primary Industries 2008; Ministry of Fisheries 2011; Department of Agriculture and Water Resources 2018a; 2018b; Fisheries and Oceans Canada 2009).

1.3 Legal basis to adopt a Precautionary Approach Framework

1.3.1 Requirement to apply a precautionary approach

Article 4(c) of the SIOFA Agreement (SIOFA 2006) requires the MoP to apply the Precautionary Approach in accordance with the FAO Code of Conduct² (Code of Conduct for Responsible Fisheries 1995) and the

² The general principles and Article 6.5 of the 1995 FAO International Code of Conduct for Responsible Fisheries urge States and subregional and regional fisheries management

1995 Agreement³(Annex I, UNFSA 1995) , whereby absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.

Article 4 of the SIOF Agreement sets out the principles that CCPs are required to apply, including a requirement to manage the fishery resources so that they are maintained at levels that are '*capable of producing the maximum sustainable yield (MSY)* and depleted stocks of fishery resources are rebuilt to the said levels (emphasis added).

The functions of the MoP, set out in Article 10 of SIOFA, include requirements to review the state of fishery resources, evaluate the impact of fishery resources on the marine environment and formulate and adopt conservation and management measures (CMM) necessary for ensuring the long-term sustainability of fishery resources.

The MOP carries out these functions through its annual ordinary meetings, based on advice from its subsidiary bodies, the Scientific Committee and the Compliance Committee, in accordance with their respective terms of reference.

This Framework seeks to support the operationalisation of those legal requirements through consistent, responsible and transparent decision-making. In the SIOFA context, this includes reversing the burden of proof, systematic evaluation of biological and environmental risks, regardless of the size or value of the fishery, and adaptive management that is prepared to respond to new information and changing conditions. Nothing in the Agreement prevents the MoP from managing to more conservative levels. Accordingly, this Precautionary Approach Framework aims to manage fishery resources to *at least* MSY.

1.3.2 Addressing the SIOFA Performance Review

The SIOFA First Performance Review (SIOFA Performance Review Panel 2023) identified the need for systematic precautionary management as a priority area for improvement. Specifically,

Recommendation 10 called for SIOFA CCPs to:

"undertake the development of a framework for the provision of Scientific Advice that takes into account best international practices, whether or not combined with a framework for decision-making at managerial level in accordance with the Precautionary Approach. This

organizations to apply a precautionary approach to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment

³ Article 6 of UNFSA set out elements of a precautionary approach to the conservation and management of straddling and highly migratory fish stocks in order to protect the living marine resources and preserve the marine environment.

could accompany or complement the already decided work line dedicated to the development of harvest strategies but would provide the basis for an urgent consideration of precautionary measures in the short term."

This Framework directly responds to Recommendation 10 by establishing:

- **A structured framework for scientific advice** through clear information classification, stock status assessment, and performance monitoring systems that enable the Scientific Committee to provide consistent, risk-based advice to the MoP
- **A managerial decision-making framework** through the three-component architecture (Information Classification, Stock Status Zones, and Management Procedures) that translates scientific advice into transparent, pre-agreed management actions
- **Embeds management procedures** as the primary implementation tool while providing pathways for stocks at all information levels, including those where full management procedures (harvest strategies) may not be immediately feasible
- **A basis for urgent precautionary measures** through zone-specific management responses that trigger immediate action when stocks approach or breach limit reference points, regardless of the management procedure tier being applied

The Performance Review also noted ([Section 1.5.2](#)) that SIOFA needed to move from interim arrangements to permanent measures and "espouse the Precautionary approach in a more committed way in the face of persistent uncertainty." This Framework addresses that challenge by providing 'risk-equivalent'⁴ management across all stocks regardless of data availability, ensuring that scientific uncertainty translates into increased precaution rather than delayed action.

1.4 Relationship between this Framework, its Technical Guidelines, the Agreement and CMMs

This Framework is intended to be a non-binding framework to support the MOP in carrying out its functions under the Agreement. Notwithstanding this, elements of this framework are based on relevant rules of international law as reflected in the 1982 Convention, the 1995 Agreement and the

⁴ **Risk equivalency** in this context refers to the design goal of maintaining a consistent level of biological risk across stocks with different amounts of available data. A stock that is well-understood can be managed with relatively narrow precautionary margins, because assessment uncertainty is low. A stock that is poorly understood carries greater uncertainty about its true status and productivity; to achieve the same precautionary outcome, it must be managed more conservatively — with wider buffers between target and limit reference points, more cautious harvest control rules, and lower default exploitation levels. Risk equivalency does not mean identical management settings; it means *calibrated* settings, adjusted to uncertainty so that the probability of a stock being depleted or overfished is broadly equivalent across all information tiers. In SIOFA's Framework, setting the acceptable level of risk is a policy decision for the Meeting of the Parties; implementing risk equivalency across tiers is a technical function of the Management Procedures and the Information Classification System.

SIOF Agreement. Additionally, certain provisions of this Framework may have already been given binding effect through MOP decisions (such as CMMs).

In this respect, the Framework should be taken into account in planning for, and in taking, decisions. Departure from this Framework, while discouraged, should be justified and documented.

2 Principles

This Framework operationalizes SIOFA's obligations under the Agreement by providing a structured system for implementing the General Principles in Article 4, supporting the functions of the MoP under Article 6, and enabling the Scientific Committee to fulfil its mandate under Article 7. This Framework structures the Scientific Committee's work by:

- Establishing clear pathways for conducting scientific assessments (Information Classification)
- Defining stock status evaluation criteria (Three-Zone System)
- Specifying how scientific advice informs management action (Management Procedures)
- Enabling advice at all information levels (Three-Tier Management Procedure System)

This Framework is designed to ensure SIOFA can fulfil its institutional obligations:

As a Framework to support decision making it is:

- **Pragmatic and Accessible:** The framework needs to be practical to implement and easy to understand by all stakeholders, ensuring broad comprehension and effective application across SIOFA's diverse fisheries
- **Cost Effective:** SIOFA is a resource-constrained RFMO. Management needs to deliver optimal conservation and management outcomes while utilizing available resources efficiently and proportionately to the value and risk associated with each fishery.
- **Transparent:** All management decisions, processes, and underlying scientific rationale need be open to the same level of scrutiny as with any other SIOFA instrument, with clear documentation of decision-making pathways and rationale across all elements of the framework.
- **Enduring:** The framework needs to be robust and flexible enough to accommodate new fisheries as they come online and evolve with changing management needs, ensuring consistent application across all fishing activities over time.

Management decisions under this framework implement the Agreement's substantive obligations. Decision-making under this framework should therefore be:

- **Proactive in achieving the objective of the Agreement:** Management decisions should demonstrate consistency with achieving both conservation and sustainable use objectives set out in Article 2.
- **Scientifically Defensible:** to achieve Article 4(a), decisions must be grounded in the best available scientific evidence and be appropriate to the known biology, life history characteristics, and ecological role each stock.
- **Precautionary:** The precautionary approach must be applied in accordance with Article 4(c) of the SIOF Agreement and the 1995 UN Fish Stocks Agreement, whereby the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures. In practice, greater precaution applied as uncertainty increases.

The framework implements this through:

- Information classification systems that enable management at all data levels
- The three-zone classification system and management procedures are designed to maintain or rebuild stocks to levels capable of producing MSY (Article 4(d)) while promoting sustainable development, particularly for developing State Parties, with rebuilding plans triggered for stocks in the Critical Zone
- Risk-equivalent management procedures across information tiers
- Greater precautionary buffers as uncertainty increases
- Default reference points when stock-specific values cannot be determined
- Ensuring fishing levels remain commensurate with sustainable use through pre-agreed management procedures that adjust effort and catch in response to pre-determined performance indicators.
- **Adaptive:** new information, changing environmental conditions, and evolving understanding of stock dynamics and ecosystem interactions.
- **Ecosystem-Based:** Management decisions must consider to the extent possible the broader ecosystem context, as required by Article 4(e) and 4(f), including:
 - Multi-species interactions and food web effects
 - Habitat requirements and ecosystem services
 - Cumulative impacts of fishing on ecosystem structure and function
 - Associated and dependent species (ETP species, bycatch)
 - Climate change impacts on ecosystem productivity and species distributions.

3 Scope

The Framework applies to all fishery resources in the SIOFA Area consistent with Article 4 of the SIOF Agreement. However, recognizing practical constraints and the need to allocate management effort proportional to risk and fishery importance, the framework employs a phased implementation approach through three species coverage tiers:

- **Group A:** Those listed in Annex 1 of CMM 17 (2024) (New and Exploratory Fisheries) as amended from time to time⁵.
- **Group B:** All other primary species not specified in Annex 1 of CMM 17 (2024) (See Annex 2).
- **Group C:** Secondary species (See Annex 2)

This Framework will initially apply to Group A species. These species receive full individualized application of Components 1-3. Each stock is classified into information tiers, assigned to stock status zones, and managed through stock-specific management procedures. The MoP makes explicit decisions for each Group A stock.

The MoP will progressively expand the application of this Framework to Group B and Group C species as institutional capacity allows. The MoP may also direct work to prepare for the expansion and application of this Framework to Group B and C species, or decide to graduate a Group B or Group C species to Group A should a biological or management need arise.

4 Transparency and decision-making

Decisions made under this Framework rest with the MoP, as established in Article 8 of the Agreement. Decisions made pursuant to this framework should be made in accordance with the Rules of Procedure of the MoP.

Notwithstanding this, effective implementation benefits from early and ongoing involvement of all SIOFA stakeholders, including observers. When stakeholders engage with the Framework from the outset, discussions proceed from shared understanding of concepts and applications, leading to more informed decisions and more effective implementation. Consistent with Article 14, SIOFA should endeavour to facilitate stakeholder participation through Scientific Committee processes, including workshops, and transparent documentation of Framework application.

5 Special Requirements of Developing State Contracting Parties

The SIOFA Agreement establishes the interests of developing States bordering the Area as a foundational obligation.

Article 2 defines the Agreement's objectives as including the promotion of sustainable development "taking into account the needs of developing States bordering the Area that are Contracting Parties." Article 4(g) places the requirement to give "full recognition" to those States' special requirements among the General Principles that all CCPs are obliged to apply. Article 13 sets out in detail the nature of

⁵As at Dec 2025: Patagonian toothfish, orange roughy, alfonsino, brushtooth lizardfish and scads, shallow-water (<200m) Carangoides spp. Snappers, emperors and groupers, deepwater (>200m) snappers, lutjanids, hapuka, oilfish, squid.

those obligations, including the requirement that conservation and management measures adopted by the MoP do not result in transferring, directly or indirectly, a disproportionate burden of conservation action onto developing States bordering the Area. Article 13.4 further requires cooperation to take the form of financial and technical assistance, human resources development, technology transfer, and activities directed towards improved data collection, stock assessment and scientific research, monitoring and compliance, and participation in the MoP and its subsidiary bodies.

These obligations attach to the MoP and to all CCPs. They are not satisfied by a statement of intent. They require that the interests of developing State CCPs are taken into account at every step of the framework's development and application — from how stocks are classified and assessed, to how management procedures are designed and reviewed, to how processes are structured and conducted.

This Framework advances those obligations in several concrete ways:

- Framework design. A precautionary approach framework that is technically inaccessible leaves people behind, and people who are left behind cannot meaningfully participate in the decisions that affect them. This is more than a technical consideration. The fisheries most likely to be at low or zero information status — and therefore most dependent on the precautionary defaults this Framework provides — are disproportionately those being fished by States developing their fishing capacity. For those fisheries, a sparse technical framework that can only be navigated by a select group of experts creates a structural inequity. Accordingly, this Framework is deliberately explanatory. The level of detail in both the Framework and its Technical Guidelines is intended to serve current and future technical and policy leaders, including those who are developing their engagement with fisheries science and management. The goal is that the technical architecture of SIOFA's precautionary approach remains accessible to the full range of participants, not only to those with established scientific programmes.
- Explicit provision for data-limited fisheries. The Framework's tiered architecture — covering high, medium, low, and zero information stocks, with management procedures matched to information availability and risk-equivalent precautionary standards applied across all tiers — directly addresses the situation of many fisheries being actively developed by developing State CCPs. The Framework does not treat data-limited stocks as edge cases or deferred problems. It treats them as the operational norm for which robust, pre-agreed management approaches are required. This is not incidental; it is one of the Framework's central design choices, and it directly serves the fisheries where developing States have the greatest stake.
- Process inclusiveness. The nuances of individual fisheries — their ecology, their economics, their social context, and the limits of available data — are often best known to those closest to them, including the States and communities whose livelihoods depend on them. Processes under this Framework should be designed and conducted in ways that enable the full participation of all CCPs, recognising that technical complexity, if unmanaged, can in practice restrict effective participation to a subset of parties. The Scientific Committee should be attentive to this risk,

particularly when considering stocks that are low or zero information, which are precisely the stocks where expert knowledge held outside formal scientific programmes is likely to be most valuable.

- Capacity development. The MoP should consider how this Framework's implementation connects to SIOFA's broader capacity development programme, so that technical progress does not outpace the ability of all CCPs to engage with and benefit from it. Capacity development efforts that enable developing State CCPs to participate more fully in Scientific Committee processes, and to invest in the data collection and monitoring that enables graduation to higher information categories, are consistent with and reinforce the obligations under Article 13.4.

Nothing in this Framework diminishes the obligations of developing State CCPs under the Agreement. All CCPs, regardless of size or capacity, are required to manage their fisheries in accordance with the Agreement's conservation and sustainable use objectives. What this Framework is designed to ensure is that in meeting those obligations, no CCP is left behind.

6 Part II: Framework Architecture

6.1 Overview

This Framework is built around three interconnected components that work together to deliver consistent, science-based fisheries management across SIOFA's diverse portfolio of stocks. The framework is designed to handle the reality that SIOFA manages fisheries ranging from well-studied, high-value stocks to data-poor, low-value fisheries, while maintaining equivalent levels of conservation protection across all stocks.

The framework operates through a systematic decision-making process that moves from understanding what is known about each stock, to assessing their biological condition, to implementing appropriate management responses. This structured approach ensures that management decisions are predictable, transparent, and scientifically defensible, regardless of data availability or stock value.

6.2 The Three Core Components

6.2.1 Component 1: Information Classification System

The foundation of the Framework is a systematic approach to categorizing each stock based on the quality and quantity of available data. Every SIOFA stock is classified as **High**, **Medium**, or **Low** information, based on the availability of data.

This classification serves multiple critical functions:

- **Matches management tools to data availability** - ensuring that sophisticated management approaches are only applied where data can support them

- **Categorizes stocks by information availability**, enabling the framework to calibrate precautionary measures that achieve risk equivalency across all information tiers consistent with MoP-approved risk tolerance
- **Guides resource allocation** - helping SIOFA prioritize monitoring and research investments
- **Sets realistic expectations** - ensuring management approaches are feasible given available information.

The Information Classification System provides the structural foundation for risk-equivalent management but does not itself determine either (a) the acceptable risk tolerance for SIOFA stocks, which is a policy decision by the MoP, or (b) the specific precautionary adjustments needed to achieve risk equivalency, which are determined through the framework's risk equivalency principle and implemented through Management Procedures (Component 3).

Importantly, the goal is to provide a pathway for all stocks to graduate to higher information categories over time through targeted data collection and research. The MoP should make efforts to optimise processes that will allow for more active management of low or zero information stocks.

6.2.2 Component 2: Three-Zone Stock Status System

The second component assesses the biological condition of each stock relative to scientifically-established reference points. Every stock is classified into one of three zones based on their biological status⁶:

- **Healthy Zone** - stocks that are at or above the agreed target and can support sustainable exploitation without conservation or economic concern. (i.e. not overfished and no overfishing occurring)
- **Under Watch Zone** - stocks that have dropped below the agreed target but remain above the limit and require enhanced monitoring and management measures (i.e. one of overfishing or overfished is occurring relative to the target reference level/point)
- **Critical Zone** - stocks necessitating immediate rebuilding measures and/or minimising excessive fishing pressure (i.e. both overfished and overfishing occurring relative to the target reference level/point).

These zones are defined by reference points that establish clear boundaries between acceptable and unacceptable levels of stock depletion. The zone system provides an immediate categorical signal of

⁶ The three zones can be broadly mapped to FAO stock status categories for international reporting purposes: the Healthy Zone corresponds to *underfished* or *maximally sustainably fished*; the Under Watch Zone to stocks approaching or at maximum exploitation; and the Critical Zone to *overfished*. However, a precise equivalence is neither possible nor desirable. FAO's categories are fishing-pressure descriptors designed for aggregate global reporting, not biological management tools. SIOFA's zone system is a management framework grounded in biomass relative to biological reference points, which is consistent with the UN Fish Stocks Agreement and with the zone/tier systems used by ICES, NAFO, and other RFMOs.

management priority and triggers specific management responses appropriate to each stock's biological condition.

Classification is not static. Classifications may change if there are changes to a stock's biological condition that causes it to shift between zones.

6.2.3 Component 3: Management Procedures

The third component translates stock information and biological status into specific management actions through Management Procedures - pre-agreed, science-based decision rules approved by the MoP that automatically adjust fishing opportunities based on stock status and available information.

Management Procedures serve as the primary implementation tool of the framework, providing:

- **Predictable responses** to changing stock conditions
- **Transparent decision-making** processes that stakeholders can understand and plan for
- **Risk-equivalent management** across stocks with different information levels
- **Adaptive management** that evolves with improving knowledge.

The framework includes three types of management procedures scaled to match information availability, from full quantitative model-based approaches for high-information stocks to simplified knowledge-based procedures for data-poor fisheries.

6.3 How the Components Work Together

The three components operate through an integrated decision-making process:

Step 1: Information Assessment Each stock is classified based on available data, determining which management tools and approaches are feasible and appropriate.

Step 2: Status Evaluation Stock condition is assessed using the best available methods appropriate to the information level, and other relevant indicators that explain the context of the fishery. Stocks are placed in the appropriate zone (Healthy, Under Watch, or Critical).

Step 3: Management Response A management procedure appropriate to both the information level and biological status is implemented, with harvest control rules that automatically adjust management measures based on stock performance.

Step 4: Monitoring and Review Performance is monitored against objectives, with regular reviews which enable the Meeting of the Parties to, on the basis of Scientific Committee advice, adjust information classification, reference points, or management procedures as conditions change or knowledge improves.

6.4 Risk Governance

A fundamental principle underlying the framework architecture is **risk equivalency** - ensuring that all stocks face similar levels of conservation risk regardless of their information status or economic value. This is achieved by:

- Applying more conservative reference points and management measures to stocks with higher uncertainty
- Requiring larger precautionary buffers between target and limit reference points for low-information stocks
- Triggering management responses at higher biomass levels when assessment uncertainty is greater
- Maintaining consistent probabilities of achieving conservation objectives across all stocks.

6.4.1 Risk Tolerance and Equivalency

The Framework distinguishes between risk tolerance (a policy decision) and risk equivalency (a technical implementation):

6.4.1.1 Risk Tolerance Setting (MoP Authority)

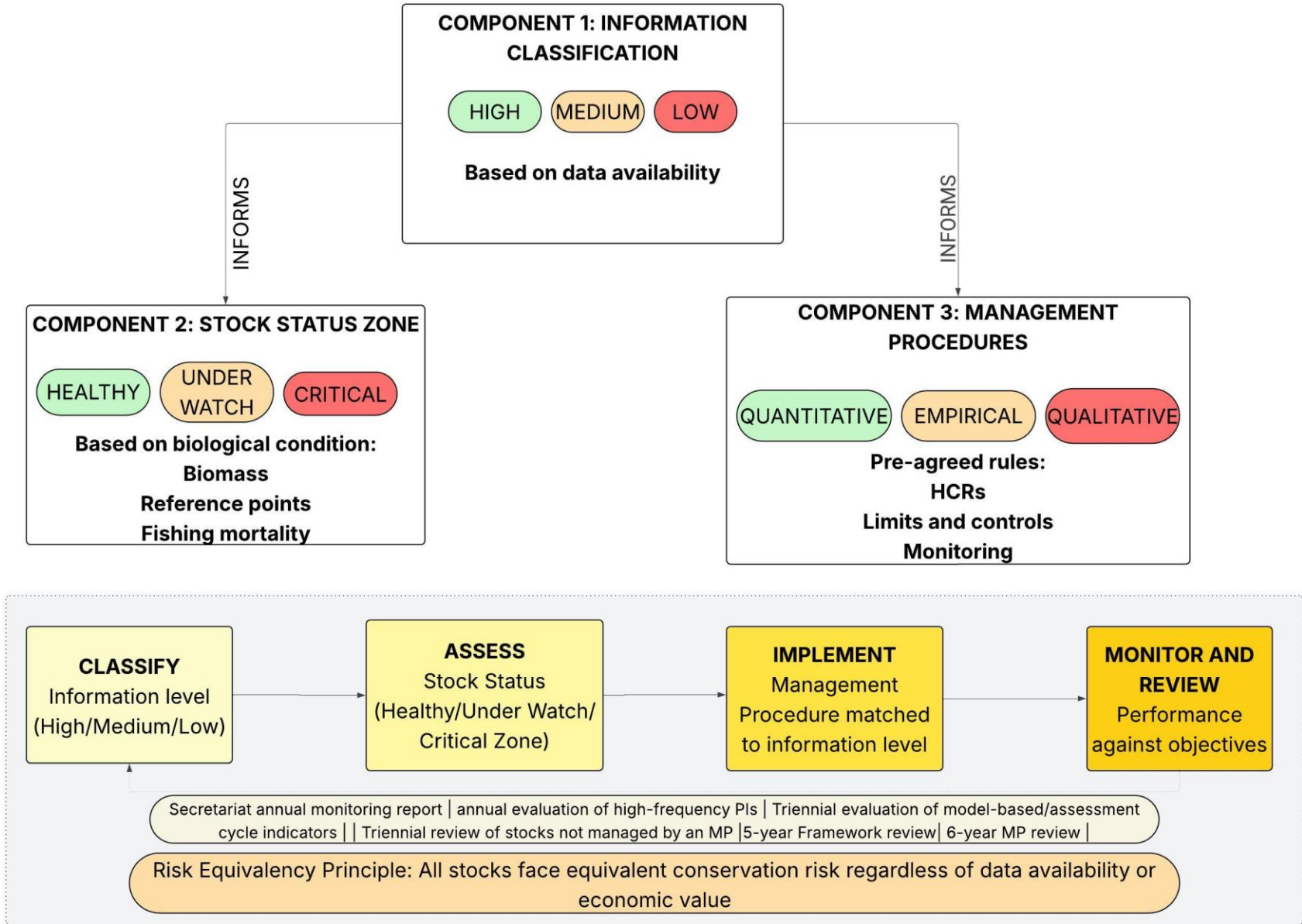
- The MoP establishes the acceptable level of conservation risk for SIOFA stocks through adoption of management objectives and reference points
- This policy decision reflects SIOFA's interpretation of international obligations under the Agreement and UNFSA
- The MoP may specify risk tolerance quantitatively (e.g., "<10% probability of falling below B(LRP)") or qualitatively through management objectives (e.g. "a high likelihood that biomass remains above the LRP across a range of plausible stock trajectories")
- All stocks, regardless of information level, should face this approved risk tolerance

6.4.1.2 Risk Equivalency Implementation (Framework Function):

- The Framework ensures that stocks classified into different information tiers face equivalent conservation risk despite varying data availability
- Risk equivalency is achieved through calibrated precautionary adjustments: larger buffers, more conservative reference points, and more responsive harvest control rules for data-limited stocks
- The Scientific Committee recommends specific adjustments needed to achieve risk equivalency based on technical analysis
- Management procedures (Component 3) operationalize these adjustments through tier-specific decision rules

6.4.1.3 *Information Classification (Component 1 Function)*

- Component 1 categorizes stocks by data availability, establishing the information context within which risk equivalency must be achieved
- Classification itself does not determine risk levels but identifies which precautionary adjustments are needed to maintain equivalent risk across stocks



6.5 Framework Benefits

This integrated architecture delivers several key advantages:

Comprehensive Coverage: Every SIOFA stock receives appropriate management attention, with no fisheries falling through regulatory gaps due to data limitations.

Proportionate Approach: Management intensity and cost are matched to stock importance and risk, ensuring efficient use of SIOFA's limited resources.

Adaptive Management: The framework provides clear pathways for upgrading management approaches as information improves or stock importance changes.

Transparency: The systematic approach ensures that stakeholders understand how management decisions are made and can anticipate responses to changing conditions.

International Alignment: The framework structure aligns with international best practices while being tailored to SIOFA's unique operating environment.

6.6 Implementation Pathway

The framework is designed for progressive implementation, recognizing that developing management procedures for all stocks will take time. Priority should be given to:

1. Stocks in the Critical Zone requiring immediate attention
2. Primary species of highest economic or ecological importance
3. Stocks where SIOFA already has existing management infrastructure in place
4. Determining limit reference points for the main SIOFA species as listed in Annex 1 of CMM 17 (2024).
5. Establishing default biological reference points for other and low-information stocks, where possible, with provision for adding stock-specific reference points as data improves.

This approach allows SIOFA to begin realizing framework benefits immediately while building institutional capacity for broader implementation over time.

7 Part III: Information Classification

Understanding the information level of a fish stock is crucial for fisheries management. This Framework seeks for each SIOFA stock to be classified as high, medium, low or zero information. The amount of data available for a fishery will not necessarily be well-correlated with the amount of useful information contained in those data. Information classification should depend on the type of data available and the credibility and robustness of any existing assessment models. This is an essential step to be taken before a stock can be assessed.

An overarching goal of this framework is to improve the information available for each fishery and to graduate all stocks to at least medium, if not high, information availability to the extent that is feasible. Information classification should be reviewed periodically, at an interval determined by the MoP on advice from the Scientific Committee, and whenever there is a substantial change in the fishery, which itself is context dependent.

This will support:

- **Matching management tools to data availability:** Different management approaches require different types and amounts of data. High information stocks can support sophisticated management procedures with detailed harvest control rules, quantitative stock assessments, and precise reference points. Low information or zero information stocks can still be managed using management procedures, but may require simpler inputs that don't rely on detailed population models.
- **Risk management and precautionary measures:** The level of available information directly determines the appropriate level of precaution needed. Low information or zero information stocks require much more conservative management approaches because uncertainty is higher. High information stocks can support more optimized fishing levels because managers have greater confidence in stock assessments and projections.
- **Resource allocation and cost-effectiveness:** Understanding information levels helps prioritise where to invest limited research and monitoring resources. High-value fisheries with low information or zero information may justify significant investment in data collection and assessment development. Low-value fisheries with low information or zero information might be better managed with simple, cost-effective approaches rather than expensive data collection programs.
- **Stock assessment approaches:** High information stocks can support detailed, quantitative stock assessment. Medium information stocks may only be able to support empirical assessments using indicators like catch per unit of effort (CPUE) trends. Low information or zero information stocks may only be able to support basic assessments using catch trends or other simple indicators.
- **Expectation management:** Classifying information levels ensures SIOFA sets realistic expectations for management choices.
- **Adaptive Management:** Information levels guide the development of adaptive management. For medium or low stocks, management can include additional mechanisms for improvement over time, including additional data collection, that can improve its information status and possibly support less conservative management. Additionally, management procedures include a scheduled review cycle that incrementally incorporates additional levels of complexity as data becomes available.

7.1 Classification Criteria

7.1.1 High Information Stocks

Data sufficient to estimate stock size with quantifiable uncertainty, detect population changes with reasonable confidence, understand key biological processes and support consideration of assumptions about ongoing trends in environmental and fisheries conditions on which to base forward projections.

7.1.2 Medium Information Stocks

Data sufficient to track stock trends over time, identify when significant changes occur, characterize basic population structure, inform responsive management adjustments. Data may have some limitations in scope, precision or duration.

7.1.3 Low (including near-zero) Information Stocks

Data sufficient to confirm species presence and catch levels, provide basic sustainability indicators, identify major changes in catch patterns, support precautionary limits. Data may be basic with substantial limitations.

7.1.4 Zero Information Stocks

Virtually no fishery-specific information is available beyond species identification and basic catch data which are incomplete (substantial gaps in time series or spatial coverage), aggregated at a family or genus level, or sporadic records rather than systematic and/or verified catch. Stocks in this category may have no fishery-independent data, limited or no life history information (or limited to literature values from related species or genera). Data are generally insufficient to confirm consistent stock trends, characterize population responses to fishing, distinguish natural variation from fishing impacts, support anything beyond highly precautionary defaults.

7.2 Classification Process and Review

Classification should be undertaken for all stocks by the Scientific Committee on the basis of available information. That may include data on catch, length, minimum times series lengths. The Technical Guidelines operationalize these criteria through a decision-pathway, key principles for borderline cases and detailed operational checklists.

A stock's information classification should be reviewed following any substantial changes to the fishery or data availability, or otherwise as regularly as is required, particularly if SIOFA has set an objective to improve a particular stock's information status.

A stock's information classification is not permanent. Information availability may improve as data collection programmes mature, assessment methods advance, or research efforts expand. Conversely, information quality may degrade due to discontinued monitoring programmes, changes in fishing patterns that render historical data uninformative, loss of analytical capacity, or deteriorating data quality.

Stocks may therefore transition between information categories as knowledge evolves. These transitions affect management approaches: higher information categories allow for more sophisticated Management Procedures and reference point frameworks, while lower information categories require simpler, more robust approaches with greater precautionary buffers to account for uncertainty; and may necessitate changes in data collection to address the newly identified data deficiencies.

The operational criteria for classifying stocks and identifying when reclassification may be warranted are detailed in the Technical Guidelines (Operational Checklist for Information Classification).

8 Part IV: Stock Status Zones

8.1 Three-Zone Framework

This Precautionary Approach Framework establishes three distinct stock status zones:

- **Healthy Zone** - stocks that are at or above the agreed target and can support sustainable exploitation without biological or economic concern. (i.e. not overfished and no overfishing occurring)
- **Under Watch Zone** - stocks that have dropped below the agreed biomass target and above the agreed fishing mortality target, but remain above the biomass limit and below the fishing mortality limit require enhanced monitoring and management measures (i.e. the stock is either experiencing overfishing or is overfished is occurring relative to the target reference level/point)
- **Critical Zone** - stocks necessitating immediate rebuilding measures and/or minimising excessive fishing pressure (i.e. both overfished and overfishing occurring relative to the target reference level/point).

Stock condition is assessed using the best available methods for the information level (detailed in Technical Guidelines - Stock Status Assessment Methods). Assessments should also consider a range of complementary indicators, as stock assessments do not necessarily capture all aspects of fishery performance. Indicators may provide early warning of changes in the fishery (e.g., lack of recent recruitment, sex bias, changing growth rates) or enable monitoring at finer spatial or temporal scales than the primary assessment. The selection and application of performance indicators is detailed in Technical Guidelines Section - Performance Indicators and Monitoring.

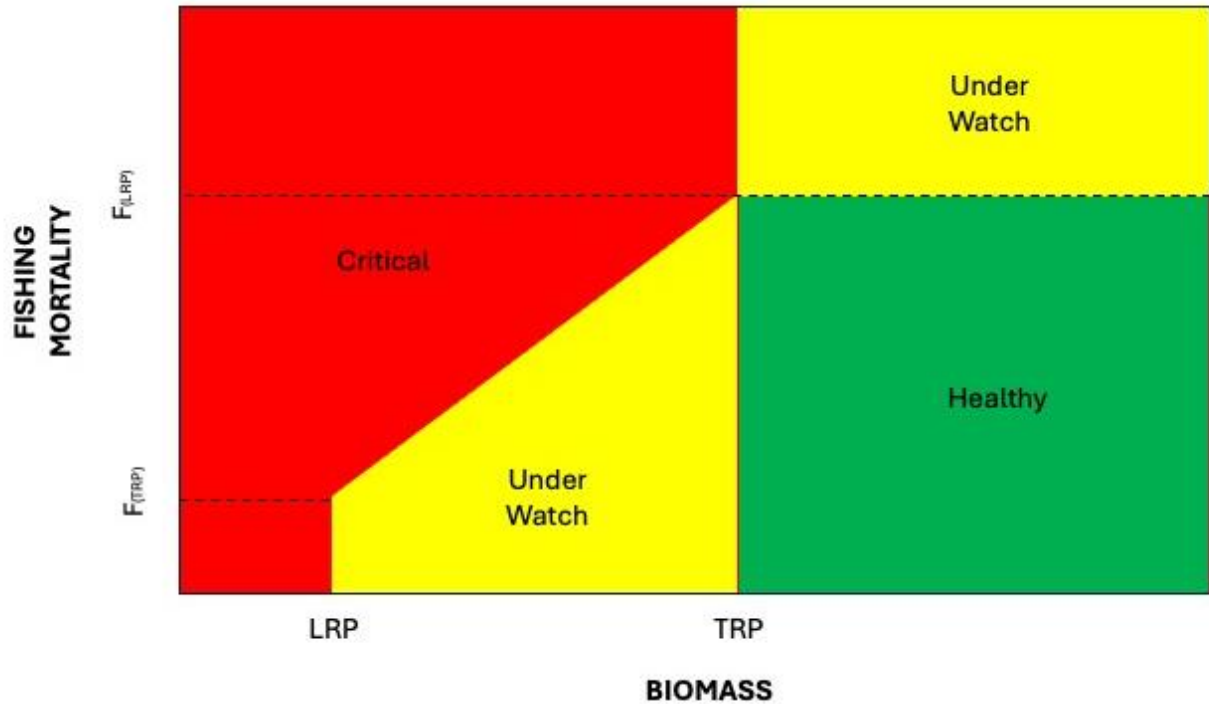


Figure 2: Generic representation of the three stock status zones. The stock specific zone shapes will be dependent on the relevant stock harvest control rule. These zones are delineated by two critical reference points (discussed later in this Framework): the limit reference point and the target reference point. (NB: a buffer zone around the TRP may be used to accommodate fluctuations). Trigger reference point not depicted as it could be between the LRP and TRP, or the TRP itself.

An overarching objective of this Precautionary Approach Framework is to prevent stocks from declining into the Critical Zone. However, for stocks that have been historically depleted and currently exist within the Critical Zone, the development and implementation of formal rebuilding plans is an essential component of framework implementation.

Each zone operates under distinct management principles designed to achieve specific conservation and management objectives.

Stocks move between zones in response to fishing pressure, environmental conditions, recruitment variability, and management effectiveness. Understanding and responding to these transitions is fundamental to precautionary management.

Stocks may shift between zones due to changes in fishing pressure, recruitment variability and strong or weak year-classes, environmental fluctuations affecting productivity or effectiveness or failure of management interventions. Zone transitions are identified through regular assessment of stock indicators against reference points, evaluation of fishing mortality rates, and monitoring of performance indicators.

8.2 Reference Points and Zone Boundaries

The three stock status zones are defined by scientifically-established reference points that serve as quantitative benchmarks for stock conditions. These reference points create clear boundaries between zones and trigger specific management responses when crossed.

Types of Reference Points

- **Target Reference Point (TRP):** The biomass level that management aims to maintain or achieve. This represents the optimal stock size that can support sustainable fishing while providing for productive fisheries. The TRP typically corresponds to biomass levels that can produce optimal socio-economic productivity benchmarks such as maximum economic yield (MEY), or a percentage of *FMSY* or *BMSY*. Targets may also be defined as a threshold, where being at or above the target is considered acceptable.
- **Limit Reference Point (LRP):** The minimum biomass level below which stocks are considered to be in a biologically unsafe condition. When stock biomass falls below the LRP, there is significant risk of recruitment impairment and potential stock collapse, noting that setting a more precautionary LRP offsets the level of risk to some degree. Crossing this boundary triggers immediate and substantial management intervention.
- **Trigger Reference Point:** pre-defined stock status levels that prompt additional management responses or actions. They can sit at or above the target reference point, or between the target reference point and the limit reference point in a management procedure, serving as early warning indicators that management intervention is needed to prevent stocks from declining toward biologically unsafe levels.

Detailed guidance on setting reference points is provided in the Technical Guidelines.

9 Part V: Management

9.1 Management Principles

As a general management principle, risk equivalency should be maintained across stocks and zones, regardless of data quality or assessment uncertainty. This provides for management to be more precautionary when there is greater uncertainty about stock status, while allowing less restrictive measures when stock assessments are highly reliable. This approach ensures equivalent risk levels across all managed stocks, preventing the inadvertent application of riskier management to poorly-studied species simply due to lack of information.

Risk Equivalency is implemented through several key mechanisms.

- Stocks are classified into information tiers based on data richness, using the classification system identified above.

- Reference points are adjusted according to assessment uncertainty, with low information or zero information stocks receiving larger precautionary buffers between target and limit reference points.
- Harvest control rules incorporate this uncertainty explicitly, triggering management responses at higher biomass levels or lower fishing mortality rates for stocks with greater assessment variability.

The system maintains a consistent probability of stock depletion or overfishing across all stock.

In practical terms, precautionary management may translate to substantial differences in exploitation levels. High information stocks might operate at a much higher proportion of their theoretical maximum sustainable catch while low information or zero information stocks may face much more conservative fishing opportunities.

This Framework focuses on **both** risk assessment (through stock status evaluation) and risk management (through management procedures).

9.2 Zone-Specific Management

9.2.1 Healthy Zone Management

In the **Healthy Zone**, fish stock status is considered optimal, and fisheries management decisions are designed to maintain stocks within this zone through sustainable management. Management focuses on optimising yield while ensuring long-term stock stability. Management considers ecosystem-level impacts and maintains fishing at levels that preserve ecosystem structure and function

When establishing fishing mortality (F) for stocks within the Healthy Zone, management decisions should be informed by a comprehensive range of options at, above, and below F_{TRP} . These options, along with their associated risks, should be provided by the Scientific Committee with the objective of maintaining stock status within the Healthy Zone.

9.2.2 Under Watch Zone Management

In the **Under Watch Zone**, management decisions and strategies prioritise stock rebuilding and/or decreased fishing pressure to return biomass levels to the Healthy Zone. A precautionary approach is applied with progressively more conservative measures as biomass approaches the lower boundary. Enhanced monitoring may be required and include ecosystem indicators and consideration of cumulative fishing impacts

Fishing mortality should be managed to remain least within the 'Under Watch' zone boundaries and ideally towards the 'healthy zone' boundaries. Fishing mortality rates should be set that achieve specific management objectives based on stock trajectory and relative position within the Under Watch Zone. Management actions should be designed to articulate increasing risk avoidance as stock biomass

approaches B(LRP), with the overarching intent of preventing biomass from falling below the limit reference point.

9.2.3 Critical Zone Management

In the **Critical Zone**, management emphasis shifts to promoting stock growth through minimising removals to the lowest possible level. Immediate intervention is required to prevent further stock decline and facilitate recovery.

Fishing mortality should be set at the lowest possible level. Management decisions should be informed by the full range of options and associated risks provided by the Scientific Committee. When a stock has declined to the Critical Zone, it may be because $B = TRP$, but F is too high, or it could be because the stock has declined below biomass LRP. If the stock has declined below B(LRP), a formal rebuilding plan must be implemented with the objective of achieving a high probability of stock recovery from the Critical Zone within a reasonable timeframe. Rebuilding plans must consider ecosystem recovery, including restoration of the stock's ecological role. Comprehensive guidance on developing, implementing, and monitoring rebuilding plans is provided in the Technical Guidelines.

9.3 Transboundary Stocks

Where stocks migrate or are likely to migrate between areas under a coastal State's jurisdiction and/or an area of the high seas managed by another regional fisheries management organisation (or equivalent), every effort should be made to ensure that management is compatible for the portion of the stocks occurring in the SIOFA Area. Classification should be coordinated with adjacent management jurisdictions to ensure compatible management approaches. Where a single stock spans multiple jurisdictions, classification should reflect the overall stock status.

9.4 Ecosystem Considerations in Management

The precautionary approach framework recognizes that fishery resources exist within complex marine ecosystems and that effective fisheries management must consider the broader ecological context in which fishing occurs. This section outlines how ecosystem considerations are integrated throughout the framework's implementation.

9.4.1 Ecosystem-Based Management Principles

Sustainable fisheries management requires understanding that:

- **Fish stocks are ecosystem components:** Target species play specific ecological roles as predators, prey, competitors, and habitat modifiers that must be maintained for ecosystem health
- **Fishing has ecosystem-wide effects:** Removal of species affects food webs, habitat structure, and ecosystem processes beyond the target species

- **Environmental variability affects stock productivity:** Climate, oceanographic conditions, and habitat quality directly influence both target and non-target species population dynamics and carrying capacity
- **Cumulative impacts matter:** The combined effects of multiple fisheries, together with other human activities, can alter ecosystem structure and function in ways that single-species management cannot address.

9.4.2 Associated and Dependent Species

The framework explicitly addresses the management of associated and dependent species (including ETP species) through:

- **Risk-based approaches:** Species with higher ecological vulnerability receive more conservative management, regardless of their commercial value, using ERA outcomes to inform management responses.
- **Integrated monitoring:** Data collection systems that capture information on bycatch, associated species, and ecosystem indicators alongside target species data.
- **Precautionary measures:** When target species management may affect ETP species or critical ecosystem components, management procedures incorporate additional safeguards and monitoring requirements.

9.4.3 Habitat and Environmental Considerations

Management decisions should account for:

- **Essential habitats:** Protection of spawning areas, nursery grounds, and other critical habitats necessary for stock productivity and ecosystem function.
- **Climate variability:** Recognition that environmental conditions affect stock productivity, with management procedures designed to be robust to climate-driven changes in fish distribution and abundance.
- **Ecosystem services:** Consideration of the broader ecosystem services provided by healthy fish populations, including their role in maintaining ecosystem structure and supporting other marine life.

9.5 Implementation Approach

Given SIOFA's data limitations, the framework takes a pragmatic approach to ecosystem integration:

- **Use available information:** Leverage existing ecological risk assessments, environmental monitoring, and regional ecosystem knowledge to inform management decisions.
- **Precautionary buffers:** Where ecosystem data are limited, apply additional precautionary measures to account for ecosystem uncertainty and potential indirect effects of fishing.

- **Adaptive management:** Design monitoring systems to detect ecosystem-level changes and adjust management measures accordingly.
- **Regional coordination:** Coordinate with other management bodies and research institutions to share ecosystem information and align management approaches across jurisdictions.

9.6 Proactive Management: Management Procedures

9.6.1 Default Management Approach rationale

As a default approach, all stocks should be managed under a management procedure. A management procedure is a pre-agreed framework for making fisheries management decisions, including the establishment of catch limits and other management measures, in a fishery for defined stock necessary to achieve its agreed ecological, economic and/or social management objective.

Management procedures provide a proactive approach to achieving long-term sustainability by establishing transparent, science-based decision-making processes that reduce uncertainty and improve management effectiveness. Pre-agreed, risk-based management actions provide clear guidance for harvest rate decisions under varying stock status conditions. International experience shows that harvest control rules provide a convenient framework for conducting management evaluations, allowing managers to agree on specific management actions that are triggered according to stock status relative to predefined reference points (see for e.g De Bruyn et al. 2013).

For low information or zero information stocks where even empirical management procedures may not be possible, management procedure principles can still be applied via a qualitative management procedure. Qualitative management procedures draw on expert opinion to assess the efficacy of candidate management procedures rather than mathematical models, though this should only be involved when there is no quantifiable approach possible. By drawing on expert opinion to bridge data gaps, management recommendations can still be made for foreseeable future scenarios, enabling the benefits of the proactive nature of management procedures, pre-agreeing action rather than the reactive nature of traditional management.

This Framework recognizes that not all fishery management approaches deal equally well with risk, with some potentially compounding rather than reducing risk (see for e.g Hilborn et al. 2001). The systematic approach provided by management procedures is designed to explicitly manage risk rather than merely assess it.

9.6.2 Core Elements of Management Procedures

Each management procedure must incorporate the following fundamental components:

- **Fishery Definition** - Clear specification of the fishery to which the management procedure applies. New or exploratory fisheries require an inherently more precautionary approach.
- **Management Objectives** - Articulation of measurable management objectives that establish the vision for the fishery.

- **Performance Indicators and Reference Points** - Identification of indicators that measure performance against management objectives, fishery status and population health, with associated target, limit and trigger reference points and specification of acceptable levels of risk for achieving management objectives. Performance Indicators should also monitor trends within the fishery for broader context and understanding of the fishery and stock assessment results. Reference points should give consideration to environmental and climate factors. Fishery-specific reference points should be established where possible, otherwise the default limit reference point should be adopted.
- **Stock Assessment** - Assessment to estimate stock status relative to established reference points . Stock assessments may range from comprehensive quantitative model-based assessments to less complex empirical methods, as outlined in the Technical Guidelines. The MoP should determine how frequently an assessment should be undertaken, based on Scientific Committee advice.
- **Monitoring** - Establishment of monitoring programs to collect relevant data and performance assessment processes to evaluate indicators against reference points and management objectives.
- **Harvest Control Rules** - Development of harvest control rules that determine fishing opportunities, including but not limited to catch limits, effort controls, and technical measures, based on indicator values relative to reference points, and supported by appropriate simulation testing, preferably through management strategy evaluation (MSE). Harvest Control Rules should be appropriate for the stock's zone and specify management actions if reference points are breached.
 - MSE is a simulation-based approach that tests management procedures by modelling the complete management cycle — data collection, stock assessment, harvest control rule application, and resulting stock dynamics — under realistic uncertainty. Operating models represent plausible stock dynamics; estimation models replicate the assessment methods applied in practice. MSE compares candidate procedures against management objectives, revealing trade-offs amongst competing goals (e.g. maximising yield versus minimising catch variability) before implementation. For data-poor stocks where quantitative MSE is not feasible, structured qualitative expert-based evaluation is applied as an equivalent. Detailed MSE specifications, tier-specific evaluation approaches, and performance standards are provided in the Technical Guidelines
- **Performance Monitoring and Review** - Implementation of ongoing performance monitoring and periodic review processes to evaluate management procedure effectiveness and identify necessary adjustments.

This approach enables strategic decision-making regarding the level of investment required for monitoring and assessment activities for specific fisheries. The catch-cost-risk trade-off becomes a critical consideration in this context, requiring careful evaluation of the balance between fishing opportunities, monitoring costs, and conservation risks, as detailed in the Technical Guidelines.

The Management Procedure Development Process ([Annex 3](#)) sets out how the framework components integrate to develop a management procedure.

9.6.2.1 *Rebuilding Plan Reporting*

For any stock in the critical zone, reporting against implementation of rebuilding plans should flow naturally from the management procedure components. At minimum, reporting on rebuilding plan implementation must include:

- **Performance against objectives** - Assessment of rebuilding plan performance against established objectives, targets, and timeframes, specifically evaluating the extent to which implemented actions have delivered against articulated strategy goals.
- **Analysis of recovery shortfalls** - Where recovery has not occurred as expected or intended, comprehensive analysis of the reasons for this occurrence, including evaluation of the extent to which incidental or unavoidable catch has been minimised.
- **Amendment** - Identification of any anticipated or suggested amendments to the rebuilding plan that may better deliver against established objectives, targets, and timeframes.

9.6.3 Choosing which Management Procedure to use

Different methodological approaches may be required based on the information available and the economic or ecological importance of the stock to SIOFA. [Annex 4](#) provides for a management procedure decision framework using three possible approaches which all incorporate the components of a management procedure to a greater or lesser extent:

- Full, quantitative, model-based management procedures
- Simplified empirical management procedures
- Qualitative, knowledge-based procedures

In determining which type of management procedure to use, the following questions may be considered:

- Is adequate information available to support the proposed management procedure type?
- Can SIOFA support, and financially support, the proposed management procedure complexity?
- For secondary stocks with medium or high information: Is the cost proportional to value and risk?
- Are adequate data collection systems in place?
- Can the stock be monitored to the degree required by the management procedure?

Regardless of the type of management procedure selected, all management procedures must:

- Be scientifically defensible
- Maintain precautionary approach appropriate to uncertainty level

- Take into account the productivity characteristics of the stock being managed
- Take into account, where known, both the potential influence of the environment on fish productivity, and any environmental or climate variables.
- Comply with the Agreement

Annex 4 sets out the essential and additional requirements for each type of management procedure.

9.6.4 Transition Pathways: Upgrading to (more) quantitative Management Procedures

Upgrading to a (more) quantitative management procedure should be an overarching goal. Upgrading is warranted where:

- Stock importance increases significantly such that the cost/benefits of investing further in that fishery have changed
- Information availability improves substantially
- Additional resources become available for enhanced management

This approach is particularly critical for addressing SIOFA where many stocks are, and will likely remain without serious data collection intervention, characterized by low information or zero information availability. Rather than allowing this reality to become a barrier to effective management, the framework provides structured options that scale appropriately with available information while maintaining a precautionary approach.

9.6.5 Management Procedures to be applied progressively

Management procedures should be considered for all stocks. However, recognising that implementation of this Framework takes time, it could be applied progressively, according to areas of the highest risk or to stocks of highest importance.

9.6.6 Monitoring exceptional circumstances and suspension of the management procedure

Certain circumstances may warrant the suspension of a management procedure. Suspension may lead to temporarily halting or modifying the management procedure, interim precautionary management controls or a suspension of fishing.

In recognition of this, management procedures should identify the exceptional circumstances (breakout rules) that may trigger departure from, or suspension of, the management procedure. As such, an exceptional circumstances protocol should be developed to guide SIOFA in deciding if circumstances warrant suspension of a management procedure. The protocol should not be overly prescriptive to avoid a lack of guidance for unforeseen situations.

9.6.7 Performance Assessment, Review and Reporting

The ongoing performance of each management procedure must be assessed against its established objectives and publicly reported. To facilitate effective performance assessment, the MoP should specify the data to be collected and maintained through adequate record-keeping systems. This includes data used in and the outputs from stock assessments and comprehensive information documenting how the management procedure has been performing for each stock. Detailed record-keeping requirements and performance monitoring protocols are specified in the Technical Guidelines.

9.6.8 Management Procedure Review Schedule

Individual management procedures should be reviewed at minimum every six years (i.e two standard stock assessment cycles) as part of a structured adaptive management approach. This regular review schedule introduces future-proofing mechanisms that allow strategies to evolve with changing conditions and improved understanding.

Reviews should also be conducted when significant changes in fishery conditions occur or when new scientific knowledge emerges regarding species biology. This adaptive management philosophy ensures that management procedures remain current and effective over time.

Major amendments to management procedure are not anticipated to occur frequently. However, when significant amendments or development of new management procedures becomes necessary, such changes must be based on current scientific and economic analysis.

Earlier review may be necessary under the following conditions:

- Stock Changes - Marked changes in a stock, its importance to SIOFA CCPs or its information classification
- New Scientific Information - Emergence of new information that substantially changes understanding of the fishery, resulting in revised estimates of indicators relative to reference points.
- Performance Indicator Failures - Performance indicators demonstrating that management procedures are not functioning effectively and that the intent of the management procedure is not being achieved.
- MSE Limitations - When MSE testing did not adequately account for changes in risk factors subsequently observed in the fishery.
- 'Exceptional Circumstances' or other review triggers are met - such as when there are significant and unexpected changes in fishery conditions outside the ranges previously tested. This includes situations where stock biomass has declined below the Limit Reference Point while subject to a management procedure, indicating that stock productivity has been overestimated or that the control rule is not responding adequately to declines in performance indicators.

If a management procedure is amended as a result of a review, it should be re-tested to ensure it maintains a high likelihood of achieving its specific objectives under the revised circumstances.

Management procedures also operationalize the risk equivalency principle by implementing precautionary adjustments that scale with information uncertainty. While the MoP sets the overall risk tolerance for SIOFA stocks, management procedures ensure this risk level is maintained across all information tiers through:

- **Tier 1 (High Information):** Standard buffers and direct estimation of reference points
- **Tier 2 (Medium Information):** Enhanced buffers and proxy reference points with additional precautionary margins
- **Tier 3 (Low Information and Zero information):** Maximum precautionary buffers and highly conservative default approaches.

Zero information stocks are unlikely to support any level of commercial fishing. Zero information stocks should only be fished as research (e.g data collection for age, length-weight relationships etc).

Each tier's specific parameters are calibrated to achieve equivalent probability of falling below limit reference points, ensuring that data-limited stocks receive greater protection to compensate for increased uncertainty.

9.6.9 Alternative Management Approaches

Management Procedures are the preferred, default management approach, including for low information or zero information stocks. However, if, based on the Scientific Committee's advice, the MoP determines that a management procedure should not be developed at that time, or is not a practical tool to address risks in a particular fishery or for a particular stock other scientifically defensible approaches may be considered -'no management' is not a reasonable alternative.

In such cases:

- Reasons for pursuing alternative management approaches should be documented;
- All available data should be considered and used to inform management strategies and controls that are robust to the uncertainties in the fishery;
- The MoP should draw on the elements outlined above (assessment, establishing reference points, pre-determined management responses and performance monitoring) and scientifically appropriate methods for assessing and monitoring the stock, driven by the management aims, should be deployed.
- The MoP should establish a clear timeline for review, including considering whether a management procedure is feasible at a later point.
- A biologically appropriate limit reference point should be adopted for all stocks that are not, or will not, be managed under a management procedure.

10 Roles and Responsibilities

Responsibility for implementing this Framework is as follows:

10.1 CCPs

- Submit required data in standardized formats according to established timelines
- Contribute research and expertise, where possible, to support implementation of this framework to primary and secondary species
- Apply and enforce conservation and management measures to flagged vessels

10.2 Scientific Committee

- Categorize and classify stocks in accordance with this framework
- Conduct regular assessments using the best available methods
- Provide clear, timely advice to the MoP on the implementation of the Framework
- Provide best estimates and confidence intervals for current biomass and/or fishing mortality (or related biological reference points)
- Provide options for limit, target and trigger reference points, and associated harvest control rules
- Develop rebuilding plans for stocks when required
- Investigate the implications of management responses taken under this Framework.
- Recommend precautionary adjustments needed to achieve risk equivalency across tiers
- Conducting or reviewing MSE analyses that evaluate whether proposed management procedures maintain risk equivalency
- Oversee MSE processes
- Continuously improve assessment methods and approaches

10.3 Compliance Committee

- Provide general advice on implementation challenges of this framework
- Provide advice on information CCPs need to collect to support monitoring the performance of the management procedure.

10.4 Meeting of the Parties

- Determine pre-agreed management actions based on different biological scenarios
- Act on, and support generation of, best available science
- Act without delay if the Limit Reference Point is breached
- Adopt conservation and management measures, or other decisions, to implement this framework based on Scientific Committee advice
- Periodically review and update this Framework
- Ensure adequate budgetary and other resources are provided to support the implementation of this Framework
- Define risk tolerance setting (see [‘Risk Governance’](#))
- Determine appropriate arrangements and consultative processes to involve observers, experts and other relevant stakeholders in the implementation of this Framework.

10.5 Secretariat

- Support oversight and implementation of this Framework, including awareness raising and capacity assistance where required.
- Maintain records relating to the implementation of this Framework
- Produce regular reports on the Framework's implementation and effectiveness, as well as any emerging issues
- Maintain a stock assessment schedule

11 Review

Effective implementation of this Framework requires review at two distinct levels.

At the stock level, both this Framework and the Technical Guidelines establish regular review of individual management procedures and their components — e.g stock status assessments, zone classifications, reference points, and performance indicators — on a stock-by-stock or management procedure by management procedure basis. These reviews are ongoing and operational: they ensure that management of each stock remains responsive to new data, changing stock conditions, and the performance of the management procedure against its objectives. The schedules and triggers for these stock-level reviews are set out in the relevant sections of the Technical Guidelines and summarised in Figure 1 of this document.

At the framework level, this document and the Technical Guidelines should be reviewed every five years to ensure they remain fit for SIOFA's purposes, or more frequently if circumstances require. A framework review is a different exercise from any stock-level review — it examines whether the overarching architecture, principles, criteria, and governance arrangements remain appropriate for SIOFA as a whole. Neither substitutes for the other.

That review is essential because the context in which this Framework operates will change over time. Best practice in fisheries management evolves, the standards for fisheries information and stock assessment methods will shift, and the circumstances of SIOFA's fisheries — the species under management, the data available, and the capacity of Members to implement management measures — will develop as the organisation matures. A framework that is well-calibrated today may need its settings, classification criteria, or reference point defaults adjusted in future to reflect these changes. The five-yearly review provides a structured opportunity to make those adjustments.

12 Amendment

This framework may be amended by the MoP in accordance with its usual decision-making procedures.

13 Conclusion

This Framework provides SIOFA with a comprehensive, flexible system for implementing precautionary fisheries management across all stocks, regardless of data availability. The framework's success depends on strong commitment from all CCPs, adequate resources for implementation, and continuous adaptation based on new information and experience.

The framework directly addresses SIOFA Performance Review Recommendations 1 and 10 by providing clear guidelines for precautionary management and establishing systems for continuous improvement.

Annexes

Annex 1: UNFSA Requirements

Annex 2: List of Primary and Secondary Species

Annex 3: Management Procedure Development Process

Annex 4: Management Procedure Decision Framework

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Annex 1 UNFSA Requirements - Article 6

Application of the precautionary approach

1. States shall apply the precautionary approach widely to conservation, management and exploitation of straddling fish stocks and highly migratory fish stocks in order to protect the living marine resources and preserve the marine environment.

2. States shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.

3. In implementing the precautionary approach, States shall:

(a) improve decision-making for fishery resource conservation and management by obtaining and sharing the best scientific information available and implementing improved techniques for dealing with risk and uncertainty;

(b) apply the guidelines set out in Annex II and determine, on the basis of the best scientific information available, stock-specific reference points and the action to be taken if they are exceeded;

(c) take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities on non-target and associated or dependent species, as well as existing and predicted oceanic, environmental and socio-economic conditions; and

(d) develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment, and adopt plans which are necessary to ensure the conservation of such species and to protect habitats of special concern.

4. States shall take measures to ensure that, when reference points are approached, they will not be exceeded. In the event that they are exceeded, States shall, without delay, take the action determined under paragraph 3 (b) to restore the stocks.

5. Where the status of target stocks or non-target or associated or dependent species is of concern, States shall subject such stocks and species to enhanced monitoring in order to review their status and the efficacy of conservation and management measures. They shall revise those measures regularly in the light of new information.

6. For new or exploratory fisheries, States shall adopt as soon as possible cautious conservation and management measures, including, inter alia, catch limits and effort limits. Such measures shall remain in

force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment shall be implemented. The latter measures shall, if appropriate, allow for the gradual development of the fisheries.

7. If a natural phenomenon has a significant adverse impact on the status of straddling fish stocks or highly migratory fish stocks, States shall adopt conservation and management measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impact. States shall also adopt such measures on an emergency basis where fishing activity presents a serious threat to the sustainability of such stocks. Measures taken on an emergency basis shall be temporary and shall be based on the best scientific evidence available.

Annex 2 List of Primary and Secondary Species

The interim definitions to prioritise species for work including primary, secondary and ETP species as follows⁷:

Primary species: Species for which management tools and measures should be in place and the achievement of stock management objectives is expected. These species-gear encounters tend to encompass a high proportion of the fished area for that fishery. The Scientific Committee would be expected to undertake relevant biological studies and periodic stock assessments (quantitative, semi-quantitative or qualitative whichever is appropriate) for these species. These species should have SIOFA species specific fisheries summary reports compiled annually in years when no assessment is being undertaken.

Secondary species: All other species that comprise 5 per cent or more of the total catch (determined using a 3-5 year average) or, for 'less resilient' species (most sharks etc., based on ERA), 2 per cent or more of the total catch, or otherwise as designated by the Scientific Committee. The Scientific Committee would be expected to undertake periodic evaluations, to assess trends in catch and effort, for these species. Information on trends for these species could be included in a future general fishery summary report.

Endangered, Threatened or Protected (ETP species): All reptiles, birds, and mammals, as well as any species listed as endangered, threatened or protected by a CCP's national legislation, international agreements, or relevant international instruments (e.g., IUCN Red List as vulnerable, endangered or critically endangered) once designated by SIOFA. The Scientific Committee would be expected to undertake catch and impact evaluations, on the incidental catch of these species from time to time or undertake risk-based analyses. Information on trends for these species should be included in general ETP species summary report.

The following definitions were adopted for Scientific Committee planning and prioritisation:

- I. Target: Target species are declared by the skipper in logbook catch returns as required in Annex A of CMM 2022/02.
- II. Targeted species: the intended catch and other valuable species landed in sets aimed at the intended catch. These species usually consist of 50% or more of the species composition of the retained catch, but in some highly diverse fisheries (e.g., shallow water tropical fisheries) these may make up as little as 15% of the retained catch. Targeted species are usually landed in consecutive sets within a trip, where there may be more than one intended target, and as such are not limited to those listed on set and haul declarations. Targeted species that are damaged or of an undesirable size are, from time to time, discarded by some vessels.
- III. Bycatch: Fishery resources that are not target nor targeted typically in the taxonomic classes Chondrichthyes and Actinopterygii and infraphylum Agnatha and class Cephalopoda and Crustacea, that are part of the catch which is not the target.

⁷ As adopted at MOP10

- IV. Retained bycatch: Species that are less valuable than the target species and often caught and retained, or retained often but in low proportions and have commercial value.
- V. Discarded bycatch: Unwanted species that have little or no commercial value and are usually discarded. Species that are not allowed to be retained.

Table 1⁸ List of Primary and Secondary Species

Fishery	Target/Targeted	Bycatch	
		Retained	Discarded
Deepwater bottom trawl (CK, AU)	BYS-Splendid alfonsino	ORD-Oreos nei.	All elasmobranchs
	ORY-Orange roughy	BOE-Black oreo	HYD-Ratfishes nei.
	SSO-Smooth oreo dory	BOR-Boarfishes nei.	ONV-Spiky oreo
	EPI-Black cardinal fish	BEO-Crested sculpin	SQU-Squid
	EDR-Pelagic armourhead		
Deep mid-water trawl (CK)	BYS-Splendid alfonsino	ORD-Oreos nei	All elasmobranchs
	ORY-Orange roughy	BOE- Black oreo	OIL-Oilfish
	CDL-Cardinal fishes	BNS-Smallfin lanternfish	ONV-Spiky oreo
	BWA-Bluenose warehou	BOR- Boarfishes nei.	HYD-Ratfishes
	EPI-Black cardinal fish	EMM-Cape bonnetmouth	SQU-Squid
	EDR-Pelagic armourhead	BBY-White-ribbed toadfish	
	SEY-Violet warehou	WHA-Hapuku wreckfish	
		ONV-Spiky oreo	
Mid-water trawl (JP,)	BYS-Splendid alfonsino	WHA-Hapuku wreckfish	CDL-Cardinal fishes
	SEY-Violet warehou	EDR-Pelagic armourhead	EMM-Cape bonnetmouth
		BWA-Bluenose warehou	RGY-Narrowbanded sole

⁸ Table 1, including colour coding, as extracted from the Report of the 10th Meeting of the Parties

		BXD-alfonsino	
		EPI-Black cardinal fish	
		ONV-Spiky oreo	
		SEY-Violet warehou	
		WRF-Wreckfish	
		PRP-Roudi escolar	
		SFS-Silver scabbardfish	
Shallow bottom trawl (TH)	LIB-Brushtooth lizardfish	SUN-Angel shark	SCO-Scorpion fish
	RUS-Indian scad	SDV-Mustelus species	FIP-Red cornetfish
	KZJ-Thredfin bream	CWZ-Carcharhinus sharks nei.	CRS-Swimming crabs?
	UPM-Goldfin goatfish		
	DCC-Shortfin scad		
	LTQ-Sky emperor		
	BIS-Bigeye scad		
	YBS-bigeye barracuda		
Bottom longline (AU, EU, FR-OT)	TOP-Toothfish	CYO-Portuguese dogfish	CYO-Portuguese dogfish
	WHA-Hapuku wreckfish	ANT-Violet cod	ANT-Violet cod
	RIB-Common mora	GRV-macrourids	SKX-skates
		WHA-Hapuku wreckfish	BYR-Sandpaper skate
		RFA-Whiteleg skate	RFA-Whiteleg skate
			COX-Congor eels
			BSF- Black scabbard fish
Surface longline (TW)	OIL-oilfish	BIL- Billfish*	GES-Snake mackerel
	LEC-Escolar	TUN-Tuna *	CUT-Scabbard fishes
		BSH-blue shark	ALV-Common thresher shark

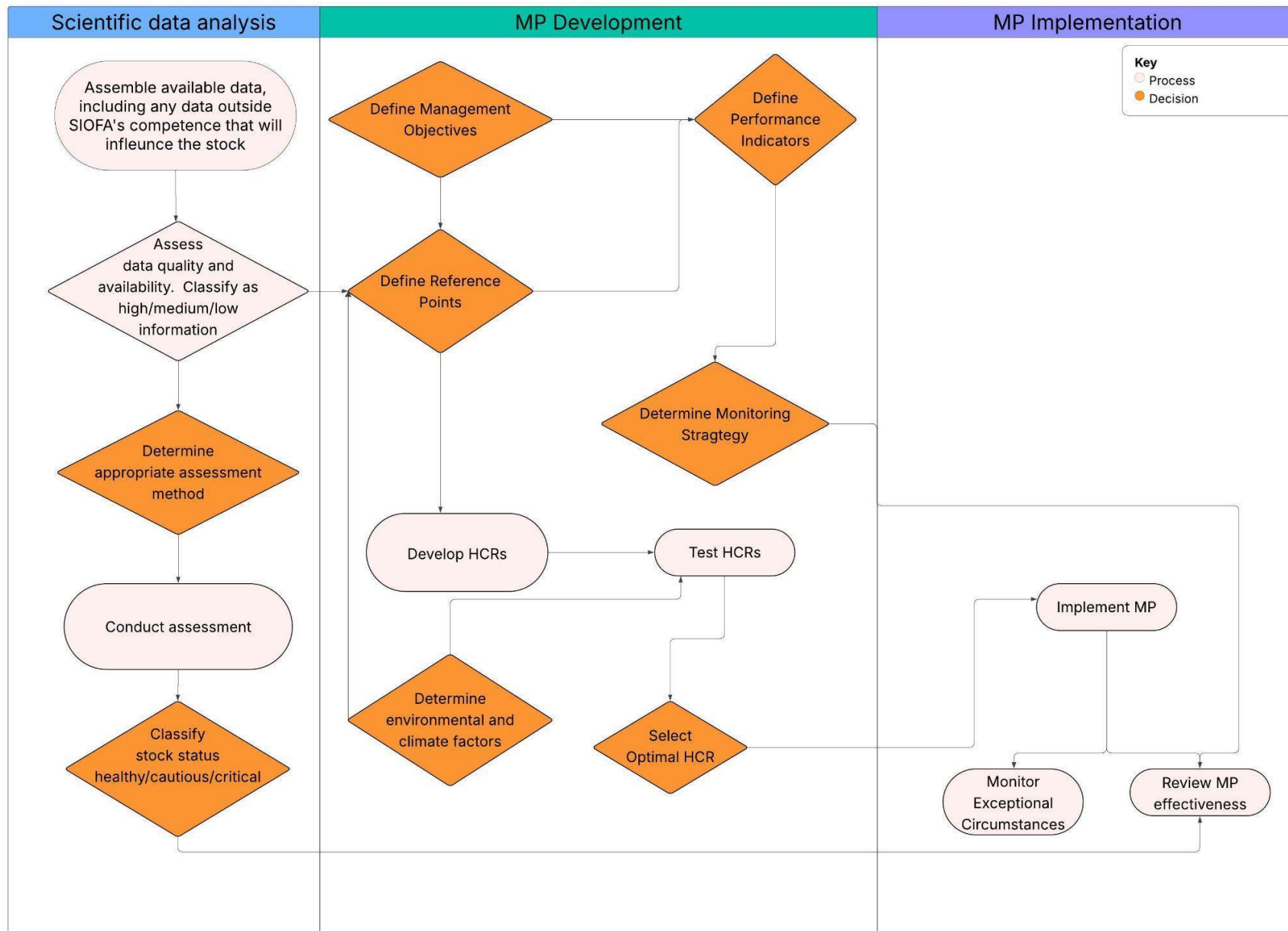
		FAL-Silky shark	PTH-Pelagic thresher
		MAK-Mako sharks	BTH-Bigeye thresher
		DOL-Mahi mahi	THR-Thresher sharks
		WAH-Wahoo	RMB-Giant manta
		COM-Spanish mackerel	RMV- <i>Mobula</i> spp.
		BAC-Pickhandle barracuda	OCS-Oceanic whitetip shark
		LAG-Opah	
Handline shallow water (MR)	LTQ-Sky emperor	ARV-Green jobfish	
	LHN-Spangled emperor		
	LHB-Spotcheak emperor		
Lines (Mechanised) deep water (MR)	ETC-Deepwater red snapper	PLM-Spotted coral grouper	
	ETA-Deepwater longtail red snapper	VRL-Yellow edged lyretail	
	LWA-Goldflag jobfish	ARV-Green jobfish	
	PFM-Crimson jobfish		
	OXR-Frenchman seabream		
	EEP-Comet grouper		
Handline (TH, MR)	NGU-Yellow spotted trevally	CCF-Pigeye shark	YFT-yellowfin tuna
	NGY-Bludger		MTM-Eagle ray
	NGX- <i>Carangoides</i> species		KAW-Kawakawa
	EMN-Marbled coral groper		
	LTQ-Sky emperor		
	LUB-Emperor red snapper		
	LJB-Two-spot red snapper		

* These species are managed by, and reported at the species level to, IOTC.

Annex 3 Management Procedure Development Process

Figure 3 below illustrates the Management Procedure Development Process as an integrated sequence of steps spanning three phases: Scientific Data Analysis, MP Development, and MP Implementation. The process begins with data assembly and quality assessment, which determines the information tier and appropriate assessment method. MP development then proceeds through the definition of management objectives, reference points, and performance indicators, followed by harvest control rule development and testing, and selection of the optimal HCR. Environmental and climate factors are considered at this stage. Once developed, the MP moves to implementation, where it is applied and subject to ongoing monitoring — including monitoring for exceptional circumstances — and periodic review of MP effectiveness. The cyclical nature of the review phase reflects the framework's adaptive management intent.

Development of the SIOFA Precautionary Approach Framework (PAF) (SIOFA PAM-2024-01)
 Final Project Report



Annex 4 Management Procedure Decision Framework: A Graduated Approach for Proactive and Precautionary Fisheries Management

Framework Intent

This Management Procedure Decision Framework is founded on proactive, precautionary fisheries management that recognizes the practical realities of SIOFA's data availability and the breadth of stocks within its remit, which have different levels of importance to CCPs.

The framework establishes management procedures as the default management option for all stocks as the preferred approach. However, it also acknowledges that different methodological approaches may be required based on the information available and the economic or ecological importance of the stock to SIOFA.

The fundamental intent of this framework is to ensure that all stocks receive appropriate management attention, regardless of their data status or value. Some stocks may necessarily require more conservative management than others. This framework provides a structured pathway that allows SIOFA to meet its precautionary approach obligation across its entire portfolio of stocks.

Central to this, reduced data availability does not justify reduced precaution. However, the methodological approaches to achieve that may vary across the gradient of data availability, the commitment to precautionary management remains constant.

A Graduated Approach to Management Procedures

This Framework presents three possible methodological approaches to implementing a management procedure. It takes a graduated approach, beginning with established, model-based quantitative approaches to management procedures and working through a decision hierarchy if that is not achievable to less quantitative approaches.

All management procedures should to a greater or lesser extent, include the components specified in the Framework. However, these components are addressed in different ways depending on the type of management procedure approach taken. All available data should be used, regardless of the approach data.

The three possible approaches are:

Tier One: Full, Model-Based Management Procedures

These represent the gold standard for fisheries, incorporating stock assessment based operating models to assess candidate management procedures robustness to potential future scenarios via MSE. They require quantitative knowledge of population dynamics and life history characteristics, as well as detailed fishery data in order to simulate a range of future scenarios. While these management procedures are data and computationally intensive, they represent the most reliable form of management procedure.

Tier Two: Simplified, Empirical Management Procedures

These management procedures are inherently less complex. Their procedures rely on simple rules based on observable trends and indicators, designed to be robust across a range of conditions without requiring detailed knowledge of the underlying population dynamics required for model-based approaches. They are designed for situations with moderate data availability. They provide a pragmatic middle ground that maintains quantitative rigor while reducing data requirements and analytical complexity. In these cases, empirical harvest control rules may be based on observable indicators, linking them to catch advice. Catches could be regulated based on trend-based rules that adjust advice according to recent observations (e.g. catches or a relative biomass index). Candidate management procedures are still subject to simulation testing, for example testing a conservative constant catch scenario.

Tier 3: Qualitative, “Knowledge-Based” Management Procedures

The first two categories are well established approaches (See for e.g Geromont and Butterworth 2015b; 2015a; Dowling et al. 2015). This third category addresses the reality that many stocks will never justify or support even simplified quantitative approaches. These procedures harness expert judgment, and practical monitoring to provide proactive management for the most data-limited situations.

Some SIOFA fisheries may only be able to achieve this qualitative management procedure - not necessarily because of a lack of some inherent biological characteristics but because the fisheries are low in value.

While quantitative approaches are preferred, and their feasibility should be explored, this approach may be the best case situation for fisheries where:

- No quantitative data are available or feasible to collect
- They are low-value where data collection costs exceeds benefits
- No quantitative monitoring systems exist or are feasible
- Traditional scientific assessment methods are impossible
- Even simplified empirical indicators cannot be calculated and it is difficult to quantify performance

In these situations, management procedures will rely more heavily on qualitative analyses, such as:

- expert judgement applied to biological understanding from similar systems, such as life history knowledge
- Observable, qualitative indicators such as perceptual changes (fish are getting smaller, fish are harder to catch, species composition is changing) or changes in fleet behaviour (changes in fishing patterns, effort distribution, participation, gear) or other observable ecosystem changes.

Simple harvest control rules should be implemented. Management actions may, initially, be experiments, and need to be monitored and adapted. It may be helpful to define escalating levels of intervention or what constitutes ‘concerning’ changes to manage the risk of overfishing.

The graduated nature of this framework ensures that no stock falls through the management cracks due to data limitations. By providing appropriate tools for each level of data availability, the framework enables SIOFA to:

- **Maintain consistency** in applying the precautionary approach across all managed stocks
- **Optimize resource allocation** by matching analytical intensity to stock value and data availability
- **Provide clear pathways** for upgrading management approaches as data and resources become available
- **Ensure transparency** in management decisions regardless of the analytical approach employed

Decision Pathway for Management Procedures

Step 1: Fishery selection

- Determine the fishery to which the management procedure will apply

Step 2: Information Assessment

- Determine whether the information base is high, medium or low

Step 3: Management Procedure (MP) type selection

General guidance

- For all stocks, the default, preferred option is a quantitative, model-based management procedure. If that is not possible the next best option, simplified empirical management procedures should be considered before considering the qualitative approach. In other words, SIOFA should take a process of elimination approach based on advice from the Scientific Committee on the basis of risk and information available.
- It is likely that the quantitative, model-based management procedure will only be possible for high information or medium information primary stocks. Nevertheless, Table 2 sets out a general aspiration for the types of management procedures that could, either now or into the

future, be in place for primary and secondary stocks.

- Every management procedure, regardless of type, should contain the essential elements identified below in the Management Procedure Elements Matrix (Table 3) in a way that is appropriate to the management procedure’s form and character.

Table 2 -Management Procedure Type Selection

	Information Classification			
	High	Medium	Low	Zero
Primary	Quantitative, model based MP	Quantitative, model based (preferred where possible)	Full MP (preferred where possible)	
Secondary*	Full MP (preferred where possible)	Full MP (preferred where possible)	Full MP (preferred where possible)	No commercial fishing

*Decision based on cost vs value

Management Procedure Elements Matrix

Table 3 Management Procedure Elements Matrix — required, additional, and enhanced elements by tier (Tier 1: full quantitative; Tier 2: simplified empirical; Tier 3: qualitative)

Element	Tier 1 Full, quantitative MP	Tier 2 Simplified, empirical MP	Tier 3 Qualitative MP	Notes
ESSENTIAL ELEMENTS				
Fishery Definition	✓ Required	✓ Required	✓ Required	Basic requirement for all MPs
Management Objectives	✓ Required	✓ Required	✓ Required	Primary: detailed; Secondary: basic sustainability

Reference Points (LRP)	✓ [Default values unless otherwise determined]	✓ [Default values unless otherwise determined]	✓ [Default values unless otherwise determined]	Can use default LRP for secondary stocks
Stock Assessment	<p>✓ Regular schedule, regular intervals as defined in monitoring plan</p> <p>✓ Assessment based on data availability</p>	<p>✓ Regular schedule, regular intervals as defined in monitoring plan</p> <p>✓ Assessment based on data availability</p>	<p>✓ Regular schedule, regular intervals as defined in monitoring plan</p> <p>✓ Assessment based on data availability</p>	<p>Use best assessment method available based on the data availability.</p> <p>Frequency of assessment determined based on scientific advice</p> <p>Forms part of the MP monitoring procedure</p>
Harvest Control Rules	✓ Required	✓ Required	✓ Required (can be qualitative for low data, secondary species)	HCRs appropriate to the fishery
Performance Monitoring	✓ Comprehensive	✓ Based on best available data	✓ Essential indicators	Focus on key indicators for secondary; cost effective approach.
Exceptional circumstances protocol	✓ Required	✓ Required	✓ Required	

Review of the MP	✓ Typically every two cycles of the MP	✓ Typically every two cycles of the MP	✓ Typically every two cycles of the MP	
Reference Points (TRP)	✓ Required	✓ Required	✓ Required	May be across a range of values
ADDITIONAL ELEMENTS				
Simulation testing	✓ Model based MSE Testing	✓ Model based MSE Testing	✓ Expert judgement based MSE testing	
ENHANCED ELEMENTS				
Economic Analysis	◦ Optional	◦ Optional	◦ Not required	Primarily for high-value primary stocks
Ecosystem Indicators	◦ Encouraged	◦ Encouraged	◦ Encouraged	Where relevant and feasible
Climate Considerations	◦ Encouraged	◦ Encouraged	◦ Encouraged	Where relevant and feasible

Legend: ✓ Required ◦ Optional



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Attachment B - Development of a SIOFA Precautionary Approach Framework - Technical Guidelines



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Executive Summary

These Technical Guidelines operationalise SIOFA's Precautionary Approach Framework, translating its three core components — the Information Classification System (Part III), the Three-Zone Stock Status System (Part IV), and Management Procedures (Part V) — into practical workflows and decision protocols.

The fundamental challenge the Guidelines address is how to maintain equivalent conservation risk across a portfolio of stocks ranging from data-rich target species with full integrated assessments to data-poor bycatch species where little beyond species identification is possible. The solution is a tiered system calibrated to information availability: assessment methods, reference points, harvest control rules, and management procedure types are all matched to what the data can support, with precautionary margins that widen as uncertainty increases.

For Part III, the Guidelines provide operational checklists and decision criteria that enable consistent, transparent stock classification — and identify the data gaps preventing upgrade to a higher category.

For Part IV, they detail assessment method selection, zone classification protocols, and reference point frameworks across all four information tiers, with explicit guidance on handling uncertainty in classification decisions.

For Part V, they specify how to develop, test, and operate management procedures, including harvest control rule design, MSE requirements across the three management procedure tiers, performance monitoring, and the exceptional circumstances protocols that ensure procedures remain valid over time. Guidance for stocks not yet managed under a formal management procedure — including minimum requirements and transition pathways — is also provided.

The Guidelines are intended to evolve. Classification criteria, reference point defaults, and evaluation methods will be updated as SIOFA gains implementation experience and as scientific understanding develops. The version history records material changes.

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Version History

Version	Date	Author	Description of Changes
1.0	2026 - MM - DD	Meeting of the Parties	Initial adoption

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1 Introduction

These Technical Guidelines support the operational implementation of the SIOFA Precautionary Approach Framework (the Framework). The Framework establishes three interconnected components: an Information Classification System (Part III), a Three-Zone Stock Status System (Part IV), and

Management Procedures (Part V). These guidelines provide the practical workflows, operational checklists, and decision protocols needed to implement each component.

The document structure mirrors the Framework structure.

- Part III guidance addresses how to classify stocks based on data availability and assessment capability.
- Part IV guidance details methods for evaluating stock status and establishing reference points.
- Part V guidance specifies how to develop, evaluate, and implement management procedures matched to information availability and management objectives, and provides guidance for stocks that are not, or not yet, managed under a management procedure.

Throughout, the guidelines provide tailored approaches scaled to information level, with specific pathways for High, Medium, Low, and Zero Information stocks, and zone-specific management responses for stocks in Healthy, Under Watch, or Critical condition. This tiered structure ensures the Framework can be applied across the breadth of SIOFA's diverse fisheries, from well-assessed populations to data-limited stocks. These Guidelines reflect, and take account of, technical advice provided to the Scientific Committee⁹.

2 Relationship between these Technical Guidelines, the Framework the Agreement and CMMs

These Technical Guidelines support the operational implementation of the Framework.

They are intended to implement the non-binding framework, which supports the Meeting of the Parties (MOP) in carrying out its functions under the Agreement. The Guidelines provide important contextual information to assist implementation of the Framework and are expected to continually evolve as any new data, analyses and insights become available.

3 Developing State Contracting Parties

Article 13.4 of the SIOFA Agreement requires that cooperation with developing State CCPs include assistance directed specifically towards stock assessment and scientific research, data collection and management, and participation in SIOFA meetings and processes. These Guidelines support that obligation in two practical ways.

⁹ Notably Butterworth et al (2021) and Mormede and Hoyle (2025)

First, these Guidelines are written to be self-contained and explanatory. The technical detail they provide — including rationale, decision criteria, and pre-worked scenarios — is intended to make the scientific basis for management procedures understandable to all participants, including those building their engagement with fisheries science. This is deliberate: technical guidelines that are legible only to established scientific programmes create barriers to meaningful participation and, in doing so, work against the purposes of Article 13.4.

Second, the operational guidance in Parts III, IV and V explicitly provides for stocks at all information levels, including low and zero information stocks. Many fisheries being actively developed by developing State CCPs fall into these categories, and the provisions made for them — including default reference points, qualitative management procedures, and precautionary interim measures — are designed to ensure that these fisheries receive appropriate management attention rather than being deferred until richer data become available. Where these provisions are being applied to a fishery, the relevant CCPs should be actively engaged in the classification and management procedure development processes, since knowledge of the fishery's local context and operational realities is often critical to their sound application. This is especially important for low and zero information stocks, where formal scientific data is limited and practitioner knowledge — including from developing State CCPs — may represent the most substantive available information.

These Guidelines should be read in conjunction with any capacity development and technical assistance programme that SIOFA establishes pursuant to Article 13.4, and their implementation should be considered in that broader context.

4 Guidance to Implement Part III- Information Classification System

4.1 Purpose and Application of the Information Classification System

The Information Classification System categorises stocks into four information categories — High, Medium, Low, and Zero — based on the quality, quantity, and breadth of available data. Classification drives the entire downstream framework: it determines which assessment methods are appropriate, guides selection of management procedures, and calibrates the precautionary margins applied to reference points.

A critical distinction underlies the classification process: what data exist is not the same as what those data can support analytically. A stock may have extensive catch records but lack an abundance index, making surplus production modelling infeasible despite reasonable data breadth. Classification describes the information available; assessment capability describes what can be done with it. The two are related — High Information stocks will generally support integrated assessments; Zero Information stocks will not support any formal assessment — but they are not identical, and classification decisions should not be driven by backward-reasoning from a desired assessment method.

The Operational Checklist in [Annex 1](#) translates these category definitions into practical criteria. The checklist is a guidance tool, not a rigid threshold system; expert judgement is essential, particularly for borderline cases. The precautionary default is to classify lower when genuinely uncertain — this has the added benefit of creating a clear incentive to improve data collection.

Classification should be revisited regularly — typically every 3–5 years, at every formal stock assessment, or when significant new data become available. Stocks may move both up and down the information classification system.

4.2 Information Classification

4.2.1 Classification Process

The information classification process is as follows:

Step 1: Review the Operational Checklist

Review [Annex 1](#). Where values are expressed algebraically, the Scientific Committee should determine the stock-specific thresholds that constitute high, medium, low, or zero information benchmarks for the species under consideration.

Step 2: Compile Available Information

Gather all available data across the relevant domains: fishery data (catch, effort, abundance indices), stock-specific knowledge (stock structure, productivity, life history, fleet composition), biological sampling, and ecosystem and environmental context, drawing on Secretariat records. Suitable indicators should also be established to support review and analysis of this information for classification.

Step 3: Classify Using the Checklist

Working from High to Zero, assess the stock against each information category in sequence and assign the highest category whose criteria are met across all domains. Note that all four stock-specific elements (stock structure, productivity, life history, fleet composition) must be addressed for any classification above Zero — a stock lacking information on any one of them classifies as Zero regardless of data richness elsewhere.

Step 4: Document the Decision

Record which criteria were met and not met in each domain, the rationale for any borderline decisions, identified data gaps, and any planned improvements to data collection. Stock and ecosystem indicators

and any trends in spatial CPUE should also be documented (such as relevant and available environmental statistics, growth rates, recruitment metrics, smaller spatial scale trends in CPUE etc).

4.3 Key Principles for Borderline Cases

Classification may not always be straightforward. In these situations, the following principles may guide the process.

Before considering any other principle, the four stock-specific elements in Annex I— stock structure, stock productivity, life history, and fleet characteristics — should be considered as essential. A stock lacking information on any one of them should classify a stock as Zero Information regardless of how rich the data are in other areas.

For stocks where the four elements are present, the distinction between High, Medium, and Low turns primarily on the quality and source of stock-specific knowledge rather than data volume. High Information requires knowledge verified through direct study — genetics, tagging, stock-specific sampling — with quantitative parameter estimates. Medium relies on reasonably well-understood characteristics supported by regional or literature-based parameters with documented justification. Low is characterised by broad inferences, basic assumptions, and family-level characteristics where stock-specific data are sparse.

Breadth matters as much as quality. High Information requires comprehensive coverage across fishery, biological, and ecosystem domains — exceptional data in one area should not compensate for gaps elsewhere. A stock lacking ecosystem or environmental context should be classified as Medium, not High. Similarly, Medium Information should require at minimum a working understanding of habitat requirements, depth range, and trophic position; stocks without even this basic ecosystem knowledge are better placed in Low. Note that this assessment concerns what information exists, not whether ecosystem context has been incorporated into the stock assessment — those are separate questions.

When genuinely uncertain, classify lower. This is the precautionary default and has the added benefit of creating clear incentive to improve data collection. Notwithstanding this, high-quality, representative data from a slightly shorter time series may occasionally justify higher classification than poor-quality data spanning a longer period. This should be applied sparingly and the rationale documented.

Finally, assessment feasibility is a useful reality check. High Information stocks will generally be capable of supporting full quantitative assessments; Medium stocks simpler quantitative approaches; Low stocks data-limited methods such as depletion models or PSA; Zero stocks nothing beyond highly precautionary defaults. If the methods implied by a classification are clearly not feasible with the data available, the classification is like to be too high — and vice versa.

4.4 Reclassification and Data Improvement

Information classification is not permanent. Stocks should be reconsidered for reclassification when circumstances change. Stocks may move both up and down the information classification system.

4.4.1 Examples of Reclassification Triggers

- New data collection programs implemented (e.g., observer coverage expanded, dedicated survey initiated)
- Time series extends beyond classification threshold (e.g., Low Information stock reaches [χ] years of systematic data)
- New assessment methods successfully developed or applied
- Stock structure understanding fundamentally changes (e.g., genetics study reveals previously unknown population structure)
- Data quality substantially improves (e.g., transition from aggregated to haul-by-haul reporting)
- Data quality substantially degrades or data collection efforts have failed over time
- Biological sampling program implemented or significantly improved
- Major change in fishery characteristics (e.g., new fleet enters fishery, targeting patterns shift)
- Ecosystem or environmental data become available where previously absent
- Changes in information classification standards.

4.4.2 Facilitating Graduation to Higher Categories

For each stock, the Scientific Committee could identify the most critical data gaps preventing classification in a higher information category. This creates a clear pathway for improvement and helps prioritize data collection investments. Documentation should include:

- Which specific criteria prevent higher classification
- Feasibility of obtaining missing information (e.g., implementing biological sampling program vs. conducting genetics study)
- Timeline for potential improvements
- Resource requirements
- Priority ranking relative to other stocks

This approach ensures that information classification serves not only to categorize current stock status but also to guide strategic improvements in the SIOFA data collection program.

5 Guidance to Implement Part IV - Three-Zone Stock Status System

This section operationalizes the Three-Zone Stock Status System, providing the technical protocols for categorizing fish stocks into Healthy, Under Watch, or Critical zones based on their biological status. It establishes a systematic framework for selecting assessment methods, ranging from integrated analytical models for high-information stocks to data-limited indicators for low-information populations, ensuring that stock status can be evaluated across the full spectrum of data availability. Central to this

system is the application of tiered reference points (Limit, Trigger, and Target), which serve as the essential benchmarks for measuring management success and determining the appropriate scale of intervention. By integrating assessment results with these predefined reference levels, the framework provides a transparent, science-based trigger for management actions designed to maintain stock sustainability and initiate recovery where necessary.

5.1 Stock Status Assessment Methods

5.1.1 Assessment Method Selection

Stock status assessment methods will be driven by a stock's Information Classification (as classified in Part III of the Framework). Stock assessments and status evaluations should aim to explicitly account for all known non-fishing related sources of mortality that cannot be managed or constrained by SIOFA, such as natural predation shifts or environmental mortality events.

The relationship between classification and assessment capability is generally as follows.

The below information is summarized from PAM02 and PAM 03 and may need revision, depending on the SC's consideration of those outputs. It could be useful to add an assessment method selection operational checklist into these guidelines if the advice in those outputs is accepted

5.1.1.1 High Information Stocks

High information stocks support analytical assessments that estimate absolute abundance, fishing mortality rates, and biological reference points with quantified uncertainty. Integrated analysis methods are the preferred approach for high information stocks.

Integrated assessments incorporate multiple data types (catch, CPUE, length compositions, age compositions) using maximum likelihood or Bayesian methods. They provide estimates of initial biomass (B_0), current biomass, fishing mortality, and recruitment dynamics.

While model-based assessments can synthesize diverse data streams into integrated biomass estimates, these models depend on numerous structural assumptions, parameter estimates, and data inputs where errors can accumulate. Thorough model validation is essential and should include:

- Standardized diagnostic procedures (residual patterns, retrospective analysis, sensitivity tests)
- Evaluation of model fit to all data sources
- Assessment of assumption validity
- Quantification of uncertainty through appropriate methods
- Peer review of assessment methodology

5.1.1.2 *Medium Information Stocks*

Medium information stocks support simpler quantitative assessments that provide stock trend information and relative abundance estimates, often with reference point proxies.

Surplus production models require a time series of catch data, an index of abundance (typically CPUE or survey-based), and life history parameters to inform prior distributions. These models can provide MSY-based or depletion-based reference points and are best applied using Bayesian methods.

Index-based approaches require a time series of catch and effort data, appropriate metadata on fishing strategy, and ideally consistent vessel coverage across the time series. Where reliable catch data are unavailable, CPUE alone can be used to estimate population trends, with reference points designated relative to historical index values. These approaches are unsuitable where CPUE is not proportional to abundance, such as in species prone to hyperstability or serial depletion.

Length-based methods require length frequency data from one or more years and a set of life history parameters — typically asymptotic length, growth rate, natural mortality, and length at maturity. Direct estimates of life history parameters are often unavailable in data-limited situations, but values from meta-analyses or empirical relationships are increasingly accessible and acceptable. Several methods exist within this family (including LB-SPR, LBB, LIME, and LBPA), each with slightly different data requirements and assumptions; selection should be guided by what data are available and whether equilibrium assumptions are justified for the stock in question.

5.1.1.3 *Low Information Stocks*

Low information stocks require data-limited methods that provide broad indicators of stock status with substantial uncertainty.

Catch-only methods require a full time series of catch or landings data. However, simulation testing and practical experience indicate these approaches generally perform poorly at determining stock status, as catch history alone contains limited information about stock condition. Ensembles of multiple methods have shown better performance than individual approaches, but use of catch-only methods is not recommended where alternatives exist.

Productivity-Susceptibility Analysis (PSA) requires basic life history information (growth rate, age at maturity, fecundity, natural mortality) and fishery interaction data (gear selectivity, spatial overlap with fishing effort, post-capture mortality). PSA is relatively straightforward to apply and useful for ranking species by relative risk, but results are semi-quantitative and most meaningful as a comparative tool across species within the same fishery. It is not amenable to use with quantitative reference points, and has been found prone to misclassification relative to more quantitative approaches in the SIOFA context.

SAFE (Sustainability Assessment for Fishing Effects) requires life history parameters and species and effort distribution data at sufficient spatial resolution. It provides a more quantitative estimate of fishing

impact relative to sustainability benchmarks derived from life history traits, including proxies for F_{MSY} and F_{crash} . The spatial data requirement can be a practical limitation in the SIOFA context.

5.1.1.4 Zero Information Stocks

Stocks with virtually no fishery-specific information beyond species identification and incomplete, aggregated, or sporadic catch records do not support formal stock assessment. For these stocks, no quantitative assessment is feasible and management relies on highly precautionary default approaches.

5.1.2 F-Based Assessment Approaches

For many SIOFA stocks — particularly data-limited teleosts and chondrichthyans — robust biomass estimation is not feasible. Where biomass cannot be reliably estimated, risk-based assessments that evaluate sustainability in terms of fishing mortality provide the primary means of evaluating stock status.

The Framework accommodates both assessment paradigms. Biomass-based assessments define the three-zone system and provide the most direct stock status evaluation when data permit. F-based assessments — including per-recruit analysis, PSA, and SAFE — inform catch limits and sustainability evaluation when biomass cannot be estimated with useful precision. Both approaches are valid; the appropriate choice is determined by what the data can support.

Where F-based methods are applied, precaution is maintained through conservative F reference points calibrated to stock productivity, default Under Watch Zone classification unless abundance data confirm Healthy status, and explicit transition pathways to biomass-based assessment as data accumulate. F-based assessments, though valuable, cannot substitute for biomass-based evaluation when assessing recovery or confirming that a stock has reached the Healthy Zone.

5.1.3 Multiple Indicators Approach

Even for high information stocks with robust stock assessments, relying solely on a single biomass estimate may not capture the full state of the fishery. Stock status determination should be informed by a range of complementary indicators including:

- Abundance indices from multiple sources (fishery-dependent and independent)
- Population structure indicators (size/age composition, sex ratios)
- Biological condition indicators (growth rates, maturity schedules, recruitment success)
- Spatial patterns in catch rates and stock distribution

This multi-indicator approach provides redundancy, early warning of changes not yet reflected in assessment models, and verification that model outputs align with observed fishery patterns.

5.1.4 Assessment Frequency

Assessment frequency should be determined based on:

- Stock information classification (higher information stocks assessed more frequently)
- Stock status zone (Critical Zone stocks require more frequent assessment)
- Rate of stock change (fast-growing species require more frequent updates)
- Fishery development phase (new/exploratory fisheries require frequent initial assessments)
- Resource constraints (balanced against biological risk)

The Scientific Committee should recommend assessment schedules for each stock, with formal reviews at minimum every six years.

5.1.5 Uncertainty Characterisation

All assessments must explicitly characterise and report uncertainty:

- **High information stocks:** Probabilistic statements about stock status relative to reference points, confidence intervals around biomass and F estimates, likelihood profiles
- **Medium information stocks:** Sensitivity analyses across plausible parameter ranges, scenario testing with alternative model structures
- **Low information stocks:** Ranges of plausible stock status, explicit statement of assumptions and their influence on conclusions
- **Zero information stocks:** Qualitative description of uncertainty and potential risks

Assessment reports should clearly communicate the basis for stock status determinations and the reliability of those determinations to decision-makers.

5.2 Reference Points

5.2.1 Setting Reference Points: The Information-Risk Relationship

Reference point values depend on the quality and quantity of information available for each stock. This relationship embodies the risk equivalency principle set out in the Conceptual Framework.

High Information Stocks can support reference points that are:

- Set closer to theoretical optimal levels due to greater confidence in assessments
- Based on detailed population models that account for stock-recruit relationships, environmental variability, and fishing impacts
- Adjusted more precisely as new information becomes available

Medium Information Stocks require reference points that are:

- Set more conservatively with larger buffers between target and limit points
- Based on empirical relationships and indicators rather than detailed population models
- Applied with greater precautionary margins to account for assessment uncertainty

Low Information Stocks necessitate reference points that are:

- Set with substantial precautionary buffers to account for high uncertainty
- Based on life history characteristics, productivity proxies, and comparative analysis with similar species
- Applied with maximum precautionary margins due to limited ability to detect population changes

5.3 Limit Reference Points

This section establishes the principles and technical considerations for determining Limit Reference Points (LRPs) for SIOFA stocks. It serves dual purposes: ensuring all stocks under the framework are captured whilst allowing stock-specific approaches where appropriate.

5.3.1 What is a Limit Reference Point?

Limit Reference Points are based on the biology of a species and represent a level at which the risk to the stock becomes unacceptably high (Sainsbury, K 2008). Under the precautionary approach framework, LRPs identify the boundaries of undesirable states that should be avoided with high probability, such as the minimum biomass level below which stocks are considered to be in a biologically unsafe condition.

5.3.2 Ecosystem Role

Where species interactions and ecological sustainability are essential elements in fisheries management, a lower end fishing mortality benchmark such as F_{MSY} should be considered as a Limit Reference Points, for example, for keystone predator or prey species.

5.3.3 Setting Limit Reference Points

The consultants note that the technical component of this section is drawn from PAM02 outputs and may need to be updated depending on the SC's response to that advice

The framework recognises that appropriate reference point types depend on the assessment method that can be applied to each stock, not simply on data availability.

The hierarchical framework (below, [Table 3](#)) provides LRP types based on the following assessment categories:

- **Integrated assessments:** Use biomass-based or F-based LRPs depending on stock-recruit relationship certainty
- **Surplus production models:** Use percentage of unfished biomass or target fishing mortality
- **Productivity-based:** Use percentage of target fishing mortality

- **CPUE index only:** Use percentage of historical CPUE from reference period
- **Length-based methods:** Use percentage of $F_{SPR-MSY}$
- **Catch-only:** Use upper and lower bounds on historical catch
- Both biomass-based and fishing mortality-based LRPs are valid alternatives depending on the assessment type applied. The framework does not establish a hierarchy between these approaches, rather, the appropriate metric is determined by assessment capability.

5.3.3.1 Default Proxy Values

Where information to support selection of a stock-specific LRP is not available, the following default reference point proxy values provide a scientifically defensible starting point:

Table 1 Default Reference Point proxy values

Reference Point Type	Potential Value
Spawning Stock Biomass (SSB)-based	20% of unfished biomass (B_0)
Vulnerable Biomass - based	25% of unfished biomass (B_0)
Fishing Mortality-Based	150% of F_{MSY} or $F(TRP)$
Low Information Stocks	F_{lim} or F_{crash} (interim, based on life history)

Note: These defaults should be considered interim starting points. Stock-specific evaluations should be conducted to determine whether adjustments are warranted based on species biology and ecosystem role.

5.3.3.2 Species-Specific Adjustments

LRPs can and should be set higher than proxy values where circumstances warrant. Considerations include:

- **Low productivity stocks:** Species with slow growth, late maturity, or low fecundity may require more conservative LRPs to account for reduced resilience to fishing pressure.
- **Ecosystem role:** Stocks serving as key forage species or fulfilling critical ecosystem functions may require more conservative LRPs to maintain ecosystem stability and food web dynamics.
- **High uncertainty:** Where scientific uncertainty is high or stocks show high variability, more conservative reference points may be appropriate to ensure adequate protection.

5.3.3.3 Low Information Stock Approaches

For low information stocks where determining an appropriate biomass-based LRP is difficult or impossible, alternative approaches maintain the intent of the LRP whilst acknowledging data constraints:

- **Risk-based reference points:** Use $F(LRP)$ or F_{crash} calculated from life history parameters as interim LRPs until more reliable indicators can be generated.
- **Historical reference periods:** Use CPUE or biomass from time periods when the stock was in an undesirable state (but subsequently recovered) to define levels that should be avoided.
- **Catch-based bounds:** For catch-only situations, set upper and lower bounds on historical catch (e.g., 1.5× and 0.5× historical reference period catch) as precautionary limits.
- **Proxy indicators:** Use alternative metrics such as size composition data, length-based indicators, or other fishery-dependent indicators that correlate with stock status.

5.3.3.4 LRP Risk Management

All stocks must be maintained above their LRPs with high probability. The management system must ensure the risk of breaching LRPs remains acceptably low.

Stocks should remain above their LRP at least 90% of the time. This translates to a maximum acceptable probability of 10% that the stock will fall below the LRP over the defined management period. The 90% probability forms a key performance criterion when evaluating candidate management procedures through MSE.

5.3.3.5 Supporting Information

See [Annex 2](#) for detailed technical specifications for setting limit reference points:

- **Table 11:** Comprehensive list of potential LRP types organised by information class, with guidance on selection criteria and appropriate contexts for use.
- **Table 12:** Hierarchical framework defining Reference Points based on assessment method, with default percentage values for stocks where x% or y% values are used.

Together, these resources provide a complete technical basis for establishing scientifically defensible limit reference points across SIOFA's diverse portfolio of stocks.

5.4 Trigger Reference Points

5.4.1 What are Trigger Reference Points?

The fundamental purpose of trigger points is to:

- Ensure the fishery remains close to its target state
- Prevent stocks from approaching or breaching limit reference points
- Initiate management responses before drastic action becomes necessary
- Reduce management shocks to fisheries by allowing more orderly adjustments.

5.4.2 Setting Trigger Levels

Trigger reference points should be established at levels between the target reference point and the limit reference point. The specific level depends on the management objectives, variability in the stock status and the degree of precaution desired. Stocks with large fluctuations may have a trigger set further from the target reference point to avoid unnecessary total allowable catch (TAC) changes. Trigger points should be set sufficiently far from limits to ensure there is a low probability that limits will be exceeded.

Common approaches include:

- Fixed proportion of target biomass (e.g., a threshold at $(1-M)B_{MSY}$, where M is natural mortality, as recommended by Restrepo et al. 1998)
- Percentage of unfished biomass (e.g., $\frac{1}{2}B_{MSY}$, commonly used in the United States as a "soft limit")
- Specific CPUE levels or other proxy indicators for data-limited stocks
- Catch levels for byproduct or low/no data species

5.4.3 Types of Trigger Reference Points

Biomass-Based Triggers

Most commonly used for high information stocks where biomass can be estimated relative to reference points such as B_{MSY} . These triggers identify when stock biomass has declined to a specified level, prompting changes in exploitation rate.

Catch-Based Triggers

Used particularly for byproduct or data-limited species. When catches exceed the trigger level, this initiates additional management actions such as increased data collection, formal stock assessment, or catch reductions.

Zone-Based Triggers

Triggers mark the boundaries between stock status zones with different management responses associated with each zone.

5.4.4 Management Responses

When a trigger point is breached, pre-agreed management actions are implemented. These actions should be:

- Consistent with biological, economic or social objectives.

- Specified in advance as part of the management procedure
- Designed to return the stock toward the target level
- Proportionate to the severity of the breach
- Time-constrained where formal rebuilding is required

Graduated Management Response

Pre-agreed management responses are triggered when a stock's status crosses trigger levels. Responses must be specified in advance as part of the management procedure, consistent with biological, economic, and social objectives, and proportionate to the severity of the breach.

A graduated response is generally preferable to a single binary trigger. By implementing progressively more stringent actions as stock status declines, graduated responses reduce the likelihood of needing drastic intervention. Trigger reference points should be placed to provide sufficient warning and response time before the limit reference point is approached, with the distance between trigger and limit reflecting the degree of uncertainty — greater uncertainty warrants more conservative placement.

A typical graduated sequence might look like:

- Stock at or above target → fish at $F(\text{TRP})$
- Stock at 80% of target → reduce F by 10%
- Stock at 60% of target → reduce F by 30%
- Stock at 40% of target → implement a formal, time-constrained rebuilding plan with further catch reductions
- Stock at or below the limit reference point → cease targeted fishing until recovery is demonstrated

While most readily applied to high information stocks with biomass estimates, graduated trigger approaches can be adapted to lower information situations using proxies such as CPUE trends or catch levels as the status indicator.

5.4.5 Examples of Trigger Reference Point Applications

The following are examples of trigger reference points. Each is used in different contexts, relevant to the overall management of fishery.

Table 2(a) Theoretical application to different information classification types

Information Level	Trigger Type	Typical Management Response
High	Biomass-based triggers relative to $B(\text{TRP})$ or other estimated reference points; multiple thresholds can be defined	Graduated adjustment of exploitation rate according to stock status relative to each threshold

Medium	Relative abundance indices (CPUE trends), length composition changes, or proxy reference points	Effort or catch adjustments; enhanced monitoring where trends are ambiguous
Low	Catch-based triggers relative to agreed reference catches	Initiation of data collection programs; application of more precautionary catch fractions
Zero	Triggers based on recent or average catches	Review of catch levels; data collection if resources permit

Table 2(b) Examples of Trigger Reference Points¹⁰

Example	Details
<p>Example 1: Australian Southern and Eastern Scalefish and Shark Fishery</p> <p>Biomass-based trigger with graded response:</p>	<p>Above trigger point: Constant exploitation rate ($F(TRP)$) applied for all biomasses above the trigger (set just below B_{MSY})</p> <p>Trigger breached: Exploitation rate declines linearly as biomass falls</p> <p>At limit (B_{LIM}): Exploitation rate reaches zero (no targeted fishing below the limit)</p> <p>Result: The trigger lies below the target reference biomass (B_{MEY}) but well above the limit reference biomass (B_{20})</p>
<p>Example 2: Western Australian Rock Lobster</p> <p>Trigger points mark boundaries between stock status zones (Reid et al. 2013)(Reid et al. 2010)</p>	<p>Green zone: Stock above threshold, normal fishing operations</p> <p>Amber zone: Stock between threshold and limit, increased management attention</p> <p>Red zone: Stock approaching or at limit, significant management intervention required</p>
<p>Example 3: Great Australian Bight Trawl Fishery</p>	<p>Trigger catch levels set for several byproduct species</p> <p>When catch exceeds the trigger: Initiates increased research program to collect more data</p>

¹⁰ For further reading see Restrepo et al (1998)

<p>This fishery uses catch-based triggers for byproduct species (Harrap et al. 2010)</p>	<p>Objective: Enable quantitative stock assessments in the future Demonstrates: Catch/cost/risk trade-off in practice</p>
<p>Example 5: International Commission for the Conservation of Atlantic Tunas (ICCAT) (Recommendation by ICCAT on the Development of Harvest Control Rules and of Management Strategy Evaluation 2015)</p>	<p>ICCAT uses "thresholds" as management objectives based on biomass levels ($B_{\text{THRESHOLD}}$) that:</p> <ul style="list-style-type: none"> · Reflect the precautionary approach · Trigger pre-agreed management actions to reduce the risk of breaching limits · Are set sufficiently far from limits to ensure low probability of limit exceedance
<p>Example 6: Pacific Halibut (<i>IPHC Harvest Strategy Policy (2025) 2025</i>)</p>	<p>The Pacific halibut harvest strategy includes a threshold-based objective:</p> <ul style="list-style-type: none"> · Maintain female spawning biomass at or above a threshold reference (fixed or dynamic) · Threshold should be achieved at least 50% of the time · Threshold optimizes fishing activities on spatial and temporal scales relevant to the fishery · Subject to constraints on optimizing average coastwide yield and limiting annual changes in mortality limits

5.5 Target Reference Points

5.5.1 What is a Target Reference Point?

A target reference point (TRP) is a management objective based on a desired level of a stock indicator that management should aim to achieve or maintain. Targets define the values of an indicator for a fish stock or fisheries management unit that are desirable or ideal. They typically relate to desired economic and/or social outcomes, such as high catch rates or high long-term average yields.

Targets can be expressed as:

- Biomass level ($B(\text{TRP})$) - the desired stock biomass
- Fishing mortality rate ($F(\text{TRP})$) - the desired exploitation rate
- Catch level - target total allowable catch

- Proxies - such as CPUE levels when biomass cannot be estimated directly

5.5.2 Natural Fluctuations Around Targets

Fish populations fluctuate in size even in the absence of fishing. Even if a management procedure is implemented exactly as designed, biomass will continually fluctuate due to natural variability in recruitment, environmental conditions, and other factors. The target represents the average level around which biomass is expected to fluctuate over time, not a fixed point that must be maintained at all times.

Similarly, fishing mortality may fluctuate around a target fishing mortality, and catch may fluctuate around an average target catch. Management procedures should generally constrain fishing to maintain stocks near or above the target, well within the range of natural fluctuations.

5.5.3 Setting Target Reference Points

5.5.3.1 *MSY-Compatible Reference Points as Minimum Standard*

At minimum, target reference points should be based on MSY-compatible criteria. When stock size is at or near B_{MSY} and fishing mortality is at or near F_{MSY} , the stock produces at least MSY on average over the long term.

However, MSY-compatible reference points are only one input into target setting. Other relevant considerations include:

- Economic factors (pursuing Maximum Economic Yield (MEY))
- Social and cultural considerations
- Ecosystem impacts and multispecies interactions
- Stock-specific biological characteristics
- Type, amount, and quality of available data
- Uncertainty and risk tolerance

These considerations will generally result in targets equal to MSY-compatible reference points or more conservative (higher biomass, lower fishing mortality). Accordingly, MSY-compatible reference points should be regarded as a minimum standard for targets, not necessarily the target itself.

5.5.3.2 *Maximum Economic Yield (MEY) Targets*

A common economic objective is MEY. MEY is typically achieved at biomass levels above B_{MSY} and fishing mortality rates below F_{MSY} . Target reference points for MEY are generally based on harvest rates, biomass targets, or biomass proxies such as CPUE.

When economic data required for establishing MEY targets are not available, proxies can be used. For example, $1.2 \times B_{MSY}$ is a common proxy for MEY. Historical levels of CPUE that occurred during periods of high economic yield have also been used as target reference points.

5.5.3.3 Commonly Used Target Reference Points¹¹

While there is no single target level applicable for all species and stocks, certain targets have emerged as commonly recommended standards:

- 40% B_0 : The most commonly recommended and used single-species biomass target reference point is 40% of unfished biomass (B_0). This provides a substantial buffer above typical limit reference points while allowing reasonable harvest levels.
- $F_{40\%}$: The most commonly recommended and used single-species fishing mortality target reference point is $F_{40\%}$ (the fishing mortality rate that reduces spawning potential ratio to 40% of unfished levels). This is commonly used as a proxy for F_{MSY} when stock-recruitment relationships cannot be reliably estimated.

The targets chosen for individual stocks will vary depending on the biological characteristics of the stock, the management procedure adopted, and the type, amount, and quality of data available.

5.5.3.4 Choosing Between Target Types

As noted above, target reference points can be expressed in multiple ways, as biomass levels, fishing mortality rates, catch levels, or proxies such as CPUE. The choice of target type depends on the information available for the stock and the assessment methods that can be applied.

5.5.3.5 Decision Framework for Target Selection

The following framework guides selection of appropriate target types based on stock information level:

Biomass-Based vs Fishing Mortality-Based Targets

¹¹ Examples of jurisdictions and organizations using 40% B_0 and/or $F_{40\%}$ as target reference points include: **United States** (Pacific Fishery Management Council uses 40% B_0 as default B_{MSY} proxy for most groundfish; Mid-Atlantic Council uses 50% B_0 for ocean quahog; $F_{40\%}$ SPR widely used as F_{MSY} proxy across U.S. fisheries under National Standard 1 Guidelines; **New Zealand** (recommended default B_{MSY} proxies ranging from 30-50% B_0 , with orange roughly specifically managed at 30-50% B_0 using F_{SPR} proxies including $F_{40\%}$); **Australia** (uses $0.4 \times B_0$ [40% B_0] as proxy when B_{MEY} unknown or $1.2 \times B_{MSY}$ as alternative proxy under the Commonwealth Fisheries Harvest Strategy Policy); **SIOFA** (adopted interim TRP of 40% B_0 for orange roughy and alfonsino at MoP10 in 2023); though **CCAMLR** (uses 50% B_0 for toothfish). Globally, 40% B_0 is documented as "the most common" B_{MSY} proxy, with recommended ranges from 30-60% of B_0 depending on species productivity. $F_{40\%}$ was recommended by Mace (1994) as a target fishing mortality when the stock-recruitment relationship is unknown and has been adopted as a reasonable proxy for F_{MSY} internationally based on collective experience and meta-analyses showing values between 40-45% SPR are appropriate defaults for stocks with uncertain productivity as discussed in FAO (1996).

When stocks have sufficient information for quantitative assessment (High or Medium Information), a key decision is whether to use biomass-based or fishing mortality-based targets:

Biomass-based targets (B(TRP)):

- More intuitive for stakeholders and managers
- Directly measure stock abundance
- Easier to communicate conservation outcomes
- Require absolute biomass estimates (High Information) or well-calibrated relative indices (Medium Information)
- Can be directly monitored through surveys or assessment models

Fishing mortality-based targets (F(TRP)):

- More directly related to management control (effort, catch limits)
- Less sensitive to environmental fluctuations that affect biomass
- Often more stable as reference points
- Can be implemented through F-based harvest control rules
- Particularly useful when stock-recruitment relationship is uncertain (use $F_{40\%}$ or similar proxy)

Many management procedures use both types in combination. For example:

- Target: Maintain $B > 0.4 \times B_{MSY}$ while fishing at $F \leq F_{MSY}$ OR
- Maintain CPUE $> 60\%$ of historical high while $F < F_{40\%}$

See [Annex 2](#) for potential target reference points.

5.6 Risk-Based Reference Points for Low-Information Stocks

For stocks with limited data, risk-based reference points provide a precautionary approach based on life history parameters. These reference points include:

- F_{MSM} (Maximum Sustainable Fishing Mortality): The instantaneous fishing mortality rate that corresponds to the maximum number of fish in the population that can be fished in the long term. F_{MSM} is analogous to F_{MSY} for target species but can be calculated from life history parameters without requiring a stock assessment. $F_{MSM} = 0.87M$ for teleost fish (where M = natural mortality).
- F_{LIM} (Limit Fishing Mortality): The fishing mortality corresponding to a limit biomass (B_{LIM}), typically set at half of the biomass that supports maximum sustainable fishing mortality. F_{LIM} is generally calculated as $1.5 \times F_{MSY}$ or $1.5 \times F_{MSM}$.
- F_{CRASH} : The minimum unsustainable fishing mortality that would theoretically lead to population extinction in the long term. While F_{CRASH} provides a biological boundary, it is too high to serve as a useful limit reference point.

These risk-based reference points are particularly valuable for bycatch species and data-poor stocks where traditional assessment methods are not feasible. For stocks using risk-based assessment, the combined limit reference point (cF_{LIM}) derived from multiple estimation methods should be used as an interim LRP.

5.6.1 Climate Change Considerations

5.6.1.1 *Static Framework with Climate Monitoring (Recommended Approach)*

For most SIOFA stocks, particularly low or zero information stocks, static reference points with enhanced climate monitoring are recommended. This approach maintains fixed biological reference points (such as 40% B_0 and 20% B_0) while establishing robust monitoring systems to detect productivity changes.

Variability in ocean conditions, driven by natural cycles, climate change, or other factors, can significantly affect the productivity of stocks. Management procedures should be developed and implemented to be robust to this variability, utilizing monitoring systems to detect productivity changes and adjust management advice accordingly.

- Key advantages:
 - Precautionary management standards are maintained
 - Avoids the “ratcheting down” effect where reference points progressively decline
 - Builds the data foundation necessary for future adaptive strategies
 - Reduces risk of misattributing biomass changes to climate rather than fishing
- Implementation requirements:
 - Regular monitoring of biological parameters (growth, maturity, natural mortality)
 - Environmental data collection to identify potential regime shifts
 - Performance indicators that track deviations from expected stock dynamics
 - Clear protocols for reference point revision when persistent productivity changes are detected. See [‘Performance Indicators for Detecting Changes’](#)

Static reference points can incorporate climate change considerations through

- Breakout rules triggered by environmental changes
- Performance indicators that detect productivity shifts
- Precautionary buffers that account for increasing environmental uncertainty
- Regular review triggers for reference point revision

5.6.1.2 *Dynamic Reference Points (Advanced Approach - High information stocks only)*

Dynamic B_0 approaches (using $B_F=0$, the biomass that would have resulted under current conditions if no fishing had occurred) can account for temporal variability but introduce significant risks.

- Risks to avoid:
 - Ratcheting down effect: Dynamic B_0 can progressively reduce limit reference point levels, potentially lowering conservation thresholds toward zero
 - Attribution uncertainty: Difficulty in correctly identifying whether changes are due to climate, fishing, or other factors
 - Lower stock sizes: May result in accepting lower biomass levels and higher exploitation rates compared to static B_0
 - Stock-specific variation: Implications differ significantly among species, no one-size-fits-all solution
- When to consider (high information stocks only):
 - Strong evidence of persistent environmental regime shift
 - Ability to reliably separate fishing impacts from environmental changes
 - MSE has tested dynamic approaches
 - Consistent treatment between target and limit reference points

5.6.2 Data Requirements and Minimum Information Standards

Each type of reference point has specific minimum data requirements. Understanding these requirements is essential for: Classifying stocks into appropriate information tiers - Identifying data gaps - Planning data collection priorities - Ensuring reference points are technically defensible

5.6.2.1 *Information Requirements by Reference Point Type*

- Biomass-based reference points ($B(\text{TRP})$, $B(\text{LRP})$, or $\% B_0$):
 - Minimum: Time series of catch, abundance index, basic life history (growth, maturity, natural mortality)
 - Preferred: Age or length composition, multiple abundance indices, recruitment index
 - Assessment methods: Integrated stock assessment, surplus production model, or biomass dynamic model
 - Note: The same data support setting both targets (e.g., 40% B_0) and limits (e.g., 20% B_0)
- Fishing mortality-based reference points ($F(\text{TRP})$, $B(\text{LRP})$, or $F_{40\%}$):
 - Minimum: Life history parameters (M , growth parameters, maturity schedule), fishery selectivity
 - Preferred: Age composition, tag-recapture data, multiple fleet selectivity estimates
 - Assessment methods: Per-recruit analysis, integrated assessment, or life-history-based methods
 - Note: The same analysis produces both target (e.g., F_{MSY}) and limit (e.g., $1.5 \times F_{\text{MSY}}$) reference points
- CPUE-based reference points:

- Minimum: Standardized catch and effort data (minimum 5-10 years), stable fleet composition
- Preferred: Environmental covariates if possible, fleet-specific catchability estimates, validation against independent surveys such as scientific surveys or genetic studies (CKMR)
- Critical limitations: CPUE are fishery-dependent abundance indicators also are subject to bias. CPUE is unsuitable for aggregating species (e.g., orange roughy on spawning aggregations), species subject to serial depletion, or stocks with changing catchability
- Note: CPUE can be used to set both target levels (e.g., 60-80% of historical high) and trigger points
- Catch-based reference points (low-information stocks):
 - Minimum: Reliable catch time series (minimum 5 years), basic species identification
 - Preferred: Effort data, length frequency, opportunistic biological sampling, fisher observations
 - Note: Used primarily for setting precautionary catch limits when other reference point types cannot be estimated.

5.6.2.2 Minimum Data Requirements by Information Level

Table 3 Minimum data requirements for establishing reference points by information levels

Information Level	Minimum Required Indicators	Recommended Additional Indicators
High Information	• Biomass estimate• F estimate• Catch• Biological sampling	• Multiple abundance surveys• Recruitment index• Size/age composition• Environmental data
Medium Information	• Standardized CPUE• Catch• Effort• Basic biological data	• Size composition• Multiple CPUE indices• Survey data if available• Recruitment indicators
Low Information	• Catch• Effort (if possible)• CPUE trends	• Size frequency• Opportunistic biological sampling• Fisher observations
Zero Information	• Catch (by species)• Basic effort data	• Any biological data• Species identification verification• Distribution information

5.6.3 Data Collection Priorities

The minimum data requirements outlined above should guide data collection priorities:

1. **For all stocks:** Maintain reliable catch records with species-level identification

2. **For medium-information stocks:** Invest in CPUE standardization and biological sampling programs
3. **For target species:** Develop comprehensive data collection programs including:
 - Age-length sampling
 - Maturity and reproductive biology studies
 - Tagging programs where feasible
 - Independent surveys (acoustic, trawl, or other methods as appropriate)
 - Genetic tissue sampling for population structure
 - Sex-age-CKMR and potential future studies
4. **For low information or zero information stocks:** Focus on establishing basic biological parameters and improving species identification

As data availability improves, stocks can move up the information tiers, allowing for more refined reference points and more effective management.

Data collection plans on a fishery-by-fishery basis may be implemented to support this.

5.6.4 Reference Point Updates and Review Process

Reference points should be reviewed and potentially updated when:

- New stock assessment completed: Major assessment with updated biological parameters or stock status estimates
- Significant new biological information: Validated changes to growth, maturity, natural mortality, or stock structure
- Persistent deviations from expectations: Performance indicators show sustained differences between observed and expected stock dynamics
- Environmental regime shifts: Documented persistent changes in ocean conditions affecting stock productivity
- Management procedure performance review: Scheduled reviews (typically every 3-5 years) of overall management procedure effectiveness
- Management objective changes: MoP adopts new or modified management objectives requiring reference point adjustment.

5.6.5 Tiered Framework for Reference Points

This tiered framework links the appropriate type of limit and target reference points to the assessment method that can be applied based on data availability. This hierarchical approach ensures that reference points are matched to the information available for each stock:

Table 4 Reference point bases by assessment type

Assessment Type	Target Reference Point (TRP)	Limit Reference Point (LRP)
-----------------	------------------------------	-----------------------------

Full Bayesian (h well-determined)	B_{MSY}, F_{MSY}	x% B_0 , y% F_{MSY}
Full (h not well-determined)	x% B_0 , F(TRP)	y% B_0 , z% F(TRP)
Surplus production	x% B_0 , F(TRP)	y% B_0 , z% F(TRP)
Productivity and constant F	F(TRP)	z% F(TRP)
CPUE index only	$CPUE_{t1-t2}$	x% $CPUE_{t1-t2}$
LB-SPR	F_{SPR_MSY}	z% F_{SPR_MSY}
LIME	F(TRP)	z% F(TRP)
SAFE/EASI-FISH/SEFRA	F_{MSM}	y% F_{MSM}
Catch only	$Catch_{t1-t2}$	1.5 $Catch_{t1-t2}$ & 0.5 $Catch_{t1-t2}$

Note: For percentage-based reference points, default values are: x=40% for spawning stock biomass TRPs, x=25% for vulnerable biomass TRPs, x=20% for LRPs, y=150%, z=150%. These values may be adjusted based on stock-specific evaluations and management objectives.

This tiered approach recognizes that low or zero information stocks require pragmatic approaches that balance scientific rigour with practical implementation needs. As data collection improves for individual stocks, the appropriate tier and corresponding reference points can be updated.

5.7 Zone Classification Protocol

5.7.1 Overview

The zone classification protocol provides a systematic process for assigning each stock to one of three stock status zones, Healthy, Under Watch, or Critical, based on assessment results relative to established reference points. This classification guides the appropriate management response and triggers specific actions under the Framework.

5.7.2 Classification Process

Step 1: Establish Reference Points

Before classification can occur, appropriate reference points must be established for the stock based on its information classification and assessment method. [See 'Reference Points'](#) for further details.

Step 2: Conduct Stock Assessment

Conduct stock assessment using methods appropriate to the stock's information classification. ([See 'Information Classification System'](#) for further details). The assessment must provide an estimate of current stock status relative to the established reference points.

Step 3: Evaluate Stock Status Against Reference Points

Based on the assessment results, classify the stock by comparing current stock status against the target and limit reference points. Generally speaking:

Classify as Healthy Zone when:

- Stock is at or above the target reference point
- Biomass-based: $B \geq B(\text{TRP})$
- Fishing mortality-based: $F \leq F(\text{TRP})$
- Qualitative: Best available evidence indicates stock at or above desired levels

Classify as Under Watch Zone when:

- Stock is below the target reference point but remains above the limit reference point
- Biomass-based: $B(\text{LRP}) < B < B(\text{TRP})$
- Fishing mortality-based: $F(\text{TRP}) < F < F(\text{LRP})$
- Qualitative: Best available evidence indicates stock between target and limit

Classify as Critical Zone when:

- Stock is below the limit reference point, or high risk of breaching the limit
- Biomass-based: $B \leq B(\text{LRP})$
- Fishing mortality-based: $F \geq F(\text{LRP})$
- Qualitative: Best available evidence indicates biomass is at an unsustainable level or fishing pressure is too high
- Status is unknown and insufficient information exists to conduct any assessment that can be compared against reference points

Step 4: Account for Uncertainty

Assessment uncertainty must be incorporated into classification decisions. When uncertainty is high, apply precautionary classification:

- Consider the lower bound of confidence intervals for biomass estimates when comparing against reference points
- Consider the upper bound of confidence intervals for fishing mortality estimates
- Default to the more precautionary zone when classification is ambiguous

- When multiple indicators are available and they conflict, adopt the more precautionary classification

Example: If biomass estimate suggests Healthy Zone ($B \geq B(\text{TRP})$) but fishing mortality estimate suggests Under Watch Zone ($F > F(\text{TRP})$), classify as Under Watch Zone following the precautionary approach."

Step 5: Document Classification

For each stock classified, the Scientific Committee should document:

- Assessment method used
- Reference points applied (stock-specific or default values)
- Quantitative or qualitative results (point estimates and uncertainty where available)
- Data quality and assessment reliability caveats
- Rationale for classification decision
- How uncertainty was incorporated into the classification
- Any assumptions made and their potential influence

5.7.3 Classification Review and Update

Zone classifications must be reviewed:

- Following each new stock assessment
- When new data substantially change understanding of stock status
- When reference points are revised
- Immediately if exceptional circumstances occur

5.7.4 Special Circumstances

Transboundary Stocks: Classification should be coordinated with adjacent management jurisdictions to ensure compatible management approaches. Where a single stock spans multiple jurisdictions, classification should reflect the overall stock status. Transboundary stocks may require engagement with neighbouring jurisdictions as an early step in the process.

Newly Developing Fisheries: Unless there are sufficient reasons to act otherwise, new or exploratory fisheries should be classified as Under Watch or Critical by default until sufficient data demonstrate the fishery can operate sustainably in the Healthy Zone.

5.7.5 Managing stocks in the Critical Zone

Stocks in the critical zone could be driven by excessive F , biomass below B_{lim} , or both. The Framework requires that rebuilding plans be implemented for any stock below its limit reference point. The Framework also sets out the minimum reporting requirements of any rebuilding plan - performance

against objectives, analysis of any recovery shortfalls and any amendment required to better deliver against established objectives, targets and timeframes.

This section provides technical guidance in developing rebuilding plans.

5.7.6 When is a Rebuilding Plan required?

Rebuilding plans must be implemented for any stocks in the Critical Zone (that is, any stock that is below, or at risk of breaching, its LRP) as a priority. Rebuilding plans may also be necessary for stocks in the Under Watch Zone that are approaching the Critical Zone and at risk of breaching the LRP. In such cases, rebuilding plans aim to prevent further stock depletion. Ultimately, the goal of any rebuilding plan is to return a stock to the Under Watch Zone, and ideally to the Healthy Zone, where fishing can be conducted sustainably.

5.7.7 Components of a Rebuilding Plan

A rebuilding plan should include the following key elements:

- **Rebuilding Target:** This is the desired reference point for the stock, such as a target biomass or a specific stock size. The rebuilding plan should be designed such that there is a high likelihood¹² that the target will be met by the end of the designated period.
- **Timeframe for Rebuilding:** The timeframe specifies the period over which the stock is expected to rebuild to the target level. It should be based on factors like biological characteristics of the species, interdependence with other stocks, environmental conditions, and socioeconomic factors. Further information on rebuilding timeframe is set out below.
- **Management Actions:** specify management actions that will reduce fishing pressure to meet rebuilding objectives with a reasonable level of certainty. This may include fishery closures or scientific data collection measures to promote stock recovery or protect vulnerable concentrations, but should ensure pressure is not simply displaced. These actions should aim to meet rebuilding objectives with a reasonable degree of certainty, taking into account available scientific data, the stock's current status, and any environmental and socio-economic conditions. Incidental mortality on overfished stocks should be constrained as much as possible to levels that allow rebuilding to above the limit reference point within the specified timeframe. Rebuilding plans should evaluate the impact of different gear types to determine whether gear modifications (e.g., bycatch reduction devices) and restrictions to increase selectivity and reduce the mortality of depleted stocks in multi-species fisheries will support rebuilding objectives.
 - Where complete or near-complete cessation of commercial fishing would eliminate the observational capacity needed to monitor recovery, the Scientific Committee may determine a minimum catch level necessary to maintain adequate data flow from the

¹² Higher initial rebuilding probability of 60% or greater generally produce superior outcomes. The minimum standard for a rebuilding plan in New Zealand, for example, is that 70% of the projected trajectories will result in the achievement of a targeted based on MSY-compatible reference points or better within the timeframe of T_{min} to $2 * T_{min}$ (See further Patrick and Cope 2014; Wetzel et al. 2016; Ministry of Fisheries 2011)

fishery. Any such determination must be explicitly documented in the rebuilding plan, must be the minimum necessary for monitoring purposes, and does not alter the rebuilding objective — it should function as a data collection provision, not a relaxation of the rebuilding requirement.

- **Performance criteria** to evaluate the effectiveness of the rebuilding strategy against its objectives, throughout the rebuilding period
- **Key threats to the recovery of the stock** in question and strategies to counter these threats. Where habitat suitability is a limiting factor for recovery, habitat protection or enhancement measures should be considered within the rebuilding process.
- Rebuilding strategies should note where **sources of mortality** exist that cannot be managed or constrained by SIOFA and should take this mortality into account.

There are many factors that can influence rebuilding success. Some of these factors are identified in [Annex 3](#) and should be taken into account in developing a rebuilding plan.

5.7.8 Rebuilding Timeframes

Determining appropriate rebuilding timeframes is one of the most critical and technically challenging aspects of stock rebuilding plan development. The selection of rebuilding timelines should balance biological realities, socioeconomic impacts, and regulatory requirements while providing a scientifically defensible pathway for stock recovery.

Timeframes for rebuilding are generally set relative to the minimum time required to rebuild the stock in the absence of fishing. Rebuilding timeframes should account for the species' biological characteristics, recruitment rates, and level of depletion. For some species, longer timeframes may be necessary due to life history traits that limit growth or when environmental conditions are not conducive to recovery.

The fastest rebuilding timeframe is typically achieved by completely closing the fishery. However, this can impose significant costs on the fishing community and related industries. A balance should be struck between the biological needs of the stock and the socioeconomic impacts of management actions. In some cases, limited fishing under scientific permits, or a minimum catch level determined by the SC to maintain data flow, may be permitted to monitor recovery and ensure that rebuilding strategies remain evidence-based.

5.7.8.1 The TMIN/TMAX Approach

One framework for establishing rebuilding timeframes is the TMIN/TMAX approach. It is based on three key temporal reference points that together define the acceptable range for stock recovery (Patrick and Cope 2014).¹³

¹³ The TMIN/TMAX approach is a U.S. National Standard Guidelines requirement under the Magnuson-Stevens Act. It uses generation time in TMAX calculation: If TMIN < 10 years: TMAX = 10 years; If TMIN > 10 years: TMAX = TMIN + 1 × mean generation time

- TMIN (Minimum Time to Rebuild) represents the minimum time required for a stock to rebuild to target biomass levels in the complete absence of fishing mortality (Patrick & Cope, 2014). This metric provides the biological baseline for the fastest possible recovery under optimal conditions and serves as the lower bound for all rebuilding scenarios.
- TMAX (Maximum Allowable Time) establishes the upper limit for rebuilding timelines. The calculation methodology depends on the TMIN value: e.g. if TMIN is less than 10 years, TMAX is set at 10 years; if TMIN exceeds 10 years, TMAX equals TMIN plus one mean generation time. This approach ensures that rebuilding timelines remain biologically realistic while preventing indefinite delays in recovery.
- TTARGET (Target Rebuilding Time) represents the selected rebuilding timeframe, which should fall between TMIN and TMAX. The selection of TTARGET involves balancing multiple factors including stock biology, fishing community needs, economic considerations, and management feasibility.

5.7.8.2 *Generation Time Calculations*

When precise TMIN calculations are not feasible, generation time estimates provide an alternative foundation for establishing rebuilding timelines. Mean generation time, defined as the time required for a spawning female to be replaced by a spawning female in the subsequent generation, plays a crucial role in timeframe determination.¹⁴

5.7.9 *Performance Monitoring*

Performance monitoring is an essential component of the rebuilding plan. The rebuilding strategy should include performance criteria to regularly assess how well the rebuilding objectives are being met throughout the recovery period. These criteria may include specific biomass targets, catch limits, or recruitment rates that indicate progress toward the rebuilding target.

Key elements of performance monitoring include:

- Tracking Biomass Growth: Monitoring the rebuilding of biomass in relation to the target reference point.
- Evaluating Fishing Mortality: Ensuring that fishing mortality remains at levels low enough to allow stock recovery.
- Environmental and Biological Conditions: Considering the impact of changing environmental factors (such as ocean temperature or food availability) on the stock's recovery.

NZ uses the same TMIN/TMAX approach as the U.S., with the formula $G = t_{mat} + 1/M$ as the calculation method. (See further Pacific Fishery Management Council 2021; Ministry of Fisheries 2011)

¹⁴ Canadian guidelines suggest that reasonable rebuilding timeframes should range between 1.5 to 2 times the generation time for stocks to recover above their limit reference points (Fisheries and Oceans Canada (DFO) 2022)

5.7.10 Review of Rebuilding Strategies

A comprehensive review of the rebuilding strategy should be undertaken when there is no credible evidence that a stock is rebuilding as expected or will achieve recovery within the specified timeframe. These reviews should systematically:

- **Assess performance** - Document and evaluate the effectiveness of current rebuilding measures against established benchmarks and timelines
- **Identify failure mechanisms** - Determine the underlying causes preventing expected recovery, including biological, environmental, or implementation factors
- **Develop corrective actions** - Specify how identified deficiencies will be addressed through revised management measures or modified approaches
- **Evaluate timeframe adequacy** - Determine whether the existing rebuilding timeline remains viable or requires adjustment based on new information
- **Implement revisions** - Following review findings, update and re-implement the rebuilding strategy with necessary modifications to improve recovery prospects

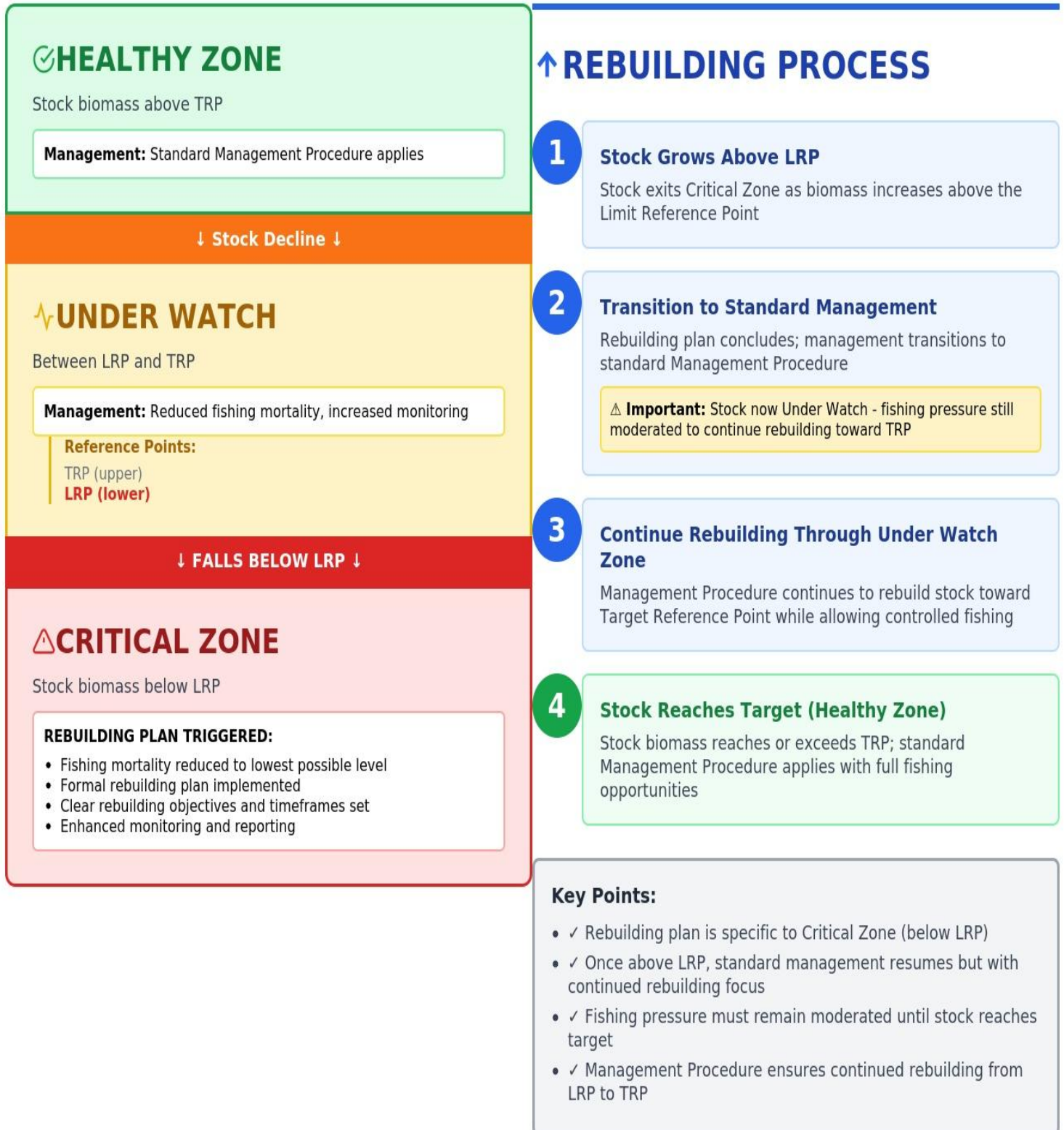
The review process should be transparent, scientifically rigorous, and incorporate stakeholder input to ensure revised strategies maintain both biological credibility and practical feasibility.

5.7.11 When Rebuilding Objectives Are Met

Once a stock has been rebuilt above the LRP, targeted fishing should only resume under a management procedure (or equivalent) that continues to rebuild the stock toward its TRP. At this stage, fishing pressure may still need to be moderated to prevent the stock from falling back into the Critical Zone.

Figure 1 below depicts a stock decline through the three-zone framework and rebuilding pathway back to the Healthy Zone.

Stock Decline and Rebuilding Process



6 Guidance to Implement Part V- Management

Part V of the Conceptual Framework establishes the management approach for SIOFA stocks, including zone-specific management responses for stocks in Healthy, Under Watch, and Critical zones, and management procedures as the primary implementation tool. The Framework requires that management maintains risk equivalency across all stocks regardless of information availability, and provides for alternative approaches where management procedures are not immediately feasible. This section of the Technical Guidelines provides operational guidance for implementing these management requirements, beginning with the process for developing management procedures, the default and preferred approach for all stocks.

A management procedure is a pre-agreed framework for making fisheries management decisions. Developing an effective management procedure requires a structured process that ensures the procedure is scientifically defensible, operationally feasible, and aligned with management objectives.

6.1 Consultation and Cooperation

Effective management procedures are most effective when scientists, managers and stakeholders are engaged from the outset. While final decisions rest with the MoP under Article 8 of the Agreement, meaningful consultation during management procedure development produces more robust, implementable, and durable outcomes.

Pre-assessment workshops can provide value when initiating management procedure development. These collaborative sessions bring together scientists, managers, industry representatives, and other stakeholders before formal assessment begins. Early engagement:

- Builds shared understanding of available data, assessment options, and management constraints
- Ensures decision-makers and stakeholders are engaged throughout the process to ensure performance statistics capture management objectives, and are able to be understood.
- Identifies practical implementation challenges while solutions remain flexible
- Addresses technical and operational concerns collaboratively, reducing later disagreement
- Strengthens stakeholder confidence in the eventual management procedure

Consistent with Article 14 of the Agreement, SIOFA should facilitate stakeholder participation throughout management procedure development and testing. This includes:

- Contributing technical information and data during scoping and design phases
- Reviewing and commenting on candidate management procedures and simulation testing approaches
- Participating in science-manager dialogues on management procedure performance and trade-offs
- Accessing transparent documentation of design rationale, testing results, and evaluation criteria

6.2 Core Elements of Management Procedures: Detailed Implementation Guidance

This section provides the operational requirements for developing and maintaining robust management procedures within the Framework. Management Procedures are a formal integration of data collection, stock assessment, and harvest control rules designed to achieve specific biological and socio-economic outcomes. The fundamental components are specified in the Framework. This section provides guidance to operationalise those core elements.

6.2.1 Species Definition

A management procedure must define the species or fishery to which the management procedure will apply.

SIOFA currently manages the following stocks through eight established fisheries (Annex I of CMM 17(2024)):

Table 5 SIOFA established fisheries as specified in Annex I of CMM 17

Fishery	Area
Patagonian toothfish	Subareas 3b and 7
Orange roughy	Subareas 1, 2, 3a, 3b, 4, 5, and 6.
Alfonsino	1, 2, 3a, 3b, 4, 5, and 6.
Brushtooth lizardfish and scads	Subarea 8 (mainly Saya de Malha Bank).
Shallow-water (<200m) Carangoides spp., snappers, emperors and groupers	Subarea 8 (mainly Saya de Malha Bank).
Deep water (>200m) snappers, lutjanids, hapuka	SIOFA Subareas 2, 3a, 3b, and 4
Oilfish	Southwest Indian Ocean

Squid	SIOFA Subareas 1, 4, 7, and 8
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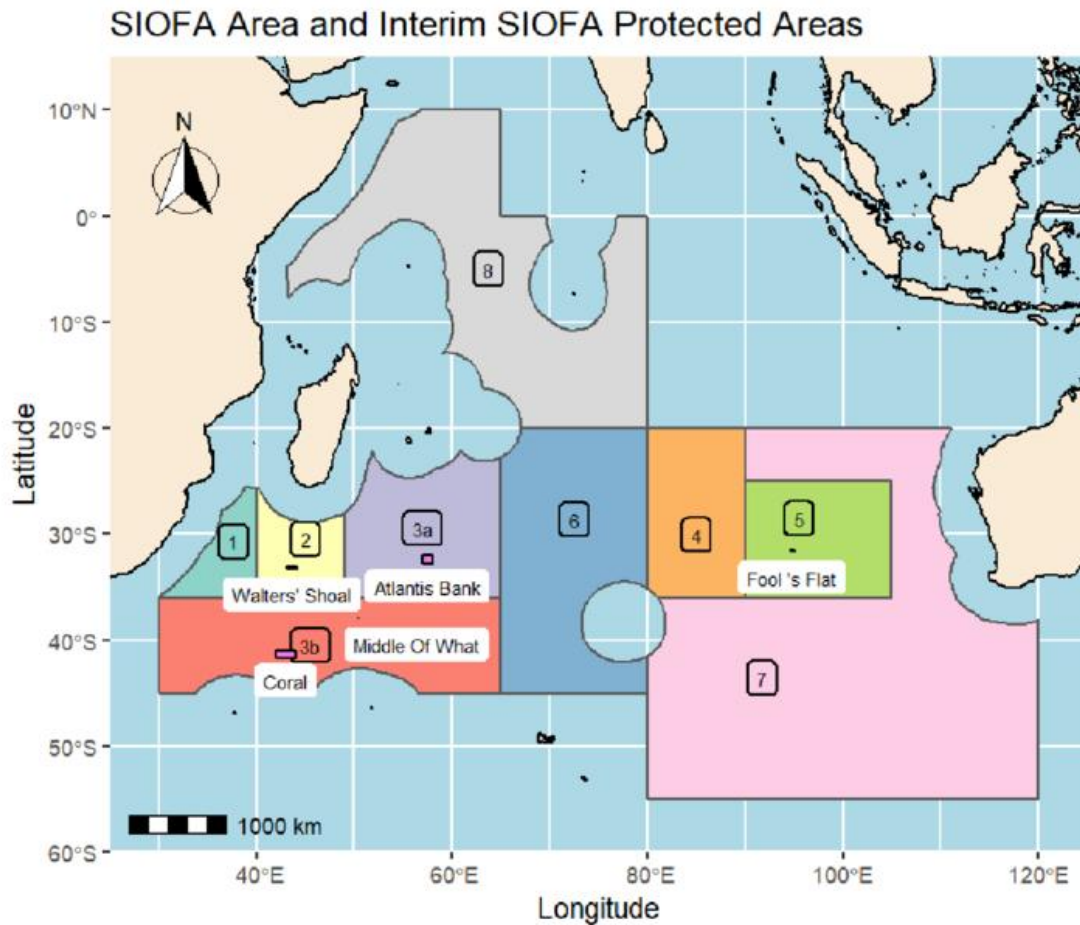


Figure 2 The SIOFA Area and Subareas (source: SIOFA Spatial Database). SIOFA Secretariat (2025).

For fisheries not meeting the criteria for established status, CMM 17(2025) defines new and exploratory fisheries as those involving: (a) bottom fishing outside the SIOFA bottom fishing footprint; (b) bottom fishing within the footprint using gear types or techniques not previously used in that area; (c) gear types not listed in Annex I; (d) fisheries not undertaken in the previous 10 years; or (e) fisheries undertaken in the previous nine years under this CMM where the MoP has not decided to close or manage as an established fishery.

Total fish catches in the SIOFA Area are composed of a wide variety of species. Species classification for management procedure purposes should distinguish:

- Primary and secondary species defined in the Conceptual Framework. These are the species for which management procedures will eventually be developed.

- Bycatch: All fish species not in the list of species identified by the SIOFA Scientific Committee as primary and secondary species

The distinction between target and bycatch species affects data collection requirements, reference point determination, and the scope of the management procedure.

The management procedure should:

- Identify the relevant species to be managed under the management procedure
- Specify SIOFA Subareas (1, 2, 3a, 3b, 4, 5, 6, 7, 8) where the fishery operates
- Identify specific underwater topographic features where applicable
- Determine whether operations occur within or outside established bottom fishing footprints
- Specify gear type(s): set longlines, traps, bottom trawl, midwater trawl, pelagic longline, droplines, hook and line (handlines), light seining, squid jigging, or other methods
- Characterize vessel types and operational patterns
- Document shared stocks with other RFMOs or national jurisdictions
- Identify spatial or temporal interactions with other SIOFA fisheries
- Assess cumulative impacts where multiple fisheries operate in overlapping areas

6.2.2 Defining Management Objectives

Management objectives identify outcomes that managers aim to achieve and provide the criteria for evaluating whether a management procedure is achieving those objectives. These objectives form the foundation of the management procedure development process, as all subsequent decisions, from selecting reference points to designing harvest control rules, flow from clearly articulated objectives.

6.2.2.1 *The Role of Management Objectives in Management Procedure Development*

Management objectives translate high-level policy goals into operational targets that can be quantified, measured, and evaluated through management strategy evaluation (MSE). Within SIOFA's policy framework, Article 4(d) of the Agreement establishes that "fishery resources shall be managed so that they are maintained at levels that are capable of producing MSY, and depleted stocks of fishery resources are rebuilt to the said levels." This mandate provides the overarching direction but requires translation into specific, testable objectives for individual stocks and fisheries.

Clearly defined management objectives directly inform all subsequent elements of management procedure development. The choice of performance indicators and methods for evaluating management procedures influences required scientific data collection and monitoring programs. SIOFA currently mandates haul and set catch and effort data, observer sampling for catch composition, otoliths, sex, length, and maturity through CMM-02 (2023). Otolith ageing, resource surveys (e.g., acoustic surveys), and CPUE analyses are also carried out, though these are not currently mandated in CMMs.

Target, limit, and trigger reference points operationalize the quantitative standards embedded in management objectives. Reference points translate status and safety objectives into specific biomass thresholds that can be monitored and evaluated. Harvest Control Rule (HCR) design balances competing

objectives by specifying how management actions respond to observed or estimated stock status. The relative weighting of yield versus stability objectives is relevant to whether HCRs emphasize rapid response to stock changes or smooth catch trajectories.

Management objectives also influence the schedule for formal assessments. CMM-15 (2023) currently defines orange roughy assessments every 3-5 years, toothfish assessments annually, and alfonsino assessments on a regular basis. These schedules reflect the trade-offs between information needs (status and safety objectives) and resource constraints. Management objectives thus provide the organizing framework for the entire management procedure development process, ensuring coherence across components and grounding technical choices in articulated management priorities.

Finally, the effectiveness of MSE in facilitating achievement of management aims depends on how well objectives are characterized and translated into performance metrics that decision-makers can understand and use (Punt et al. 2016). Poorly specified management objectives are a fundamental challenge to MSE implementation and subsequent management success.

Setting management objectives is an iterative process that evolves as scientific understanding improves, monitoring programs provide better data, economic and social priorities shift, and initial MSE results reveal unanticipated trade-offs or infeasible objective combinations.

6.2.2.2 *Standard Management Objectives in SIOFA*¹⁵

For each stock, either a single management objective or any combination of multiple management objectives can be defined. These need not be consistent across stocks, as MSE allows evaluation of trade-offs between objectives using performance indicators. Furthermore, ecosystem-based and social objectives can be used to achieve broader goals across multiple stocks and fisheries.

Management objectives should generally be set as follows;

Table 6 Potential Management Objectives

Objective Type	Potential Management Objective
Stock Status	Maintain the stock at, or fluctuating around (i.e., as likely as not) the TRP
Risk-Safety	Ensure that it is very likely that the stock is above the limit reference point (LRP)

¹⁵ WS2023-HSMO workshop (2023) convened to develop preliminary objectives for orange roughy and toothfish while identifying broader objectives related to bycatch and ecosystem considerations. Report of SC9 (Annexes H and I) specify management objectives for orange roughy and toothfish.

Economic, Yield	Maximise / Maintain catch at a level consistent with status and risk-safety objectives
Economic, Catch rate	Maintain CPUE at a given rate/level that is representative of a period of fishery stability
Spatial Distribution	Maintain finer spatial scale CPUE trends within agreed range
Economic, Stability	Minimise the variability of the catch limits from year to year that should be within a specific range
Social Goals	<ul style="list-style-type: none"> ● Maintain/create employment opportunities and contribute to food production ● Ensure safe and fair employment practices on vessels operating in these fisheries
Ecosystems goals	Maintain a healthy ecosystem
Performance of the management system itself	Maintain x% of established indicators within an acceptable range

6.2.3 Harvest Control Rules

HCRs are pre-agreed decision algorithms that determine management actions based on stock status indicators. HCRs must be specified before stock status is known (preventing post-hoc rationalisation), responsive to stock status changes, precautionary under uncertainty, and tested for robustness through simulation testing. They are dynamic in both directions - both in reducing and increased F.

6.2.3.1 HCR Design Principles

Essential Characteristics:

- Pre-agreed: Specified before stock status known, preventing post-hoc rationalisation
- Responsive: Adjusts fishing pressure appropriately to stock status changes
- Precautionary: More precautionary under uncertainty or when approaching limits
- Stable: Avoids excessive inter-annual catch variation where possible
- Understandable: Transparent operation stakeholders can comprehend
- Practical: Leads to management actions that can be implemented and monitored

6.2.3.2 Zone-Appropriate Response

HCRs should incorporate different management responses depending on which zone the stock occupies. For example:

Table 7 Zone - appropriate HCRs

Healthy	Under Watch	Critical
<p>Fishing mortality at or near target level (F(TRP))</p> <p>Tolerate normal stock fluctuations</p> <p>Management actions need not react to minor variations around target</p> <p>Risk tolerance for preventable decline: High (if well above target) to Moderate (if approaching Under Watch boundary)</p>	<p>Fishing mortality progressively decreases as stock declines towards limit</p> <p>Response calibrated to both position in zone and trajectory:</p> <ul style="list-style-type: none"> ● Increasing trajectory (moving towards Healthy): Promote stock growth, moderate restrictions ● Stable trajectory: Encourage growth through modest precaution ● Decreasing trajectory: Arrest decline immediately if low in zone; very low risk tolerance <p>Balance conservation and socio-economic considerations based on location and trajectory</p>	<p>In the Critical Zone, removals from all fishing sources must be kept to the lowest possible level to ensure no tolerance for preventable decline, prioritizing the protection of spawning stock biomass (SSB) to generate new recruits</p> <p>Conservation considerations prevail</p> <p>May require prohibition of commercial targeting (scientific/bycatch only)</p> <p>Rebuilding plan mandatory if below LRP</p> <p>Management actions should be consistent with stock recovery</p> <p>Zero tolerance for preventable decline</p>

6.2.3.3 Common HCR Structures

The consultants note that the below advice is drawn from PAM02 and PAM 03. It was integrated for completeness but is subject to changed based on the SC's response to the advice and generally whether the SC wants to have the range of technical advice and options in these Guidelines, or have them elsewhere with references in this document as appropriate.

6.2.3.4 Hockey Stick HCR (Threshold Rule)

Maintains fishing mortality at constant level when stock above threshold, with linear reduction below threshold:

If $B \geq B_{\text{THRESHOLD}}$:

$$F = F(\text{TRP})$$

If $B(\text{LRP}) < B < B_{\text{THRESHOLD}}$:

$$F = F(\text{TRP}) \times (B - B(\text{LRP})) / (B_{\text{THRESHOLD}} - B(\text{LRP}))$$

If $B \leq B(\text{LRP})$:

$$F = 0 \text{ (fishery closure)}$$

Characteristics:

- Predictable catch variability based on stock size
- Clear conservation threshold
- Requires reliable biomass estimates
- The buffer zone ($B_{\text{THRESHOLD}} < B_{\text{MSY}}$ in many cases) accounts for natural fluctuations and prevents oscillations around target

SIOFA application: MSE testing on orange roughy stocks demonstrated that hockey stick HCRs were the most appropriate for stocks with full Bayesian stock assessments and for stocks where acoustic estimates of biomass were available. These rules proved relatively robust to model misspecification provided misspecified parameters could be adequately modelled. A more precautionary variant (Rule 1) provided more robust results for depleted stocks than a modified version allowing higher exploitation at lower stock status (Rule 2).

6.2.3.5 *Constant Fishing Mortality (F) HCR*

Maintains fishing mortality at constant level regardless of stock status (though may include closure threshold):

If $B > B_{\text{CLOSURE_THRESHOLD}}$:

$$F = F(\text{TRP})$$

Characteristics:

- Simplest F-based approach
- Catch varies directly with biomass

SIOFA application: MSE testing found that constant fishing pressure rules performed poorly with regards to targets, particularly for depleted stocks. Constant exploitation rate rules are not currently accepted within the Marine Stewardship Council framework. This HCR structure is not recommended for SIOFA stocks.

6.2.3.6 Empirical CPUE-Based HCR

Adjusts catch based on CPUE trends relative to reference period:

If $CPUE_{current} \geq CPUE_{target}$:

$$TAC_{next} = TAC_{current} \times [1 + \alpha] \text{ (increase allowed)}$$

If $CPUE_{limit} < CPUE_{current} < CPUE_{target}$:

$$TAC_{next} = TAC_{current} \times (CPUE_{current}/CPUE_{target})^{\beta}$$

If $CPUE_{current} \leq CPUE_{limit}$:

$$TAC_{next} = TAC_{current} \times \max_{reduction} \text{ (substantial cut)}$$

Where:

- α = maximum allowed annual increase (e.g., 0.05 for 5%)
- β = responsiveness parameter (typically 0.5-2.0)
- $\max_reduction$ typically 0.2-0.5 (20-50% cut)

Characteristics:

- Suitable for medium-information stocks
- Does not require absolute biomass estimates
- Requires reliable CPUE-abundance relationship
- Vulnerable to hyperstability issues

SIOFA application: MSE testing on alfonso indicated that CPUE-based HCR could be adequate but required the TAC at the CPUE reference (the plateau) to be set correctly, this effectively functions as F(TRP). If not set appropriately, stock status stabilised at levels differing from target. More variable CPUE indices led to more variable TAC, requiring addition of maximum TAC change constraints. A more precautionary variant (Rule 5) performed better than a less precautionary version (Rule 6). Critical limitation: CPUE-based management requires catch rates to be proportional to stock biomass. This proportionality assumption may be compromised in fisheries with limited fleet diversity or where operations target local aggregations. For orange roughy, CPUE is not deemed a reliable abundance index because the fishery operates on spawning aggregations and search effort is not adequately represented. Feature-based CPUE should be monitored for fisheries that target feature-based spawning aggregations.

6.2.3.7 CCAMLR Ramp Rule

Combines constant F(TRP) modulated by CPUE trend, used by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) for research blocks:

Biomass estimate trend evaluation:

- If declining: Catch limit $\times 0.8$
- If increasing, stable, or unclear:
 - Adequate recaptures \rightarrow Chapman B estimate $\times 0.04$, change limited to $\times 0.8$ or $\times 1.2$
 - Inadequate recaptures \rightarrow CPUE-based adjustment with same limits

SIOFA application: Currently applied to SIOFA toothfish stocks. Because toothfish HCR rules are likely to align with those developed by CCAMLR (which is undergoing its own MSE process), SIOFA has not conducted separate MSE testing for toothfish. This could potentially be applied to orange roughy hills where acoustic estimates are available.

6.2.3.8 *Constant Catch HCR*

Maintains catch at fixed level unless indicators suggest concerns:

TAC = C_{AVG} (average of recent reference period, e.g., last 5 years)

Modified if:

- CPUE declines $>30\%$ from reference period \rightarrow reduce TAC by 20-30%
- CPUE declines $>50\%$ from reference period \rightarrow reduce TAC by 50% or close fishery
- Biological parameters indicate productivity concerns \rightarrow implement precautionary reduction

Characteristics:

- Simplest form, suitable for low-information stocks
- Provides catch stability
- May not respond quickly enough to stock changes
- Should include breakout rules for exceptional circumstances

SIOFA application: MSE testing found that constant catch rules did not perform as well as hockey stick or CPUE-based rules for both orange roughy and alfonsino, particularly for rebuilding depleted stocks. Many SIOFA stocks currently have catch limits based on mean catches from reference periods, representing an interim approach pending management procedure development. Constant catch should be treated as a temporary measure for very low-information stocks only.

6.2.3.9 *HCR Calibration*

Responsiveness Parameters

The steepness of the relationship between stock status and fishing mortality adjustment affects:

- Speed of recovery when depleted
- Catch variability between years
- Risk of breaching limit reference points

More responsive HCRs (steeper slopes):

- React quickly to stock changes → lower risk, higher catch variability
- Appropriate when uncertainty is high
- Required for low-productivity stocks

Less responsive HCRs (gentler slopes):

- Smoother catch transitions → lower catch variability, higher risk
- Appropriate when stock assessments are precise
- Acceptable for high-productivity stocks

Buffer Zones

The distance between trigger points and limit reference points should scale with uncertainty:

High Information Stocks:

- Narrower buffer (trigger at $1.5-2.0 \times B(LRP)$)
- Stock status estimates relatively precise
- Confidence in detecting threshold approach

Medium Information Stocks:

- Moderate buffer (trigger at $2.0-2.5 \times B(LRP)$)
- Greater assessment uncertainty requires more caution
- Earlier warning needed

Low Information Stocks:

- Wide buffer (e.g trigger at $3.0+ \times B(LRP)$)
- High uncertainty demands maximum precaution
- Substantial margin for error

Inter-Annual Variation Limits

To prevent excessive catch instability:

- Typical maximum increase: 5-15% per year
- Typical maximum decrease: 20-40% per year (asymmetric limits favour conservation)
- Cumulative change limits over 3-5 years may also apply

Exceptions:

- Limits may be relaxed when stock clearly recovered
- Limits should be overridden when approaching/exceeding limit reference points

SIOFA application: MSE testing on alfonsino confirmed that more variable CPUE led to more variable TAC, requiring the addition of maximum rate of TAC change constraints to the HCR shape.

6.2.3.10 Tier-Specific HCR Guidance

Table 8 Management Procedure Tier Specific HCR

Tier 1 Management Procedures	Tier 2 Management Procedures	Tier 3 Management Procedures
<p>Tier 1 MPs typically use:</p> <p>Biomass-based or F-based HCRs with quantitative thresholds</p> <p>Multiple reference points creating graduated responses</p> <p>Explicit probability statements (e.g., "maintain $B > B(TRP)$ with $\geq 60\%$ probability")</p> <p>Integration with stock assessment uncertainty</p>	<p>Tier 2 MPs typically use:</p> <p>CPUE-based or index-based HCRs</p> <p>Simple empirical rules (e.g., "if CPUE declines, reduce catch proportionally")</p> <p>Precautionary buffers to account for CPUE-biomass relationship uncertainty</p> <p>May include constant catch with monitoring triggers</p>	<p>Tier 3 MPs typically use:</p> <p>Fixed catch limits based on a precautionary catch reference — where historical catches are used, these should be from a period considered representative of sustainable fishing rather than peak early-stage catches, as catch rates tend to be elevated at the start of a fishery before subsequently declining. The SC determines the appropriate reference period and precautionary factor for each fishery.</p> <p>Qualitative triggers requiring review (e.g., "marked downward trend")</p> <p>Expert judgement on whether catch levels sustainable</p> <p>High precautionary factors (e.g., catch limit = $0.5 \times$ historical average)</p>

<p>Recommended structure: Hockey stick HCRs linking F / F(TRP) to B / B(TRP). SIOFA MSE testing demonstrated these were most appropriate for stocks with full stock assessments.</p>	<p>Critical requirement: CPUE should be proportional to biomass. For aggregation fisheries or fisheries with limited fleet diversity, this assumption may not hold. Length-based methods may provide alternative or complementary approaches.</p>	<p>Treatment: Tier 3 approaches should be treated as temporary measures pending data collection enabling development of higher-tier management procedure. Must include robust breakout rules and systematic monitoring to detect when review is needed.</p>
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6.3 Monitoring strategies to collect relevant data to assess fishery performance

A dedicated monitoring strategy should be implemented to collect the data necessary to evaluate fishery performance against operational objectives and reference points. The design and complexity of the monitoring strategy should be directly aligned with the management procedure design, as well as the scale and intensity of the fishery. The specific form of monitoring required will depend on choice of performance indicators and reference points.

6.4 Performance Indicators and Exceptional Circumstances

Performance indicators are quantitative or qualitative metrics that monitor whether a fishery management system is achieving its stated objectives. In this Framework, performance indicators serve two essential functions:

- For stocks managed under Tier 1, 2 or 3 management procedures, performance indicators track whether the management procedure is performing as expected and achieving management objectives.
- For stocks not managed under a management procedure (typically low or zero information stocks), performance indicators function as the primary management framework itself, providing evidence-based triggers for management action.

Performance indicators in SIOFA are organised into two main categories based on their update frequency and data requirements:

HCR Performance Measures – Model-based or simulation-based metrics that can only be updated when a new stock assessment model or MSE is conducted. These measures evaluate the expected performance of proposed HCR across multiple performance objectives.

Management Performance Indicators – Data-based indicators that can be updated annually (or more frequently) when new fishery data become available. These serve as early warning indicators between assessments and provide management monitoring for stocks with no formal assessment.

6.4.1 Exceptional Circumstances and Breakout Rules

Exceptional circumstances are situations where the underlying assumptions of a management procedure are no longer valid, and continuing to apply the management procedure without adjustment

would pose unacceptable risks to stock sustainability or fail to achieve management objectives. Breakout rules define the specific conditions that trigger exceptional circumstances and the management actions required in response.

For stocks managed under management procedures, exceptional circumstances may include:

- Persistent deviation of stock status indicators from expected ranges predicted by the management procedure
- Major ecosystem regime shifts affecting stock productivity
- Significant changes in fishery selectivity or spatial distribution of effort
- Stock assessment model failure or poor fit to abundance indices
- Detection of significant biological parameter changes or new information on population structure outside the ranges tested in MSE

Some of these parameters may fall outside the bounds tested in the MSE.

For very low-information stocks without formal management procedures, the performance indicators themselves function as the primary management framework, with responses based on indicator status.

6.4.2 The Green/Amber/Red Flag System

Rather than maintaining separate frameworks for performance monitoring and exceptional circumstances, SIOFA integrates both functions into a unified three-tier classification system. Each performance indicator is assigned to one of three flag categories that simultaneously describe performance status and trigger graduated management responses.

This integrated framework ensures that performance monitoring and exceptional circumstances protocols work in concert rather than as separate parallel systems. The specific thresholds defining each flag category are detailed below for each performance indicator.

Table 9: Green/Amber/Red flag performance indicators framework

Green Flag	Amber Flag	Red Flag
All indicators within expected ranges, management objectives being met, stock performing as anticipated under the current management procedure.	Moderate deviation from expected values, early warning signals detected	Critical deviations indicating exceptional circumstances. Key indicators have breached limit reference points or show persistent significant anomalies.

<p>Management action Routine monitoring only</p>	<p>Management action: Enhanced monitoring, increased data collection, scientific review triggered to evaluate causes and risks, contingency planning initiated, but immediate management intervention (catch reductions) not yet required</p>	<p>Management action: Immediate catch reductions , enhanced assessment frequency, intensified monitoring, formal scientific review process to determine causes and evaluate any management procedure revision requirements.</p>
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6.4.2.1 Harvest Control Rule Performance Measures

These measures are typically model-based and/or simulation-based and can only be updated after a new stock assessment model is carried out or a new MSE is conducted. They are used to judge the utility of a particular HCR or management system. The first letter of each indicator corresponds to whether it is model-based (M) or fisheries-data based (F), and the second letter corresponds to a broad classification group (P = stock productivity, C = catch and effort, A = assessment, E = ecosystem).

6.4.2.2 Management Performance Indicators

These are typically data-based indicators that can be updated most years when new data are available. These serve as early warning indicators between assessments and for stocks with no assessment available.

See [Annex 4](#) for technical specifications for performance Indicators

6.4.3 Implementation Principles

Performance indicators should be evaluated on schedules appropriate to their data update frequency:

- High-Frequency Indicators (FC01–FC04, FA01, FE05–FE08): Evaluated annually when new fishery data become available.
- Assessment-Cycle Indicators (MP01–MP04, MC01–MC03, MA01–MA03, ME04): Evaluated when new stock assessments or MSE exercises are conducted (typically every 6 years or two management procedure cycles for major stocks).
- Ecosystem Indicators (FE01–FE04, FA02): Evaluated as data become available, with formal review at least annually or when ecosystem monitoring programmes provide new information.

When multiple performance indicators trigger different flag categories, the following protocol guides management response:

- Single Red Flag: Triggers full exceptional circumstances protocol regardless of other indicator status.

- **Multiple Amber Flags Across Categories:** Triggers enhanced scientific review to assess cumulative risk and determine if precautionary catch reduction is warranted (even without Red flags).
- **Persistent Amber Flags:** Amber flags persisting for two consecutive assessment cycles escalate to require the same scientific review process as Red flags.
- **Conflicting Indicators:** When stock productivity indicators show Green/Amber but ecosystem indicators show Red (or vice versa), a comprehensive scientific review evaluates all available evidence before determining management response.

The following principles should guide threshold setting and indicator interpretation (Punt et al. 2016; Butterworth 1999):

- **Threshold Oscillation:** When indicator values hover near category boundaries, avoid rapid switching between Green/Amber or Amber/Red. The Amber tier provides a buffer zone that reduces this issue. Management actions should not be triggered by borderline, transient exceedances but by sustained trends or clear threshold breaches.
- **Ratchet Effects:** Poorly calibrated reference points can create "ratchet effects" where catch limits continually increase or decrease regardless of true stock state. Reference periods and thresholds should be validated through MSE testing to ensure they reflect genuine sustainability concerns rather than data artefacts.
- **Lag Indicators:** Time lags between actual resource state changes and their detection in monitoring data can delay management response. The multi-indicator approach combines both leading indicators (e.g., recruitment trends, ecosystem changes) and lagging indicators (e.g., biomass estimates) to provide earlier warning signals.

6.4.4 Review of Performance Indicators

Performance indicator thresholds and the overall framework should be reviewed and revised on both routine and trigger-based schedules:

Routine Review Schedule

- **Annual:** Review adequacy of data collection systems for high-frequency indicators
- **3-Year (Assessment Cycle):** Evaluate threshold performance for model-based indicators, validate reference periods remain appropriate
- **5–10 Year:** Comprehensive performance indicator framework review incorporating MSE testing of threshold values, evaluation of new indicator candidates, assessment of whether indicator suite adequately captures all management objectives

Trigger-Based Review

Additional review is triggered when:

- New assessment methods or data sources become available that could improve indicator reliability
- Multiple Red flags occur simultaneously, requiring evaluation of whether threshold calibration is appropriate
- Persistent Amber flags suggest thresholds may need recalibration
- Major changes in fishery operating conditions (technology, markets, management measures) that may affect indicator interpretation

Important Note: *The thresholds provided in this framework are provisional pending formal MSE testing and stakeholder consultation for each stock. Initial implementation should include sensitivity testing to ensure thresholds provide appropriate warning signals without excessive false alarms.*

6.5 Technical Evaluation of Management Procedures

6.5.1 Evaluation Requirements

The Framework requires all management procedures to undergo simulation testing before implementation. The type and rigour of the evaluation will differ between Tier 1, Tier 2 and Tier 3 management procedures. However, the requirement for testing applies universally across SIOFA's three-tier management procedure framework. This is a key element of implementing a precautionary approach.

Events that warrant concern and should be considered as part of the management procedure approach and may be incorporated into a reference set of scenarios, within a robustness testing set of scenarios or addressed via the exceptional circumstances process. Scenarios to consider should include where possible, but not be limited to:

- Change in fishing dynamics such as new gear, increased efficiency, shifting patterns (spatial or temporal)
- Alternative biological assumptions including variability (growth, recruitment, maturity, length-weight ratio)
- Alternative fishery assumptions including selectivity, CPUE, catchability
- Recruitment shock/failure
- Significant changes to catch dynamics (numbers, sizes, weight-length ratios, sex ratios, condition)
- Change in environmental conditions such as temperature, currents, productivity
- Natural mortality events (e.g. disease)
- Ecosystem changes, such as impacts on food webs or reductions in prey availability

MSE provides the standard evaluation method for management procedures where data and assessment

capability permit formal quantitative testing (Tiers 1 and 2)¹⁶. For data-poor stocks (Tier 3), qualitative expert-based evaluation methods apply.

6.5.2 Management Strategy Evaluation

MSE tests management procedures through simulation of the complete management cycle: data collection, stock assessment, HCR application, and resulting stock dynamics. Operating models represent plausible stock dynamics under uncertainty, whilst estimation models infer stock status from simulated data containing realistic observation error and bias.

MSE compares performance of alternative management strategies by assessing how candidate procedures perform against management objectives under system uncertainties. This reveals trade-offs amongst competing objectives (e.g. maximising yield versus minimising catch variability), enabling managers to evaluate whether proposed management procedures achieve acceptable balance amongst objectives before implementation. Proactive testing through MSE minimises the risk of unintended consequences and identifies robust management strategies that maintain performance across plausible uncertainty ranges.

MSE Components:

- Operating models span plausible ranges of stock productivity, recruitment variability, natural mortality, stock structure, and other biological parameters identified through sensitivity analyses
- Observation models simulate data collection processes including CPUE hyperstability, length composition sampling variability, ageing error, and tag reporting rates
- Estimation models replicate the stock assessment methods that would be applied in practice
- Implementation models incorporate realistic implementation error in TAC setting and catch reporting
- HCR define the management responses to be tested
- Performance metrics quantify outcomes against management objectives

6.5.3 Performance Standards

Management procedures tested through MSE should be able to demonstrate:

- Probability of maintaining or achieving the MSY-compatible target reference point $\geq 50\%$ over the projection period. Ideally, MSE Initial MSE exercises should evaluate

¹⁶ MSE-tested harvest strategies represent an accepted application of the precautionary approach (2018) (FAO, 2012), with simulation testing increasingly recognized as best practice in international fisheries management (See for e.g Working Party on Methods 1999; General Fisheries Commission for the Mediterranean 2024)=

alternative sensitivity choices of 50, 60 and 70% probability of being at or above the TRP.

- Probability of breaching limit reference points $\leq 5\%$ over the projection period.
- Adequate performance across the range of plausible operating models representing structural uncertainty, parameter uncertainty, and alternative assumptions about stock dynamics.
- Acceptable inter-annual TAC variability.

Performance metrics should be calculated across multiple projection replications (typically ≥ 100) for each operating model scenario. Results should be presented showing the distribution of outcomes across both replicates and operating model scenarios.

6.5.4 Tier-Specific Evaluation Approaches

6.5.4.1 Tier 1 MPs

Stocks with robust age- or length-structured integrated assessments require comprehensive MSE. Operating models should be conditioned on historical data and tested against alternative structural assumptions including:

- Spatial population structure and movement
- Stock-recruitment relationships
- Natural mortality variation by age, sex, or time period
- Selectivity patterns and fleet dynamics
- Environmental drivers of productivity, when and if this is feasible for SIOFA.

HCRs should be tested across multiple designs (e.g. hockey-stick, ramp, constant F) to identify configurations that meet performance standards. Testing should specifically examine robustness to biological parameter misspecification, particularly for influential parameters such as natural mortality where estimation model compensation may prove insufficient.

6.5.4.2 Tier 2 MPs

Stocks with CPUE series or other empirical indicators but lacking integrated assessments require simplified MSE using biomass dynamics or production model operating models. These should:

- Represent key biological processes (recruitment, growth, natural mortality) at population rather than individual level
- Incorporate realistic CPUE-biomass relationships including potential hyperstability, catchability changes, and spatial effects
- Test management procedure sensitivity to CPUE reliability assumptions
- Explore scenarios where proportionality between indices and biomass degrades

Given the increased sensitivity of empirical management procedures to assumption violations, robustness testing across alternative operating model structures becomes particularly critical. Scenarios

should include hyperdepletion, fleet dynamics changes, and spatial redistribution effects that could compromise index reliability.

6.5.4.3 Tier 3 MPs

Where quantitative MSE is not feasible, structured qualitative evaluation applies, whereby a panel of experts acts in place of a mathematical MSE. The panel should comprise an odd number (preferably >1) of independent experts and consider, as much as is feasible, all the potential scenarios that would be considered under a standard Tier 1 or 2 MSE. The panel shall be tasked with recommending, based on majority opinion, the preferred management approach (akin to a HCR from Tier 1 or 2) of the options proposed, including expected performance against management objectives. In addition, the panel may also propose additional management options that it judges may outperform proposed approaches.

Risk-based evaluation methods may also be used but should be calibrated against more quantitative methods where possible to provide greater confidence that the management procedure will meet the objective of the Framework.

All Tier 3 evaluations require structured documentation with supporting rationale. The evaluation process, data considered, expert opinions (where applicable), and supporting rationale should be recorded to enable subsequent review and refinement. Where experts disagree, record the range of opinions and factors driving divergence

6.5.5 Practical Constraints and Prioritisation

The Framework recognises that it will take some time to implement across SIOFA, and management procedures will take time to progressively develop.

As MSE requires substantial resources, scientific capacity, computing infrastructure, and stakeholder engagement time. Resource allocation should prioritise:

1. Stocks where exploitation rates approach or exceed sustainable levels
2. Stocks with sufficient data to support meaningful operating model parameterisation
3. Fisheries with significant economic or social importance
4. Stocks where existing management procedures lack clear performance benchmarks.

6.5.6 MSE Design Specifications

Projection Period: Projection periods should be adapted to the species.

Scenario Coverage: Operating models should represent:

- Alternative stock productivity assumptions (e.g. natural mortality $\pm 20\%$ of base case)
- Recruitment variability consistent with available data or life-history analogues
- Implementation error in TAC setting (typical range 5-15% coefficient of variation)
- Observation error in data sources (CPUE, length compositions, age compositions)
- Alternative structural assumptions identified through sensitivity analyses

Reporting Requirements: MSE results shall include:

- Performance metric distributions (median, 10th and 90th percentiles) across scenarios
- Trade-off plots showing relationships between conflicting objectives
- Time series projections showing stock trajectories under alternative management procedures
- Identification of scenarios where management procedures fail to meet standards
- Sensitivity analyses quantifying performance changes across operating model assumptions.

For transboundary, or closely related, stocks, SIOFA should consider related MSE frameworks, operating models, and performance metrics developed by other RFMOs or coastal States, as applicable.

As SIOFA gains experience with MSE, techniques and frameworks should evolve to reflect improved understanding, technological advances, and lessons learned from implementation. The Scientific Committee should be encouraged to continue developing appropriate MSE methods to test the robustness of alternative limit, target and trigger reference points, and associated HCRs in relation to the management objectives, probabilities and timeframes determined by the MoP.

6.6 Record Keeping

The Framework provides for ongoing performance monitoring of a management procedure against its objectives. To facilitate this, certain records should be collected and maintained in respect of each fishery. These include:

- characterisation and categorisation of stocks into 'healthy' 'under watch' or 'critical', including details of the data used to allocate stocks to categories. Circumstances under which stocks would transition between categories, and under which the categorisation process should be more broadly reviewed and revised, should also be identified
- record of any assumptions made for undertaking forward projections.
- Code, assumptions and analytical workflows should be archived and accessible, even if not publicly released.
- descriptions of management procedures developed for each fishery or stock, including details of:
 - any fishery specific objectives or deviations from those set out in Framework or these Guidelines
 - Assessment methods, as applied to each stock
 - stock-specific indicators and/or performance measures adopted
 - target and limit reference points expressed in terms of the specified indicators or performance measures
 - details of HCRs adopted

- description of any additional meta-rules incorporated into the management procedure, including conditions under which the management procedure would be considered to require review, revision or re-testing
- assumptions made in developing the management procedure, such as limited mixing or recreational catch estimates
- details of how estimates of discards are taken into account
- results of MSE or other testing conducted on candidate management procedure, confirming that the adopted management procedure and HCRs have a high probability of achieving their objectives
- data used in stock assessments and application of the management procedure for each stock, including:
 - Effort data, such as number of vessels, days fished, number of sets
 - Catches by stock, including any available data on retained versus discarded catch
 - size composition of stocks in the catch, including data on size composition of retained versus discarded fish, if collected
 - other ancillary data used in stock assessments for each stock
- record of assessments conducted for each stock, documenting the date and results of assessments, including:
 - best assessment estimate of stock status relative to specified limit and target reference points, including confidence intervals around that estimate, if the assessment method provides this
 - results of the application of the management procedure and HCRs using the best estimate of stock size in relation to reference levels
 - record of resulting management action taken in response to the results of application of the HCR.

7 Alternative Management Approaches if a Management Procedure is not Feasible

Management procedures are the default management approach for all stocks under this Framework. Where a full management procedure is not immediately feasible, the Meeting of the Parties may determine, based on Scientific Committee advice, that an alternative approach is temporarily appropriate. That determination must be the result of a deliberate decision, not an absence of one — 'no management' is never an acceptable outcome.

7.1 When Alternative Approaches May Be Considered

Alternative approaches may only be applied under three documented circumstances.

- **Interim management pending management procedure development** applies where a new fishery requires immediate management controls before a management procedure can be developed and tested through MSE. The alternative approach must be explicitly time-limited (typically no more than three to five years), with a clear timeline for transition to a full management procedure.
- **Truly minimal fisheries** are those where catches are sporadic bycatch only, with no targeting, and where catch levels are demonstrably negligible relative to likely stock productivity. In such cases, the cost and effort of full management procedure development is disproportionate to the management risk.
- **Technical infeasibility** applies where species biology or data constraints make even a Tier 3 management procedure approach unachievable — for example, cryptic deepwater species with no feasible survey methods and no practical means of aggregating monitoring data across the multiple fisheries in which they occur as rare bycatch.

The determination that a full management procedure is not appropriate must be made formally by the MoP, recorded with reference to Scientific Committee advice, and scheduled for re-evaluation at least biennially.

7.2 Minimum Requirements for Non-MP Approaches

All stocks managed under alternative approaches must meet the following minimum requirements. These are not discretionary — they are the floor below which alternative management must not fall.

7.2.1 Catch limits or catch triggers based on best available science

All stocks must have either a catch limit (a direct ceiling on removals) or a catch trigger (a catch level that initiates enhanced investigation or management action). The appropriate basis depends on data availability and stock characteristics. Table 10 sets out three approaches.

Table 10: Basis for catch limits set for fisheries not managed under a management procedure

Limit Basis	Summary
Historical Catch-Based Approach:	<p>For stocks where historical catches have been stable and no evidence exists of resource decline, catch limits or triggers may be based on recent historical catch levels adjusted by a precautionary factor such as</p> $Catch_{Limit/Trigger} = \phi \times Average_{Historical} Catch$ <p>Where ϕ is a precautionary factor accounting for uncertainty in stock status and productivity, potential unreported mortality, and lack of formal assessment to confirm sustainability.</p>

	<p>Management responses may include:</p> <p>Catch approaches limit/trigger: Investigate whether F is sustainable, considering all available evidence</p> <p>CPUE trends available: Assess whether trends are consistent with sustainable catch assumption</p> <p>New biological information: Re-evaluate precautionary factor ϕ in light of updated life history parameters, productivity estimates, or stock status indicators</p>
<p>Productivity-Based Limits</p>	<p>For species with known life history parameters allowing natural mortality (M) estimation, productivity-based limits may be derived:</p> <p>Sustainable Catch $\approx \gamma \times M \times B_{\text{current}}$</p> <p>This approach is applicable for species with known life history allowing M estimation. The coefficient γ represents approximate maximum exploitation rate (e.g 0.5).</p>
<p>Comparative Approach</p>	<p>For species with a well-studied stock of the same species and documented similarity in biological characteristics, productivity, and fishery operation:</p> <p>$\text{Catch}_{\text{Limit}} = (\text{Catch}_{\text{Reference}} / \text{Biomass}_{\text{Reference}}) \times \text{Biomass}_{\text{Current}} \times \phi$</p> <p>Precautionary factor ϕ accounts for dissimilarities between reference and current stock and uncertainties in the comparative approach. This method requires documented similarity in biological, productivity, and fishery characteristics</p>

7.2.2 Stock assessment

A stock assessment should be undertaken following the framework established in these Guidelines.

7.2.3 Biological reference points

A biologically appropriate limit reference point must be established for all stocks not managed under a full management procedure, following the framework established in these Guidelines.

7.2.4 Monitoring strategy

Monitoring is especially critical for alternative management approaches, which lack the integrated feedback mechanisms of a full management procedure. At minimum, this requires data reporting in conformity with CMM 02 and opportunistic biological sampling where practicable, including length frequency data, sex ratio monitoring, maturity staging, and collection of ageing material.

7.2.5 Performance indicators

Defined performance indicators must signal when review or management adjustment is needed. The Green/Amber/Red flag system established in these Guidelines applies directly to stocks managed under alternative approaches. Applicable indicators include FC01–FC04 (catch, effort, compliance, unstandardised CPUE), FA02 (data availability and quality), and FE01–FE08 (ecosystem and external indicators). Any Amber or Red flag triggers the management responses defined under that system. Multiple persistent Amber flags or any Red flag requires formal Scientific Committee review.

7.2.6 Transition plan

Alternative approaches are temporary measures, not permanent substitutes. Every alternative approach must include a transition plan that identifies conditions under which management procedure development will be triggered and a pathway to achieve it. Transition triggers should include, at minimum: minimum data requirements being met; annual catches exceeding a defined threshold; technical assessment methods becoming available; persistent performance concerns (Amber or Red flags); and fishery expansion through new vessels, gear types, or exploitation patterns. The plan should identify priority data gaps, collection methods, resource requirements, and a realistic timeline. The Secretariat should produce an annual summary of catch levels, performance indicator status, and any issues arising for each stock managed under an alternative approach.

7.3 Compliance and Implementation

Management procedures depend on accurate data to function as designed. Compliance implementation serves two essential purposes: ensuring effective catch monitoring and reporting, and detecting and preventing illegal, unreported and unregulated (IUU) fishing.

All known sources of mortality need to be accounted for, including retained catches and estimated discard mortality across all fleets and gear types. This depends on:

- Comprehensive catch monitoring systems that capture all fishing activity
- Timely and accurate reporting by all fishers operating under SIOFA CMMs
- Verification mechanisms to ensure reported data reliability
- Clear reporting requirements that fleets understand and can meet

7.4 Addressing IUU fishing

IUU fishing is a known source of mortality with potentially unknown scale and impact. Even sophisticated management procedures fail when unaccounted removals occur. Addressing IUU requires:

- Methods to detect IUU activity and estimate its scale
- Active enforcement to prevent IUU fishing
- Mechanisms to account for estimated IUU mortality in catch limits and assessments
- Regular evaluation of whether IUU levels threaten Framework objectives

7.5 Role of the Compliance Committee

As specified in the Framework, the Compliance Committee monitors adherence to conservation and management measures adopted under this Framework. Effective compliance implementation requires:

- Robust catch monitoring and reporting systems that capture all sources of mortality
- Active enforcement programmes to minimize IUU fishing
- Regular reporting to the Compliance Committee on catches relative to removal limits
- Timely investigation and response when reported catches approach or exceed limits

7.6 Continuous Improvement

These Technical Guidelines represent current best practice for implementing the Framework. As SIOFA gains experience with practical application, the Guidelines should evolve to reflect lessons learned and incorporate improved methods. They are intended to be responsive to both SIOFA's experience implementing the Framework as well as its evolving understanding of its fisheries and best practice methods and applications, particularly for managing low or no information stocks.

7.6.1 Regular Review

The Scientific Committee should review these Guidelines periodically, typically every 5 years or when significant issues emerge, to assess whether:

- Guidance remains clear, practical, and fit for purpose
- New scientific methods or international best practices warrant incorporation
- Implementation experience reveals gaps, ambiguities, or conflicts requiring resolution
- Tier criteria, reference point approaches, or other technical specifications need refinement

Reviews should draw on documented case studies from SIOFA fisheries and relevant developments in other RFMOs and national jurisdictions.

7.6.2 Learning from implementation

Each application of the Framework provides evidence about what works, what proves problematic, and where guidance needs strengthening. SIOFA should systematically document:

- Challenges encountered during tier assignment, reference point setting, or management procedure development
- Solutions developed for novel situations not fully addressed in current Guidelines
- Feedback on clarity and usability of technical guidance
- Examples of successful implementation worth highlighting for future applications

8 Amendment

These Technical Guidelines may be amended by the MoP in accordance with its usual decision-making procedures.

Annexes

Annex 1: Operational Checklist for Information Classification

Annex 2: Technical Specifications for Reference Points

Annex 3: Factors Influencing Rebuilding Plans

Annex 4: Technical Specifications for Performance Indicators

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Annex 1: Operational Checklist for Information Classification

Purpose and Scope

This document provides operational criteria for classifying SIOFA stocks into information categories (High, Medium, Low, Zero) for the Precautionary Approach Management (PAM) Framework.

Each information category evaluates the same elements (Stock Structure, Stock Productivity, Life History, Fleet Composition, Ecosystem Context) but with different information requirements reflecting data availability.

High-Level PAM Framework Criteria

High Information Stocks:

Data sufficient to estimate stock size with quantifiable uncertainty, detect population changes with reasonable confidence, understand key biological processes and support consideration of assumptions about ongoing trends in environmental and fisheries conditions on which to base forward projections

Medium Information Stocks:

Data sufficient to track stock trends over time, identify when significant changes occur, characterize basic population structure, inform responsive management adjustments. Data may have some limitations in scope, precision or duration.

Low Information Stocks:

Data sufficient to confirm species presence and catch levels, provide basic sustainability indicators, identify major changes in catch patterns, support precautionary limits. Data may be basic with substantial limitations.

Zero Information Stocks:

Virtually no fishery-specific information is available beyond species identification and basic catch data which are incomplete (substantial gaps in time series or spatial coverage), aggregated at a family of genus level, or sporadic records rather than systematic and/or verified catch. Stocks in this category may have no fishery-independent data, limited or no life history information (or limited to literature values from related species or genera). Data are generally insufficient to confirm consistent stock trends, characterize population responses to fishing, distinguish natural variation from fishing impacts, support anything beyond highly precautionary defaults.

OPERATIONAL CHECKLIST FOR INFORMATION CLASSIFICATION

HIGH INFORMATION STOCKS

A comprehensive range of information across multiple domains is available.

A. CORE FISHERY DATA

Required (Must meet ALL):

- **CATCH DATA:** Species-specific catch records collected systematically for X years with <Y% data gaps
- **EFFORT DATA:** Standardized effort data (haul-by-haul records with spatial/temporal detail, consistent reporting across fleets)
- **ABUNDANCE INDEX:** At least ONE reliable abundance index (CPUE, survey, acoustic, tagging) available for $\geq X$ years
- **DATA COVERAGE:** Data represents >Y% of total fishing activity on the stock

B. STOCK-SPECIFIC KNOWLEDGE

Required (Must meet ALL 4):

- **STOCK STRUCTURE:** Stock boundaries verified or well-understood through scientific evidence (genetics, tagging, demographics, otolith microchemistry, morphometrics). Spatial structure documented. Mixing rates with adjacent populations quantified or bounded.
- **STOCK PRODUCTIVITY:** Quantitative estimates of productivity parameters available (intrinsic rate of increase, carrying capacity, or parameters of stock-recruit relationship). Stock-recruit relationship investigated even if not definitively characterized. Productivity level well-understood relative to fishing pressure.
- **LIFE HISTORY:** Stock-specific growth, maturity, natural mortality, fecundity estimated from data collected in SIOFA fisheries (not solely literature). Age-reading validated or ageing error quantified. Sex-specific parameters where relevant.
- **FLEET COMPOSITION:** Detailed information on fleet characteristics (gear types, vessel sizes, fishing strategies, target vs. bycatch fisheries). Spatial and temporal fishing patterns documented. Effort allocation understood. Historical changes in fleet composition tracked.

C. BIOLOGICAL SAMPLING

Required:

- Regular biological sampling with adequate coverage across size range and fishing areas (documented % of catch sampled, stratified by size/area/season, consistent methods documented, quality control procedures in place)

D. ECOSYSTEM AND ENVIRONMENTAL CONTEXT

Required (≥ 2 of 5):

- **PREDATOR-PREY RELATIONSHIPS:** Diet studies available (stomach content analysis from observers or surveys), known predators documented, prey species identified, feeding ecology understood
- **HABITAT REQUIREMENTS:** Spawning areas identified, depth/temperature preferences documented, substrate associations known, migration patterns understood, essential fish habitat characterized
- **ENVIRONMENTAL DATA:** Relevant oceanographic information available (SST, productivity indices, currents, oxygen levels), environmental covariates for abundance/recruitment identified, regime shifts or climate effects investigated
- **SPECIES INTERACTIONS:** Documented interactions with other commercial species (competition, predation, facilitation), bycatch patterns analyzed, multispecies relationships understood
- **ECOSYSTEM ROLE:** Trophic level determined from data or well-established literature, food web position understood, biomass/production estimates in ecosystem context, ecosystem model parameterization available

MEDIUM INFORMATION STOCKS

Sufficient relevant information to support a Management Procedure with some ecosystem context.

A. CORE FISHERY DATA

Required (Must meet ALL):

- **CATCH DATA:** Species-specific catch records for $\geq X$ years with reasonable consistency
- **EFFORT DATA:** Effort data available even if standardization incomplete or coverage $< Y\%$
- **ABUNDANCE INDICATOR:** At least ONE indicator showing interpretable patterns (CPUE, survey index, or depletion analysis possible)

B. STOCK-SPECIFIC KNOWLEDGE

Required (Must meet ALL 4):

- **STOCK STRUCTURE:** Stock boundaries reasonably understood based on available evidence (fishing patterns, species distribution, literature on related stocks). Assumptions about spatial structure documented and justified. Aware of potential mixing with adjacent populations.
- **STOCK PRODUCTIVITY:** General understanding of productivity level (low/medium/high) from life history characteristics or meta-analysis. Productivity category assigned based on longevity, age at maturity, fecundity. Understanding of whether stock is likely above/below BMSY proxy levels.

- **LIFE HISTORY:** Basic population parameters available from regional data or scientific literature (may include estimates from related species or genus if justified). Growth, maturity, natural mortality understood at least qualitatively. Maximum age/size documented.
- **FLEET COMPOSITION:** Basic information on fleet types and fishing patterns (gear types, whether target or bycatch fishery, general spatial/temporal distribution). Main fleets taking the species identified. Changes in fishing patterns over time documented at a broad level.

C. BIOLOGICAL SAMPLING

Required:

- Representative sampling (documented % of catch sampled, stratified by size/area where possible) even if coverage or consistency is limited. OR sufficient literature-based parameters with documented uncertainty.

D. ECOSYSTEM CONTEXT AND SPECIES INTERACTIONS

Required (≥ 1 of 4):

- **ECOSYSTEM CONTEXT:** General trophic level known from literature or databases, food web position understood at broad level, functional group identified
- **SPECIES INTERACTIONS:** Bycatch associations documented (which species caught together, assemblage membership), basic understanding of competitive or facilitative interactions with other species
- **HABITAT INFORMATION:** General depth range and habitat type documented (from fishery data or literature: benthic/pelagic/demersal), broad distribution patterns and environmental preferences understood, habitat associations identified (e.g., seamounts, ridges, slope)
- **PREDATOR-PREY:** Basic diet information available from literature or limited sampling, main predators or prey species known, general feeding behavior understood (piscivore, invertebrate feeder, etc.)

LOW INFORMATION STOCKS

Some relevant information to support a limited or qualitative Management Procedure.

A. CORE FISHERY DATA

Required (Must meet ALL):

- **CATCH DATA:** Species-specific catch records for more than one generation (not aggregated at family/genus level)
- **REPORTING:** Catch reporting reasonably complete (estimated $>X\%$ coverage)

B. STOCK-SPECIFIC KNOWLEDGE

Required (Must meet ALL 4):

- **STOCK STRUCTURE:** Basic assumptions about stock boundaries documented (may be based on management convenience or broad biogeography). Species distribution in SIOFA Area generally known (which subareas it occurs). Awareness that actual stock structure may differ from assumed.
- **STOCK PRODUCTIVITY:** Broad productivity category inferred from family/genus characteristics and life history traits (e.g., deep-water sharks = low productivity, small pelagics = high productivity). Order-of-magnitude understanding sufficient to inform precautionary approaches.
- **LIFE HISTORY:** Life history characteristics available from scientific literature for species or related species/congeners (maximum age/length/weight, approximate size/age at maturity, general longevity, reproductive mode). Family-level characteristics applicable and documented.
- **FLEET COMPOSITION:** Basic understanding of which fleets/gears catch the species (trawl, longline, gillnet, etc.), whether caught as target or bycatch, general understanding of when/where species encountered

C. BIOLOGICAL SAMPLING

Required:

- Some opportunistic sampling provides basic biological information (length measurements, observed maturity stages, sex ratios) OR comprehensive literature review establishes parameters with documented sources.

D. BASIC ECOSYSTEM ROLE AND HABITAT

Required (≥ 1 of 3):

- **ECOSYSTEM ROLE:** Basic understanding of whether species is primarily predator, prey, or both (from literature, taxonomic knowledge, or basic observations). Trophic level category (apex predator, mesopredator, forage, etc.)
- **HABITAT REQUIREMENTS:** General depth range known from fishery records or literature, broad habitat type identified (benthic/pelagic/demersal/reef-associated), general environmental tolerances.
- **DISTRIBUTION:** General distribution in SIOFA Area understood (which subareas, broad spatial patterns), known range limits, general abundance patterns (common/rare/patchy)

ZERO INFORMATION STOCKS

Virtually no fishery-specific information beyond species identification and basic catch data.

A. CORE FISHERY DATA

- Catch data aggregated at family/genus level only (no species-specific records), OR
- Catch records with substantial gaps ($>X\%$ years missing) or sporadic/opportunistic only, OR
- Time series $<Y$ years of systematic verified catch, OR

- No verification mechanism for catch reporting

B. STOCK-SPECIFIC KNOWLEDGE

- **STOCK STRUCTURE:** Unknown - no information on whether species occurs as single population or multiple stocks in SIOFA Area
- **STOCK PRODUCTIVITY:** Unknown or only very broad inference from taxonomic order (e.g., elasmobranchs generally less productive than teleosts)
- **LIFE HISTORY:** Limited or no life history information even from literature on related species or genera. May lack basic parameters like maximum size, longevity, maturity.
- **FLEET COMPOSITION:** Minimal information - species caught opportunistically or incidentally, unclear which fleets/gears responsible for catches

C. BIOLOGICAL SAMPLING

- No systematic sampling. Species may be misidentified or taxonomic resolution poor

D. ECOSYSTEM AND HABITAT

- No understanding of habitat requirements, ecosystem role, or basic ecology beyond very broad taxonomic inferences.

Examples of Borderline Classification Decisions

Scenario:

Stock has 7 years of excellent haul-by-haul data (just below 8-10 year threshold for High), comprehensive biological sampling with stratified design, verified stock structure through genetics, and documented ecosystem interactions.

- **DECISION:** Could classify as High Information if data quality and breadth clearly compensate for slightly shorter time series, OR classify as Medium with documented pathway to High once 8+ years achieved. Document rationale clearly.

Scenario:

Stock has 10 years of catch data and comprehensive literature-based life history, but still insufficient for abundance indices to be generated.

- **DECISION:** Classify as Low Information. Lack of any abundance information prevents Medium classification even with good catch history and biological knowledge.

Scenario:

Stock has excellent fishery data (15 years catch/effort, multiple surveys, biological sampling), well-understood stock structure and life history, but no information on habitat, predator-prey relationships, or ecosystem role.

- **DECISION:** Classify as Medium Information. Excellent core data but lacks ecosystem/environmental breadth required for High Information.

Scenario:

Stock has basic catch history (5 years) and which fleets catch it, but no information on stock structure (single stock vs. multiple populations unknown).

- **DECISION:** Classify as Zero Information. Missing a core stock-specific element (structure) prevents classification above this level regardless of other available data.

Scenario:

Stock has 6 years of data but daily aggregated effort (not haul-by-haul), CPUE shows interpretable patterns but data quality concerns documented, biological sampling sporadic but representative when collected.

- **DECISION:** Likely Medium Information - has key components but limitations in precision and consistency prevent High classification.

Annex 2: Technical Specifications for Reference Points

Table 11: Potential limit reference points (modified from Table MI-1 in WCPFC Scientific Committee 2021).

LRP	Information class	Comments
$x\% F_{MSY}$	High	Choose the level of x based on an evaluation.
$x\% B_0$	High	Choose the level of x based on an evaluation.
$x\% B_{F=0}$	High	Choose the level of x based on an evaluation.
$SPR x\% B_{F=0}$	Medium or low	Choose the level of x based on an evaluation.
$x\% F(TRP)$	High or medium	Choose the level of x based on an evaluation.
$x\% CPUE_0$	High or medium	Choose the start of a reliable CPUE series and the level of x.
$x\% CPUE_{t1-t2}$	High or medium	Choose a time period where the stock was considered in a desirable state.
$B_{F=0, t1-t2}$	High	Choose a time period where the stock was considered in an undesirable state (and should be avoided in future) but recovered back to suitable levels.
B_{t1-t2}	High	Choose a time period where the stock was considered in an undesirable state (and should be avoided in future) but recovered back to suitable levels.
$CPUE_{t1-t2}$	High or medium	Choose a time period where the stock was considered in an undesirable state (and should be avoided in future) but recovered back to suitable levels.
$B/B_{F=0_low}$	High	Choose a low year where the stock was considered in an undesirable state (and should be avoided in future) but recovered back to suitable levels.
B_{low}	High	Choose a low year where the stock was considered in an undesirable state (and should be avoided in future) but recovered back to suitable levels.
$CPUE_{low}$	High or medium	Choose a low year where the stock was considered in an undesirable state (and should be avoided in future) but recovered back to suitable levels. Note $CPUE_{t1-t2}$ is more precautionary.
F_{LIM}	Low	Use as an interim LRP until a more reliable indicator can be generated.

F_{CRASH}	Low	Use as an interim LRP until a more reliable indicator can be generated.
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Table 12: Hierarchical approach for defining BRPs based on the type of assessment applied to the stock. For RPs set to x% or y%, choose level of x or y based on an evaluation. For TRPs, default x=40%. For LRPs, default y is 20% for SSB and 25% for vulnerable biomass; default z is 150%; default w is 50%.

Assessment type	TRP	LRP	Minimum data requirements
Integrated analysis, steepness well-determined	B_{MSY}, F_{MSY}	y% B_0 , z% F_{MSY}	Steepness, Growth, M, catch, CPUE
Integrated analysis, steepness not well-determined	x% B_0 , F(TRP)	y% B_0 , z% F(TRP)	Growth, M, catch, CPUE
Simplified integrated analysis (e.g., SS-CL, SSS, surplus production model)	x% B_0 , F(TRP)	y% B_0 , z% F(TRP)	Catch, size frequency or index of abundance
Productivity & constant F	F(TRP)	z% F(TRP)	Biomass
CPUE index only	mean $CPUE_{t1-t2}$	w% mean $CPUE_{t1-t2}$	CPUE, preferably standardized
LB-SPR	SPRtarget, F_{SPRMSY}	z% F_{SPRMSY}	Sizes, growth curve
LIME	F(TRP)	z% F(TRP)	Sizes, growth curve
Risk-based (e.g. SAFE, EASI-FISH, SEFRA)	F_{MSM}	z% F_{MSM}	
Catch only	$Catch_{t1-t2}$	1.5 $Catch_{t1-t2}$ & 0.5 $Catch_{t1-t2}$	Catch

Table 13: Potential target reference points

TRP	Group	Information class	Comments
X% B_{MSY}	Target & Bycatch	High	Choose the level of x based on an evaluation.

$x\% F_{MSY}$	Target & Bycatch	High	Choose the level of x based on an evaluation.
$x\% B_0$	Target & Bycatch	High	Choose the level of x based on an evaluation.
$x\% B_{F=0}$	Target & Bycatch	High	Choose the level of x based on an evaluation.
F(TRP)	Target & Bycatch	High and medium	Determine F using a simulation.
F_{SPRMSY}	Target & Bycatch	Medium or low	Choose the level of x based on an evaluation.
SPR $x\% B_{F=0}$	Bycatch	Medium or low	Choose the level of x based on an evaluation.
$x\% CPUE_0$	Target & Bycatch	High or medium	Choose the start of a reliable CPUE series and the level of x.
$B_{F=0, t_1-t_2}$	Target & Bycatch	High	Choose a time period where the stock was considered in a desirable state.
$B_{t_1-t_2}$	Target & Bycatch	High	Choose a time period where the stock was considered in a desirable state.
$CPUE_{t_1-t_2}$	Target & Bycatch	High or medium	Choose a time period where the stock was considered in a desirable state.

Annex 3: Factors Influencing Rebuilding Plans¹⁷

Factors Influencing Rebuilding Success

Life History Characteristics

A species' life history traits, including growth rates, fecundity, longevity, age at maturity, and size at maturity, are fundamental determinants of both vulnerability to fishing pressure and rebuilding potential. Long-lived, slow-growing species with low fecundity are inherently more susceptible to population decline under fishing pressure and typically exhibit slower recovery rates compared to short-lived, early-maturing, highly fecund species.

Rebuilding strategies should be tailored to species-specific life history characteristics, as different species will respond variably to identical management measures. A one-size-fits-all approach fails to account for the biological realities that govern population recovery dynamics.

Environmental Variability and Climate Change

Natural Environmental Influences

Environmental conditions, including temperature, salinity, and oceanographic patterns, directly impact rebuilding success by affecting growth, reproduction, and overall productivity. These conditions also influence predator-prey dynamics, which cascade through the ecosystem to affect recruitment success. Favorable environmental conditions generally enhance rebuilding prospects, while adverse conditions may impede recovery efforts.

Accounting for Variability

Rebuilding strategies should be robust to natural stock variability, recognizing that productivity, growth, and recruitment patterns are not static over time. When rebuilding progress falls short of expectations, the underlying causes should be identified and strategies adjusted accordingly.

Where environmental factors demonstrably affect rebuilding success, both the strategy and timeframe may require revision to account for altered productivity. Such revisions should be thoroughly documented as they have ongoing implications for management effectiveness.

Fisheries should seek to account for environmental variability when developing MPs, particularly for stocks in the Critical Zone where altered productivity directly impacts rebuilding timeframes and success.

Climate Change Considerations

¹⁷ Adapted from Canadian and Australian approaches (2022; 2018)

The dynamic nature of environmental conditions limits our ability to predict their full impact on rebuilding success. Historical relationships between stock and environmental conditions may not hold for depleted populations or ecosystems with altered trophic dynamics. Climate change adds further uncertainty to these relationships.

Despite these uncertainties, environmental influences should be incorporated into rebuilding efforts using the best available science while acknowledging associated risks and limitations. Rebuilding frameworks should be sufficiently adaptive to address the reasonable range of potential environmental conditions and may include specific measures to respond to oceanographic shifts.

Evolutionary Effects of Fishing

Intensive fishing pressure can induce evolutionary changes in life history traits, including growth rates, maturation schedules, and reproductive behaviors. While these rapid evolutionary effects have been documented in collapsing stocks, genetic and phenotypic recovery typically occurs much more slowly than biomass recovery.

Generally, evolutionary changes represent a secondary concern compared to the direct effects of overfishing. However, management objectives should consider genetic diversity in long-term planning and implement measures that promote comprehensive stock rebuilding beyond simple biomass increases.

Rebuilding Feasibility

Stocks may be fundamentally altered by fisheries-induced evolutionary changes, disrupted age structure, environmental shifts, or ecosystem reorganization. Consequently, rebuilt stocks may differ markedly from their pre-depletion state, and restoration to historical conditions may not always be achievable.

The feasibility of rebuilding to historical conditions should be carefully evaluated when establishing stock objectives. Socioeconomic factors should only be considered as constraints on rebuilding feasibility in extreme circumstances and should be supported by rigorous cost-benefit analysis.

Multispecies Interactions

Interspecific interactions significantly influence recovery potential, with effects varying according to environmental conditions. Predation pressure and prey availability critically affect recruitment success and rebuilding capacity of depleted stocks. These trophic interactions typically result in slower rebuilding rates compared to single-species predictions.

Rebuilding objectives and management measures should account for multispecies interactions within an ecosystem context. It is biologically impossible to simultaneously achieve Maximum Sustainable Yield predictions from single-species assessments across multiple interacting species within the same ecosystem. Therefore, rebuilding efforts should adopt an ecosystem-based approach whenever feasible.



Annex 4: Technical Specifications for Performance Indicators

Harvest Control Rule Performance Measures

Note: The specific numerical thresholds presented in square brackets [X] are indicative only and would need to be formally tested and agreed upon for each species and stock, taking into consideration the characteristics of the fishery and the data available.

Table 14 Harvest Control Rule Performance Measures

Performance Indicator	Green	Amber	Red
<p>MP01: Maintain Stock Around Target Reference Point (Stock Status)</p> <p>The probability that the stock will go below the target reference point over the defined forecasted management period. The target reference point will be different between different stocks, for example 40% B_0 for orange roughy and a CPUE target for alfonsino.</p>	<p>A lower than [50%] probability that the stock is or will be below the target reference point over the defined forecasted management period.</p>	<p>Between a [50–60%] probability that the stock is or will be below the target reference point over the defined forecasted management period.</p>	<p>A higher than [60%] probability that the stock is or will be below the target reference point over the defined forecasted management period.</p>
<p>MP02: Limit Reference Point (Risk/Safety)</p> <p>The probability that the stock will go below the limit reference point over the defined forecasted management period, for example 20% B_0 for orange roughy.</p>	<p>A lower than [5%] probability that the stock is or will be below the limit reference point over the defined forecasted management period.</p>	<p>Between a [5–10%] probability that the stock is or will be below the limit reference point over the defined forecasted management period.</p>	<p>A higher than [10%] probability that the stock is or will be below the limit reference point over the defined forecasted management period.</p>
<p>MP03: Probability of Being in Green Zone of Kobe Plot</p> <p>The probability that the stock is or will remain in the green zone of the Kobe plot (biomass above target biomass and fishing pressure below target fishing pressure) for those stocks where these values are available. Note that MP03 is the combination of MP01 (biomass</p>	<p>A greater than [50%] probability that the stock is or will be in the green zone of the Kobe plot over the defined forecasted management period.</p>	<p>Between a [40–50%] probability that the stock is or will be in the green zone of the Kobe plot over the defined forecasted management period.</p>	<p>A lower than [40%] probability that the stock is or will be in the green zone of the Kobe plot over the defined forecasted management period.</p>

Performance Indicator	Green	Amber	Red
above target biomass) and MP04 (probability of overfishing).			
<p>MP04: Probability of Not Overfishing</p> <p>The probability that the fishing pressure is or will remain below target fishing pressure for those stocks where these values are available.</p>	A greater than [50%] probability that the fishing pressure is or will be below the target fishing pressure over the defined forecasted management period.	Between a [40–50%] probability that the fishing pressure is or will be below the target fishing pressure over the defined forecasted management period.	A lower than [40%] probability that the fishing pressure is or will be below the target fishing pressure over the defined forecasted management period.
<p>MC01: Long-Term Average Annual Catch Limit (Economic, Yield)</p> <p>This measure tracks the relative economic viability of different harvest control rules. There are no flags associated with it. It is calculated as the average catch limit over the defined forecasted management period. This forecast management period might only include later forecast years, i.e., once the population has stabilised to target levels.</p>			
<p>MC02: Variability of Annual Catch Limit (Economic, Stability)</p> <p>This measure tracks economic stability of the harvest control rule. It is also a potential sustainability indicator for low-information stocks.</p>	The variability of catch limit over the defined forecasted management period is less than [15%].	The variability of catch limit over the defined forecasted management period is between [15–25%].	The variability of catch limit over the defined forecasted management period is greater than [25%].
<p>MC03: Long-Term Predicted Annual CPUE (Economic, Catch Rate)</p> <p>This measure tracks the relative economic viability of different harvest control rules. There are no flags associated with it. It is calculated as the average projected CPUE over the defined forecasted management period. This forecast</p>			

Performance Indicator	Green	Amber	Red
management period might only include latter forecast years, i.e., once the population has stabilised to target levels.			
<p>MA01: Assessment Model Convergence and Reliability</p> <p>This indicator captures the adequacy of the stock assessment model to determine status. Applicable to stocks with assessment models.</p>	<p>Diagnostics for all key parameters (biomass indices, and tag-release and recapture observations) are adequate, and no evidence of significant departure from model assumptions.</p>	<p>The majority of diagnostics for all key parameters (biomass indices, and tag-release and recapture observations) are adequate; sensitivity runs that evaluate alternative choices of parameters where diagnostics are not adequate do not significantly affect estimates of status.</p>	<p>Failure of key parameters to converge at MCMC. Key parameters are poorly estimated; or sensitivity runs that evaluate alternative key choices of parameters with model parameters where diagnostics are not adequate have a significant effect on estimates of status.</p>
<p>MA02: Fits to Indices of Abundance</p> <p>Abundance indices in disagreement with the model trajectory, which might indicate that the model is not adequate or that the abundance indices are not reliable.</p>	<p>The abundance indices are fitted without any significant trend in the residuals.</p>	<p>The abundance indices that are fitted have a significant trend in the residuals.</p>	<p>Not defined (models should not be used for management purposes if they don't fit the abundance indices).</p>
<p>MA03: Between Assessment Catch Limit Variability (Economic, Stability)</p> <p>The absolute percentage change in catch limits between assessments. This measures changes in advice resulting from the assessment, and hence the assessment stability. It also represents economic stability.</p>	<p>The percentage change in the catch limit from the assessment is less than [0.15] over the defined forecasted management period.</p>	<p>The percentage change in the catch limit from the assessment is between [0.15 and 0.25] over the defined forecasted management period.</p>	<p>The percentage change in the catch limit from the assessment is greater than [0.25] over the defined forecasted management period.</p>
<p>ME04: Change in Average Recent Recruitment</p> <p>Evidence of significant reduction in</p>	<p>Year-class strength (YCS) in the last [10] years lower than [75%] of long-term</p>	<p>YCS in the last [10] years between [50–75%] of long-term average YCS.</p>	<p>YCS in the last [10] years below [60%] of long-term</p>

Performance Indicator	Green	Amber	Red
recent recruitment, which may indicate higher or lower productivity than assumed. Only applicable for stocks with an assessment that estimates recruitment.	average YCS.		average YCS.

Management Performance Indicators

Table 15 Management Performance Indicators

Performance Indicator	Green	Amber	Red
<p>FC01: Total Annual Catch (Economic, Yield)</p> <p>This indicator tracks economic viability. It is also a potential sustainability indicator for low-information stocks. Note that for stocks with small catch limits, a difference in tonnes is likely more robust.</p>	<p><i>The annual catch is less than a difference of [15% / 5 tonnes] of the current limit.</i></p>	<p><i>The annual catch difference is between [15–25% / 5–10 tonnes] of the current limit.</i></p>	<p><i>The annual catch is greater than a difference of [25% / 10 tonnes] of the current limit.</i></p>
<p>FC02: Total Annual Effort (Economic, Yield)</p> <p>This indicator tracks economic viability. It is also a potential sustainability indicator for low-information stocks.</p>	<p><i>The mean annual effort is less than a difference of [15%] of the mean annual effort over the defined reference period ([2018–2022]).</i></p>	<p><i>The mean annual effort difference is between [15–25%] of the mean annual effort over the defined reference period ([2018–2022]).</i></p>	<p><i>The mean annual effort is greater than a difference of [25%] of the mean annual effort over the defined reference period ([2018–2022]).</i></p>
<p>FC03: Catch in Most Recent Seasons \leq Catch Limit</p> <p>The average catch taken in the most recent seasons should be less than or equal to the total catch limit.</p>	<p><i>The amount of catch taken from the fishery does not exceed the catch limit when averaged over the last [two] seasons.</i></p>	<p><i>Not defined.</i></p>	<p><i>The amount of catch taken from the fishery exceeds the catch limit when averaged over the last [two] seasons.</i></p>

Performance Indicator	Green	Amber	Red
<p>FC04: Mean Unstandardised CPUE (Economic, Catch Rate)</p> <p>This indicator tracks economic viability. It is also a potential sustainability indicator for low-information stocks.</p>	<p><i>The unstandardised CPUE is less than a difference of [15%] of the mean unstandardised CPUE over the defined reference period ([2018–2022]).</i></p>	<p><i>The unstandardised CPUE is between [15–25%] of the mean unstandardised CPUE over the defined reference period ([2018–2022]).</i></p>	<p><i>The unstandardised CPUE is greater than a difference of [25%] of the mean unstandardised CPUE over the defined reference period ([2018–2022]).</i></p>
<p>FA01: Abundance Indices</p> <p>Applicable to stocks with abundance indicators (e.g., CPUE, acoustics). If abundance indices disagree with each other, it might indicate that one or more of these abundance indices do not provide reliable management advice.</p>	<p><i>The abundance indices are in general agreement with each other.</i></p>	<p><i>The abundance indices disagree with each other.</i></p>	<p><i>Not defined.</i></p>
<p>FA02: Data Availability and Quality</p> <p>Aims to capture when the data collection is no longer adequate for the management of the stock. For example, if management advice is based on length data and insufficient length data are collected, or if based on acoustics data and insufficient surveys have been carried out.</p>	<p><i>The data used for management advice continues to be of adequate quantity and quality to provide management advice.</i></p>	<p><i>The data used for management advice have not been updated for more than one assessment cycle.</i></p>	<p><i>The data used for management advice have not been updated for more than two assessment cycles.</i></p>
<p>FE01: Major Ecosystem Regime Shift</p> <p>Evidence of significant ecosystem regime shift affecting stock productivity including major changes in prey abundance, predator populations, oceanographic conditions.</p>	<p><i>No evidence of a major environmental regime shift.</i></p>	<p><i>Indirect evidence of a major environmental regime shift.</i></p>	<p><i>Direct evidence of a major environmental regime shift that materially affects the assumptions underpinning the harvest control rule and the assessment.</i></p>
<p>FE02: Major Spatial Redistribution of Effort</p> <p>Evidence of significant spatial redistribution of effort that may be the result of a management action,</p>	<p><i>No evidence of significant spatial redistribution of effort.</i></p>	<p><i>Some spatial redistribution of effort that is unlikely to significantly affect the harvest control</i></p>	<p><i>Spatial redistribution of effort that is likely to significantly affect the harvest control rule or the</i></p>

Performance Indicator	Green	Amber	Red
changing productivity, serial depletion, or stock collapse.		<i>rule or the assessment assumptions.</i>	<i>assessment assumptions.</i>
FE03: Significant Selectivity Changes Evidence of significant selectivity change that may be the result of a management action or fleet dynamics.	<i>No evidence of significant selectivity change.</i>	<i>Some selectivity change that is unlikely to significantly affect the harvest control rule or the assessment assumptions.</i>	<i>Significant selectivity change that is likely to significantly affect the harvest control rule or the assessment assumptions.</i>
FE04: Change in Biological Parameters Evidence of significant change in biological parameters from the parameters assumed in the management advice. Biological parameters will include length-weight and growth relationship where available.	<i>Biological parameters in the last [5] years within [80–120%] of assumed parameters in the stock assessment model or stock characterisation.</i>	<i>Biological parameters in the last [5] years within [70–80 or 120–130%] of assumed parameters in the stock assessment model or stock characterisation.</i>	<i>Biological parameters in the last [5] years within [<70% or >130%] of assumed parameters in the stock assessment model or stock characterisation</i>
FE05: Catch of Vulnerable Marine Ecosystems Indicator Taxa (Ecosystem Goals) Tracks potential increased benthic effect of fishing.	<i>The annual VME catch is less than a difference of [15%] of the mean annual VME catch over the defined reference period ([2018–2022]).</i>	<i>The annual VME catch difference is between [15–25%] of the mean annual VME catch over the defined reference period ([2018–2022]).</i>	<i>The annual VME catch is greater than a difference of [25%] of the mean annual VME catch over the defined reference period ([2018–2022]).</i>
FE06: Catch of Bycatch Species (Ecosystem Goals) Tracks potential increased effect of fishing on associated species.	<i>The annual bycatch catch is less than a difference of [15%] of the mean annual bycatch catch over the defined reference period ([2018–2022]).</i>	<i>The annual bycatch catch difference is between [15–25%] of the mean annual bycatch catch over the defined reference period ([2018–2022]).</i>	<i>The annual bycatch catch is greater than a difference of [25%] of the mean annual bycatch catch over the defined reference period ([2018–2022]).</i>

Performance Indicator	Green	Amber	Red
<p>FE07: Catch of Shark Species in Annex I of CMM 12 (2023) (Ecosystem Goals)</p> <p>Tracks potential increased effect of fishing on 'high-risk' and of 'concern' shark species (Annex I of CMM 12 (2023)).</p>	<p><i>The annual catch of Annex I (CMM 12 2023) shark species is less than a difference of [15%] of the mean annual catch of Annex I (CMM 12 2023) shark species over the defined reference period ([2018–2022]).</i></p>	<p><i>The annual catch difference is between [15–25%] of the mean annual catch of Annex I (CMM 12 2023) shark species over the defined reference period ([2018–2022]).</i></p>	<p><i>The annual catch of selected shark species is greater than a difference of [25%] of the mean annual catch of Annex I (CMM 12 2023) shark species over the defined reference period ([2018–2022]).</i></p>
<p>FE08: Catch of Seabirds (CMM 13 (2022)) (Ecosystem Goals)</p> <p>Tracks potential increased effect of fishing on seabirds.</p>	<p><i>The annual seabird catch is less than a difference of [15%] of the mean annual seabird catch over the defined reference period ([2018–2022]).</i></p>	<p><i>The annual seabird catch difference is between [15–25%] of the mean annual seabird catch over the defined reference period ([2018–2022]).</i></p>	<p><i>The annual seabird catch is greater than a difference of [25%] of the mean annual seabird catch over the defined reference period ([2018–2022]).</i></p>

Annex 5 – Worked Example: Applying the Precautionary Approach

Framework to Orange Roughy

*This worked example demonstrates how SIOFA's Precautionary Approach Framework applies to the orange roughy (*Hoplostethus atlanticus*) fishery in the Walter Shoal Ridge management unit. The example uses actual data from SIOFA stock assessments and management decisions, as well as advice from PAM 02 and 03, to illustrate framework implementation in practice.*

Part III: Information Classification

Classification: High Information

Orange roughy in the Walter Shoal Ridge (WSR) management unit likely qualifies as High Information based on comprehensive catch data, acoustic survey indices, age-structured stock assessment capability, and detailed biological knowledge.

Available Data Components:

- Catch and effort data from 2000-2023 (haul-by-haul records from multiple CCPs)
- Acoustic biomass survey indices from 2004, 2006, 2015, and 2018
- Length frequency data collected by scientific observers
- Age composition data from otolith collections
- Maturity and biological parameter estimates from regional studies

The 2025 stock assessment (ORY-2024-01 Report 2) applied a fully Bayesian integrated age-structured model using CASAL software, incorporating catch history, acoustic indices, length compositions, and age data. This assessment capability places orange roughy suggests the High Information category.

Biological Parameters (from ORY-2024-01):

- Natural mortality (M): Base case 0.044 yr^{-1} , with sensitivity testing at 0.024 and 0.058
- Growth: Very slow (K values 0.045-0.070 from literature)
- Maturity: Estimated at age 31.5 for WSR, literature reports 23-40 years
- Longevity: Maximum age 180 years in SIOFA region, 200+ years reported globally

Implication for Management: High Information status enables use of model-based management procedures with MSE testing, as outlined in Part V of the framework.

Part IV: Stock Status Zones and Reference Points

Reference Points (MoP10 paragraph 77)

SIOFA adopted interim reference points for orange roughy in 2023, recognising the stock's exceptional longevity and slow productivity:

Reference Point	Value and Rationale
Limit Reference Point (LRP)	0.2B ₀ (90% probability of remaining above) <i>Below this level, stock considered at serious risk. Requires immediate rebuilding action.</i>
Target Reference Point (TRP)	0.4B ₀ (50% probability of being at or above) <i>Maintains stock at productive levels providing sustainable yields while accounting for uncertainty in orange roughy's extremely slow life history.</i>
Threshold	To be determined through MSE testing <i>MoP11 paragraph 146 endorsed testing sensitivity choices of 50-60-70% probability of being at or above TRP of 30-40-50% B₀.</i>

These reference points define three stock status zones:

Zone	Biomass Range	Status Interpretation
Healthy Zone	$B \geq \text{Threshold}$	Stock maintained well above target with acceptable risk. Standard management applies.
Under Watch Zone	$\text{LRP} < B < \text{Threshold}$	Stock below optimal level. Harvest control rule reduces exploitation as biomass declines toward limit.
Critical Zone	$B \leq \text{LRP}$	Stock at serious risk. Fishery likely closed with rebuilding plan required.

Current Stock Status (2025 Assessment)

The 2025 stock assessment (ORY-2024-01 Report 2) indicates the WSR stock status is likely well above 40% B₀, but with high uncertainty. Key assessment findings:

- Base case model: Stock status likely well above interim target (40% B₀)
- BMSY estimated at 30.8% B₀
- Target exploitation rate $F_{40} = 0.033$ (exploitation rate achieving 50% probability of being above 40% B₀)
- FMSY = 0.045
- Historical exploitation rates often above interim target

Assessment results highly uncertain due to limited information on natural mortality and acoustic catchability. Declining acoustic estimates on some hills (particularly Sleeping Beauty) warrant precautionary approach.

Classification: Likely Healthy Zone, but uncertainty requires conservative management pending improved parameter estimates.

Part V: Management Procedure Development

Management Objectives (MoP11 paragraph 147, SC9 Annex H)

SIOFA adopted seven management objectives for orange roughy spanning biological, economic, social, and ecosystem considerations:

No.	Category	Management Objective
1	Stock Status	Maintain the stock at or fluctuating around (i.e., with a 50% probability of being at or above) 40% of unfished biomass (B_0)
2	Risk-Safety	Ensure that the spawning stock biomass has at least a 90% probability of remaining above the limit reference point (20% of unfished biomass)
3	Economic Yield	Maintain the catch at a level that is consistent with the conservation objectives above
4	Economic Catch Rate	Maintain the CPUE at a level that is representative of the period 2015-2020, provided that the management objectives 1 and 2 are being met
5	Economic Stability	Minimise the level of variability in catches over time (the percentage is to be defined during the MP development)
6	Social Goals	Maintain viable fishing operations (such as employment and food security), alongside safe fishing practices as described in CMM 2022/12
7	Ecosystem Goals	Maintain a healthy ecosystem that meets the criteria established in CMMs including: CMM 2023/01, VMEs; CMM 2021/01, ETP species; CMM 2022/09, Sharks; CMM 2023/06, Seabirds

Harvest Control Rules Under Development (PAM-2024-03)

SIOFA is testing multiple harvest control rule structures through Management Strategy Evaluation. For orange roughy, the following rules are being evaluated:

Threshold Harvest Control Rules (Hockey Stick):

These rules link exploitation rate to stock status. Above the threshold, fishing operates at target exploitation rate. As biomass declines through the Under Watch Zone (between threshold and LRP), exploitation rate reduces linearly to zero at the LRP. Two variants are being tested:

- Rule 1: Precautionary hockey stick - more conservative reduction in fishing pressure
- Rule 2: Modified hockey stick - allows slightly higher exploitation at lower stock levels

Constant Exploitation Rate Rule:

Rule 3 maintains constant exploitation rate regardless of status (though may include closure threshold). Testing has shown this performs poorly for depleted stocks and is not recommended for adoption.

Constant Catch Rule:

Maintains fixed annual catch. Currently applied as interim management using 2015-2020 average (MoP10 paragraph 79). Performance under different stock status scenarios being evaluated through MSE.

MSE testing incorporates uncertainty in natural mortality, acoustic catchability, recruitment variability, and implementation error. Results from PAM-2024-03 will inform final HCR selection and parameterisation.

MSE Testing Framework

Management Strategy Evaluation tests candidate management procedures against plausible future scenarios. For orange roughy WSR, the MSE framework includes:

Operating Models:

- Base case scenario ($M = 0.044$) representing current best estimate
- Sensitivity to natural mortality ($M = 0.024$ and $M = 0.058$)
- Alternative acoustic catchability assumptions
- Current stock status vs. depleted status scenarios

Performance Metrics (from PAM-2024-03 Appendix D):

- MP01: Probability of being above B_{40} (target)
- MP02: Probability of being below B_{20} (limit)
- MP03: Probability in green zone (Kobe plot analysis)
- MP04: Probability of not overfishing ($F < F_{40}$)
- Average annual catch and catch variability

Performance assessed over short (0-10 years), medium (10-20 years), and long term (20-30 years) horizons.

Key Lessons from Orange Roughy Example

This worked example illustrates several important aspects of implementing SIOFA's Precautionary Approach Framework:

1. Data Quality Enables Sophisticated Methods, But Uncertainty Remains

Despite High Information classification with integrated assessment capability, orange roughy management still confronts substantial uncertainty. Limited knowledge of natural mortality and

acoustic catchability drive assessment results, requiring sensitivity testing across plausible parameter ranges. The framework accommodates this through MSE testing of management procedures against multiple operating models.

2. Life History Shapes Reference Point Selection

Orange roughy's exceptional longevity (180+ years) and late maturity (23-40 years) justify the 0.4B₀ target - higher than many fisheries. Extremely slow productivity means stocks cannot sustain fishing pressure viable for shorter-lived species. The framework's flexibility allows reference points tailored to species biology.

3. Multiple Objectives Create Trade-offs Requiring Explicit Evaluation

The seven objectives spanning conservation, economics, social, and ecosystem dimensions will inevitably conflict. Maintaining CPUE representative of 2015-2020 while reducing exploitation to meet conservation objectives creates tension. MSE provides the framework for quantifying these trade-offs and supporting transparent decisions about acceptable balances.

4. Interim Management Provides Precautionary Foundation

While operational management procedures undergo development, constant catch at 2015-2020 average maintains fishery continuity without increasing risk. This demonstrates how the framework accommodates phased implementation, with precautionary interim measures until full MP testing completes.

5. Framework Applies Across Information Levels

Orange roughy represents the high-information end of the spectrum. SIOFA's framework applies the same conceptual approach to medium-information stocks (using empirical indicators) and low-information stocks (using knowledge-based default rules), maintaining equivalent conservation risk across all fisheries regardless of data availability.

This worked example demonstrates practical application of SIOFA's Precautionary Approach Framework using actual SIOFA stock assessments, management decisions, and MSE testing results current as of December 2025. As harvest strategy development continues through Scientific Committee and Meeting of the Parties processes, specific management procedure parameters and performance thresholds will be refined based on stakeholder input and final MSE results.

Attachment C



24 December 2025

Dr Marco Milardi, Science Officer, SIOFA Secretariat
Dr Alistair Dunn, Chairperson, SIOFA Scientific Committee
By email

Dear Drs Milardi and Dunn

Re: PAM-2024-01 Milestone 2 Deliverables

We are pleased to present the Milestone 2 deliverables for PAM-2024-01: the draft Conceptual Framework and Technical Guidelines, incorporating feedback received following the August 2025 workshop.

Annex I of this letter documents how we addressed the specific comments from the CCPs at August workshop for ease of reference (we did not update it in tracked changes as we thought it would be too difficult to follow). We hope the improvements we have made also address the observer comments.

Noting the substantial work undertaken for PAM-2024-02 and PAM-2024-03, we have incorporated aspects of that advice into the Technical Guidelines, where relevant to implementing the Framework. It was our intention to (1) correctly represent Dr Hoyle and Dr Mormede's advice and (2) ensure the Conceptual Framework and Technical Guidelines implement that advice rather than compete with it or change it. To that extent, any errors or omissions are ours and we welcome factual or technical corrections. We have copied this letter to Dr Hoyle and Dr Mormede for this reason.

We have also considered existing Scientific Committee advice and Meeting of the Parties decisions, as well as your "living" documents (which we found very helpful), to ensure consistency. If we have not done so, please accept our apologies and we welcome any corrections. The only major difference is that we have used 'management procedures' as our nomenclature, rather than harvest strategies, as is the increasing norm in international fisheries. We can revert to harvest strategies if this preferred.

We have also provided a worked example applying the framework to orange roughy to demonstrate how the information classification and framework components would operate in practice ([Annex 2](#))

Ahead of the Final Drafts (Milestone 3), there are several technical matters we wish to draw to your, and the advisory panel's, specific attention before finalisation.

1. Implementation Scope and Progressive Application

The August 2025 Workshop raised questions on the scope of the Framework—in summary, which species should the framework apply to and how should this be addressed.

We have given this careful thought. We note that Article 4 of the Agreement applies to all fishery resources in the Area. We are also aware that this could potentially encompass 100 species within your scope of responsibility, many of which are likely to be low/no information and/or of low/no economic importance. However, we understand it is also your desire not to 'forget' these species, so as to ensure that they do not inadvertently become overfished.

In practice, implementing this Framework could either occur through substantive upfront investment to assign all species an information classification and zone, or it could occur progressively. In reality, the lower information species may be less work individually (but a lot of work initially) to appropriately categorise, as the MOP could impose generic management (trigger-based reviews/breakout rules, no specific catch limits, etc.) in line with the Technical Guidelines.

Higher information/more valuable species, such as those in Annex 1 of CMM 17, are likely to be more work individually because they will require more individualised, complex attention.

Our view is that it could be quite complex to follow the Precautionary Approach Framework if certain aspects apply to some but not all species—and it may ultimately be confusing to follow.

We also note that 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

Our recommendation:

- We recommend the MOP should explicitly determine which species the Framework initially applies to, and then progressively 'opt' other species in.
- It might be useful to create different tiers—Primary Species (specified in CMM 17), Primary Species (other), and Secondary Species. As recommended in the workshop, the framework could initially apply to the Primary Species specified in CMM 17, with each receiving the individualised attention provided for in the Framework. That decision could be reflected in the Scope section (which we have done), or it could also be made by a Resolution of the MOP should you wish to preserve the framework as a whole but have a separate decision outlining how it is to be operationalised.
- For the remaining species (Primary - Other and Secondary), the MOP could decide an indicative timeline for their progressive inclusion in the framework, and also make an

interim decision adopting trigger rules that would enable the MOP to manage any sustainability risks without having to apply the full framework to each of these species upfront.

- Those trigger rules may ultimately be useful for informing the classification and management of these species when the framework is applied to them. Realistically, these species are more likely than not to be categorised as 'low' or 'zero' information, which in itself is an important step in the progressive application of the framework. These species may also default to a particular zone (e.g., Under Watch Zone).

Example trigger rules could include:

- Catches exceed [x] tonnes annually for [y] years
- Catch increases by >x% over a [y]-year average
- Sustained upward trend over [y] years suggesting a developing fishery
- PSA or other risk assessment classifies species as High Risk
- IUCN listing change
- Evidence of aquatic disease

When/if triggered, the Scientific Committee could be asked to advise on the application of the framework to that species. (*Note: x or y values in each case not necessarily the same.*)

We note that implementation is ultimately up to the MOP, but we have included some text in anticipation (see 'scope' and 'implementation pathway' sections of the Conceptual Framework). We encourage the MOP to optimise processes that would support this phased implementation.

2. Operational Checklists for Information Classification

The workshop requested that we apply the information classification categorisation to all stocks in Annex 1 of the New and Exploratory Fisheries CMM.

While we appreciate the value this would bring, we regret to advise this was outside the scope of our contract, and we are unable to do this for two reasons:

1. Information limitations: The most detailed information we obtained during this process was the (restricted) species summaries. We do not have sufficient detailed knowledge of data availability for all these stocks to make informed classifications.
2. PAM-2024-02 work: Dr Hoyle and Dr Mormede have already made efforts to classify stocks in the context of examining which methodologies are most appropriate to the information level of those stocks. We did not wish to duplicate or contradict their work.

However, we have provided (1) amendments to the information classification criteria to clarify the information requirements in the Conceptual Framework (2) substantial operational guidance to implement this in the Technical Guidelines, including detailed operational checklists.

The checklists are intended to be a useful tool that still respects the need for expert judgement, particularly for borderline cases. It is not intended to be a rigid process, as this may not be constructive to your aims.

The operational checklist is novel. We looked extensively at different examples of how to operationalise information classification in international organisations and national organisations and could not find an existing template. What we did instead was retrofit a checklist to stocks that we instinctively thought might meet the categories of high, medium, and low information from elsewhere, considering what data would have been available for that conclusion to be drawn. We then created a checklist based on that analysis. This is included in the Technical Guidelines.

We suggest the Scientific Committee give close consideration to those checklists to determine if they are appropriate. Our view is that there are values in the operational checklist that need to be discussed and agreed by the Scientific Committee before application to a specific species. We are aware that, for example, five years of squid catch data will have a different value to the Scientific Committee than five years of orange roughy data, given their different life history characteristics. The values in the checklist may be better expressed as algebraic (X or Y) to enable the Scientific Committee to first review how much data they would consider to be high, medium, or low information for a given species, and then to undertake the classification of that species.

3. Treatment of Low and Zero-Information Stocks

A distinguishing feature of this framework is its treatment of low and zero-information stocks.

Most international frameworks and national frameworks that we reviewed treat low/no information stocks as ancillary considerations. For SIOFA, they represent the norm rather than the exception. Very few frameworks—if any—go into the level of detail we felt was required for medium and particularly low information stocks (though we drew on the document shared by Dr Walker for this purpose -for which, thanks).

Consequently, the Conceptual Framework and Technical Guidelines include comprehensive guidance for low or zero information stocks that is novel in international practice. This reflects SIOFA's unique operating environment where data-limited stocks are the majority, not the minority.

We draw this to your attention because the novelty of these approaches may warrant particular scrutiny from the Scientific Committee and advisory panel, and because their successful implementation will be critical to SIOFA's ability to manage its diverse portfolio of fisheries.

The Framework is designed to be flexible and adaptive to SIOFA's needs now and into the future. We welcome feedback on these policy matters and stand ready to refine the documents based on your input.

We remain at your disposal to address any further issues ahead of submission to the Scientific Committee in February 2026.

Yours sincerely,

Kerrie Robertson, Glen Holmes

PAM-2024-01 Project Consultants

CC Dr Simon Hoyle, Dr Sophie Mormede.

Annex 1 – Response to August 2025 Workshop Feedback

Workshop Feedback	Consultant response
<p>The Workshop suggested that the consultants revise the Reversal of Burden of Proof section to align it more closely with Article 2 of the Agreement.</p>	<p>This has been substantially revised in the Principles section</p>
<p>The Workshop suggested that the consultants revise the definition of “Precautionary” in the Principles section and align it more closely to the definition in Article 4 of the Agreement.</p>	<p>Revised accordingly</p>
<p>The Workshop suggested that when explaining the precautionary approach, the PAF should refer to Recommendation 10 of the SIOFA Performance Review, which called for the development of a framework for decision-making at managerial level in accordance with the precautionary approach</p>	<p>See new section inserted into Part 1.</p>
<p>The Workshop suggested that the consultants further refine the Principles section as a whole such that it provides a clearer explanation of how the PAF supports the implementation of the obligations under the Agreement.</p>	<p>Revised accordingly</p>
<p>Dr Bonhommeau, one of the expert reviewers, noted that:</p> <ol style="list-style-type: none"> a. The involvement of all stakeholders in the process, including managers, industry, and observers, as soon as possible will be very helpful for facilitating discussions and further progress by ensuring that everyone is engaging in the process on the same basis and with the same understanding. 	<p>We have revised the Transparency and Decision-Making section in a way that we hope meets this valid comment while respecting the general manner through which (and by whom) decisions are taken in multilateral frameworks.</p>
<p>The Workshop noted that while all SIOFA species fall within the overall scope of the PAF, it would be unrealistic to apply the PAF equally to all species and that some aspects of the PAF should be focused on the main SIOFA species. The Workshop suggested that as a first step, the target species listed in Annex 1 of CMM</p>	<p>Addressed in this letter, as well as in ‘Scope’ and ‘Implementation Pathway.’</p>

Workshop Feedback	Consultant response
<p>17(2024) (New and Exploratory Fisheries) could be considered the main SIOFA species. The Workshop requested that the consultants add clarifications to the PAF to specify which sections apply to the main SIOFA species.</p>	
<p>The Workshop discussed how risk-based assessments, such as those conducted by Australia for teleosts and chondrichthyans in the SIOFA Area, could be incorporated in the PAF. The Workshop noted that while some aspects of these assessment methods could be relevant to the PAF, one limitation is that they are only able to provide an assessment in terms of fishing mortality (F) and not biomass.</p>	<p>Incorporated</p>
<p>The Workshop suggested that the consultants revise the description “Determines appropriate levels of precaution” for one of the functions of Component 1: Information Classification System to more accurately reflect a process whereby the MoP would determine an appropriate level of risk for all stocks, while the PAF should determine risk equivalency for high, medium, and low information stocks.</p>	<p>The Workshop has made a valid point. The original text implied the Information Classification System itself sets the precaution levels. It conflated 3 distinct functions – information classification (Component 1), risk tolerance setting (a policy decision from the MOP) and Risk equivalency implementation (technical framework function).</p> <p>We have revised the text in Component 1 accordingly. We have also</p> <ul style="list-style-type: none"> • Made minor adjustments to Roles and Responsibilities to reflect the distinction • Added a ‘Risk Governance’ section. And • Updated the Management Procedures section to illustrate how MPs operationalise the risk equivalency principle.
<p>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.</p> <p>2. Dr Bonhommeau, one of the expert reviewers, noted that:</p>	<p>We hope that the revisions to the Conceptual Framework and Technical Guidelines address this valid comment.</p>

Workshop Feedback	Consultant response
<p>a. Of the three components of the PAF (Information Classification System, Three-Zone Stock Status System, and Management Procedures), so far, emphasis has been placed on how the Information Classification System and information availability will drive the other two components. However, there will likely be mutual feedback and connections among all three components, and this could be more clearly described in the PAF.</p>	
<p>When considering the proposed three-tier Information Classification System, the Workshop noted that there may be some SIOFA species for which almost no information is available, other than perhaps the species name and some basic catch information. The PAM-2024-01 consultants explained that they had originally considered such species to fall under the low information tier, but suggested that, upon further consideration, they would consider a potential fourth category for stocks with zero or near-zero available information.</p>	<p>As below, we have included a fourth category (Zero information). We have made corresponding insertions throughout the text to reflect an additional category.</p>

Workshop Feedback	Consultant response
<p>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.</p> <p>Dr Walker, one of the expert reviewers, drew the PAM-2024-01 consultants' attention to a consultation paper on applying low-medium information approaches to fisheries management to some fish stocks in New Zealand, which is available at https://www.mpi.govt.nz/dmsdocument/70080-Review-of-sustainability-measures-for-five-low-medium-knowledge-stocks-for-2025.26.</p>	<p>Noted by the Consultants. We have included a fourth category (Zero information).</p> <p>Regular review has been included in the text.</p> <p>We have taken inspiration from the document provided by Dr Walker (for which, thanks). There is a substantial focus on low/medium information stocks.</p>
<p>The Workshop noted that the definitions of the classification criteria for determining high, low, medium information stocks referred to “a comprehensive range of information”, “sufficient relevant information”, and “some relevant information”. The Workshop noted that these descriptions were quite vague and suggested that they may need to be further refined. The consultants explained that the definitions were intentionally worded in that way so as to give the SC greater flexibility when making its own determinations.</p>	<p>The original text has origins in MSC 3.0. We have revised the descriptive criteria in the Conceptual Framework and added substantial detail to the Technical Guidelines, including a checklist. We address this in our letter above.</p>
<p>The Workshop noted that “conservation status” was not a correct description of the criterion by which stocks would be classified under the proposed Three-Zone Stock Status System and suggested that the consultants revise the section accordingly. The Workshop also suggested that the consultants reconsider the current naming of the three zones (Healthy, Cautious, and Critical) and try to find new names that are both scientific and clear to managers. Furthermore, the Workshop suggested that the definitions of the zones be based</p>	<p>We agree conservation status is not an appropriate term and have revised this text accordingly.</p> <p>We take the point about transparency and reproducibility and have dealt with this at a high level in the Transparency section, and in further detail in the</p>

Workshop Feedback	Consultant response
<p>on the biological reference points that will be developed under PAM-2024-02.</p> <p>Dr Nieblas, one of the expert reviewers, noted that:</p> <ul style="list-style-type: none"> b. For stock status classification schemes, it would be important to consider these classifications in relation to major international standards, particularly the United Nations Food and Agriculture Organization (FAO) State of Stocks Index, and how these are defined, particularly for data-limited or knowledge-defined status decisions. c. As a related point, consideration should be given to transparency and reproducibility of decisions throughout the PAF. It would be useful to have typical case studies or even draft decisions on how to implement these steps throughout the PAF, so there can be a clear understanding of what these steps are and how to apply them. Rubrics, checklists, and scores could be included to enable these decisions to be taken by anybody and to be easily defended or reproduced. 	<p>TG. We address the suggestions about rubrics/checklists and scores in the Technical Guidelines.</p> <p>We have given the names a lot of thought. The zones ‘Healthy, Cautious, Critical’ are derived from both NAFO and Canada. We considered alternatives, such as:</p> <ul style="list-style-type: none"> - Green, Amber, Red -but we note that it has specific connotations both with a Kobe plot and with the PI framework proposed through PAM 03. In that respect, we thought this would be confusing to use these same terms. - We considered reference point-derived terms (at or above target/between limit and target ‘below limit) and terms derived from condition (overfished/not overfished) but ultimately decided against these as well. The latter does not create an easy to describe middle category, and reference point derived terms, while technical, may not adequately and easily convey what is required for stocks in each zones. - We considered too the FAO terms but ultimately decided against them – in part because terms like ‘maximally fished’ are controversial for some practitioners, but also because they do not align neatly with what the zones convey in terms of a management action. - We considered ICES terminology (4 categories – within safe biological limits, outside safe biological limits, at risk of reduced reproductive capacity and reduced reproductive capacity’ which are themselves set in relation to MSY, but decided that these ignore the fact that TRPs might be economically derived, and that MSY might not be reliably calculated for the majority of some stocks. <p>Ultimately, we suggest (i) retaining the terms ‘Healthy’ and ‘Critical (ii) clarifying what is meant by those terms (see text) and (iii) finding a different term for the middle category. We suggest something like ‘Under Watch’. We are open to other suggestions.</p>
<p>With regard to the generic example of the visual representation of the three stock status zones based on F and biomass, the Workshop requested that the Y-axis be inverted (with F_{limit} above and</p>	<p>Revised accordingly.</p>

Workshop Feedback	Consultant response
<p>F_{target} below). The Workshop also suggested including a shoulder around the target to reflect management around a target and the fluctuation that naturally occurs around the target.</p>	
<p>The Workshop noted that very few SIOFA species could be plotted in relation to F-based and biomass-based reference points and suggested that it may be necessary to consider other approaches for formulating decision rules and risk equivalency. The consultants explained that, even in the case of low information species, unless there was zero or near-zero information available, it should be possible to make a qualitative estimation, based on expert opinion, of where that species would fit on the plot and, consequently, identify the appropriate direction for management measures.</p>	<p>Addressed verbally</p>
<p>The Workshop endorsed the Three-Zone Stock Status System, subject to further refinement of the naming and definition of each zone.</p>	<p>Noted by the consultants.</p>
<p>The Workshop recommended that:</p> <ol style="list-style-type: none"> a. priority should be given to determining 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. 	<p>We have reflected these priorities in the ‘implementation pathway’ section of the PAF.</p>
<p>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.</p>	<p>Noted by the Consultants</p>
<p>The Workshop recommended applying a progressive approach to implementation, prioritising:</p>	<p>This is included in the Implementation section.</p>

Workshop Feedback	Consultant response
<ul style="list-style-type: none"> a. Stocks whose status warrants immediate attention b. Primary species of highest economic or ecological importance c. Stocks where SIOFA has existing management infrastructure <p>3. Dr Nieblas, one of the expert reviewers, noted that:</p> <ul style="list-style-type: none"> a. The PAF should try, through the implementation plan, to explicitly integrate data collection and learning updates, especially since many of these stocks are very data limited, and encourage transition to higher data tiers. 	<p>We note that implementation is ultimately up to the MOP but we have included some text to encourage the MOP to optimise processes that would support that – we drew on the shared by Dr Walker for this purpose.</p>
<p>4. The Workshop suggested that the term “transboundary stocks” be used instead of “straddling stocks”.</p>	<p>Revised accordingly.</p>
<p>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.</p>	<p>Noted by the Consultants</p>
<p>The Workshop recommended that Technical Guidelines be developed concurrently with Framework finalisation, addressing:</p> <ul style="list-style-type: none"> a. Stock assessment methodologies for each information tier b. Reference point calculation methods c. Management Procedure design and testing protocols d. Performance monitoring requirements 	<p>Addressed in draft Technical Guidelines rather than in the Conceptual Framework</p>

Workshop Feedback	Consultant response
<p>e. Specification of how precautionary buffers and reference points will be adjusted based on information availability and assessment uncertainty</p> <p>f. Additional guidance for how to use the scientific information to categorise stocks</p>	



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Annex 2 - Worked Example: Applying the Precautionary Approach Framework to Orange Roughy

*This worked example demonstrates how SIOFA's Precautionary Approach Framework applies to the orange roughy (*Hoplostethus atlanticus*) fishery in the Walter Shoal Ridge management unit. The example uses actual data from SIOFA stock assessments and management decisions to illustrate framework implementation in practice.*

Part III: Information Classification

Classification: High Information

Orange roughy in the Walter Shoal Ridge (WSR) management unit likely qualifies as High Information based on comprehensive catch data, acoustic survey indices, age-structured stock assessment capability, and detailed biological knowledge.

Available Data Components:

- Catch and effort data from 2000-2023 (haul-by-haul records from multiple CCPs)
- Acoustic biomass survey indices from 2004, 2006, 2015, and 2018
- Length frequency data collected by scientific observers
- Age composition data from otolith collections
- Maturity and biological parameter estimates from regional studies

The 2025 stock assessment (ORY-2024-01 Report 2) applied a fully Bayesian integrated age-structured model using CASAL software, incorporating catch history, acoustic indices, length compositions, and age data. This assessment capability places orange roughy suggests the High Information category.

Biological Parameters (from ORY-2024-01):

- Natural mortality (M): Base case 0.044 yr^{-1} , with sensitivity testing at 0.024 and 0.058
- Growth: Very slow (K values 0.045-0.070 from literature)
- Maturity: Estimated at age 31.5 for WSR, literature reports 23-40 years
- Longevity: Maximum age 180 years in SIOFA region, 200+ years reported globally

Implication for Management: High Information status enables use of model-based management procedures with MSE testing, as outlined in Part V of the framework.

Part IV: Stock Status Zones and Reference Points

Reference Points (MoP10 paragraph 77)

SIOFA adopted interim reference points for orange roughy in 2023, recognising the stock's exceptional longevity and slow productivity:

Reference Point	Value and Rationale
Limit Reference Point (LRP)	0.2B ₀ (90% probability of remaining above) <i>Below this level, stock considered at serious risk. Requires immediate rebuilding action.</i>
Target Reference Point (TRP)	0.4B ₀ (50% probability of being at or above) <i>Maintains stock at productive levels providing sustainable yields while accounting for uncertainty in orange roughy's extremely slow life history.</i>
Threshold	To be determined through MSE testing <i>MoP11 paragraph 146 endorsed testing sensitivity choices of 50-60-70% probability of being at or above TRP of 30-40-50% B₀.</i>

These reference points define three stock status zones:

Zone	Biomass Range	Status Interpretation
Healthy Zone	$B \geq \text{Threshold}$	Stock maintained well above target with acceptable risk. Standard management applies.
Cautious Zone	$\text{LRP} < B < \text{Threshold}$	Stock below optimal level. Harvest control rule reduces exploitation as biomass declines toward limit.
Critical Zone	$B \leq \text{LRP}$	Stock at serious risk. Fishery likely closed with rebuilding plan required.

Current Stock Status (2025 Assessment)

The 2025 stock assessment (ORY-2024-01 Report 2) indicates the WSR stock status is likely well above 40% B₀, but with high uncertainty. Key assessment findings:

- Base case model: Stock status likely well above interim target (40% B₀)
- BMSY estimated at 30.8% B₀
- Target exploitation rate $F_{40} = 0.033$ (exploitation rate achieving 50% probability of being above 40% B₀)
- FMSY = 0.045
- Historical exploitation rates often above interim target

Assessment results highly uncertain due to limited information on natural mortality and acoustic catchability. Declining acoustic estimates on some hills (particularly Sleeping Beauty) warrant precautionary approach.

Classification: Likely Healthy Zone, but uncertainty requires conservative management pending improved parameter estimates.

Part V: Management Procedure Development

Management Objectives (MoP11 paragraph 147, SC9 Annex H)

SIOFA adopted seven management objectives for orange roughy spanning biological, economic, social, and ecosystem considerations:

No.	Category	Management Objective
1	Stock Status	Maintain the stock at or fluctuating around (i.e., with a 50% probability of being at or above) 40% of unfished biomass (B_0)
2	Risk-Safety	Ensure that the spawning stock biomass has at least a 90% probability of remaining above the limit reference point (20% of unfished biomass)
3	Economic Yield	Maintain the catch at a level that is consistent with the conservation objectives above
4	Economic Catch Rate	Maintain the CPUE at a level that is representative of the period 2015-2020, provided that the management objectives 1 and 2 are being met
5	Economic Stability	Minimise the level of variability in catches over time (the percentage is to be defined during the MP development)
6	Social Goals	Maintain viable fishing operations (such as employment and food security), alongside safe fishing practices as described in CMM 2022/12
7	Ecosystem Goals	Maintain a healthy ecosystem that meets the criteria established in CMMs including: CMM 2023/01, VMEs; CMM 2021/01, ETP species; CMM 2022/09, Sharks; CMM 2023/06, Seabirds

Harvest Control Rules Under Development (PAM-2024-03)

SIOFA is testing multiple harvest control rule structures through Management Strategy Evaluation. For orange roughy, the following rules are being evaluated:

Threshold Harvest Control Rules (Hockey Stick):

These rules link exploitation rate to stock status. Above the threshold, fishing operates at target exploitation rate. As biomass declines through the Cautious Zone (between threshold and LRP), exploitation rate reduces linearly to zero at the LRP. Two variants are being tested:

- Rule 1: Precautionary hockey stick - more conservative reduction in fishing pressure
- Rule 2: Modified hockey stick - allows slightly higher exploitation at lower stock levels

Constant Exploitation Rate Rule:

Rule 3 maintains constant exploitation rate regardless of status (though may include closure threshold). Testing has shown this performs poorly for depleted stocks and is not recommended for adoption.

Constant Catch Rule:

Maintains fixed annual catch. Currently applied as interim management using 2015-2020 average (MoP10 paragraph 79). Performance under different stock status scenarios being evaluated through MSE.

MSE testing incorporates uncertainty in natural mortality, acoustic catchability, recruitment variability, and implementation error. Results from PAM-2024-03 will inform final HCR selection and parameterisation.

[MSE Testing Framework](#)

Management Strategy Evaluation tests candidate management procedures against plausible future scenarios. For orange roughy WSR, the MSE framework includes:

Operating Models:

- Base case scenario ($M = 0.044$) representing current best estimate
- Sensitivity to natural mortality ($M = 0.024$ and $M = 0.058$)
- Alternative acoustic catchability assumptions
- Current stock status vs. depleted status scenarios

Performance Metrics (from PAM-2024-03 Appendix D):

- MP01: Probability of being above B_{40} (target)
- MP02: Probability of being below B_{20} (limit)
- MP03: Probability in green zone (Kobe plot analysis)
- MP04: Probability of not overfishing ($F < F_{40}$)
- Average annual catch and catch variability

Performance assessed over short (0-10 years), medium (10-20 years), and long term (20-30 years) horizons.

[Key Lessons from Orange Roughy Example](#)

This worked example illustrates several important aspects of implementing SIOFA's Precautionary Approach Framework:

1. Data Quality Enables Sophisticated Methods, But Uncertainty Remains

Despite High Information classification with integrated assessment capability, orange roughy management still confronts substantial uncertainty. Limited knowledge of natural mortality and acoustic catchability drive assessment results, requiring sensitivity testing across plausible parameter ranges. The framework accommodates this through MSE testing of management procedures against multiple operating models.

2. Life History Shapes Reference Point Selection

Orange roughy's exceptional longevity (180+ years) and late maturity (23-40 years) justify the $0.4B_0$ target - higher than many fisheries. Extremely slow productivity means stocks cannot sustain fishing pressure viable for shorter-lived species. The framework's flexibility allows reference points tailored to species biology.

3. Multiple Objectives Create Trade-offs Requiring Explicit Evaluation

The seven objectives spanning conservation, economics, social, and ecosystem dimensions will inevitably conflict. Maintaining CPUE representative of 2015-2020 while reducing exploitation to meet conservation objectives creates tension. MSE provides the framework for quantifying these trade-offs and supporting transparent decisions about acceptable balances.

4. Interim Management Provides Precautionary Foundation

While operational management procedures undergo development, constant catch at 2015-2020 average maintains fishery continuity without increasing risk. This demonstrates how the framework accommodates phased implementation, with precautionary interim measures until full MP testing completes.

5. Framework Applies Across Information Levels

Orange roughy represents the high-information end of the spectrum. SIOFA's framework applies the same conceptual approach to medium-information stocks (using empirical indicators) and low-information stocks (using knowledge-based default rules), maintaining equivalent conservation risk across all fisheries regardless of data availability.

This worked example demonstrates practical application of SIOFA's Precautionary Approach Framework using actual SIOFA stock assessments, management decisions, and MSE testing results current as of December 2025. As harvest strategy development continues through Scientific Committee and Meeting of the Parties processes, specific management procedure parameters and performance thresholds will be refined based on stakeholder input and final MSE results.

Attachment D

PAM-2024-01

Summary of Responses to Expert Reviewer Feedback on the Draft Report

Kerrie Robertson (ADIRA Consulting) · Dr Glen Holmes

February 2026

This document summarises how the authors have responded to feedback received from the PAM-2024-04 expert review panel on the draft PAM-2024-01 report. Responses are organised by topic. Where a comment did not result in a change to the documents, the reason is explained.

General

For completeness, we have addressed all reviewer comments where possible. Some comments were reproduced from the workshop feedback to which we had already responded and did not result in any changes to the documents. There were also comments directed at the Conceptual Framework on the basis that certain matters were unclear or insufficiently detailed — in most cases, that detail is provided in the Technical Guidelines. Rather than expanding the Conceptual Framework, we have ensured it directs readers to the Technical Guidelines where needed.

Zone names

We have not changed the names of the zones. We are aware that at least one reviewer felt the names were not sufficiently scientific; we responded to that at length in our December 2025 communication.

FAO stock classification

One comment — repeated again here — called for alignment with international benchmarks and proposed using the FAO stock classification system for that purpose. We do not consider the FAO classification useful for this purpose, nor are they widely used in the frameworks we did turn to. However, we have added a footnote acknowledging that the zones would broadly correspond to FAO categories and explaining why we have not adopted that system. We hope that is sufficient.

Stocks without reference points

The question of how stocks without reference points fit into the zone system has been raised again. The straightforward answer is that under this framework, there are no stocks without a limit reference point — the framework takes the explicit position that all stocks must have one. What varies is how that requirement is applied across different stock types.

The Conceptual Framework states that all stocks not managed under a full Management Procedure must have a biologically appropriate reference point — this is an explicit mandatory requirement in the alternative management approach section. The nuance is how reference points are determined based on the information classification.

The absence of data does not exempt a stock from having a reference point — it changes what type of reference point is appropriate. The framework is designed so that every stock, down to catch-only level, can be assigned a scientifically defensible LRP.

Tier terminology and FAO alignment

One reviewer suggested that the tier terminology used in the management procedure classification could be aligned with the FAO State of Stocks Index tiers, which assign tiers based on data availability and the methods used to assess stock status, in the interests of terminological consistency across the framework. We would note that the tiers in our framework serve different organising functions — we use tiers one through three for the type of management procedure, and High/Medium/Low/Zero for the information classification. While it would be possible to use a tier framing for both, we think this would generate confusion since they are not the same thing.

More fundamentally, we do not think the FAO State of Stocks Index tiers are useful at the level of operational detail required here. SIOFA needs a framework designed to deal primarily with low-information stocks. The FAO approach is not well suited to that situation, and it is worth noting that ICES, NAFO, Australia, New Zealand, Canada, and other comparable bodies do not use it — presumably because it does not serve their operational needs either. We have designed something that will work for SIOFA's specific situation.

We have also taken on board comments about duplication and length, and have tightened the documents considerably.

Level of technical explanation

Some reviewers questioned whether a high level of technical explanation was warranted. We have retained most of it, for two reasons. First, other comparable guidelines we reviewed do include explanatory content — they are not simply lists of formulae, but explain concepts to users who may not have deep experience with the methods. Second, and more importantly, effective buy-in requires that people understand what the guidelines contain and what influence they may have on decisions.

We have removed some explanation of widely understood concepts — for example, what a limit reference point is — but have retained explanation around management objectives and management procedure components, where capacity is still being built. That content can be removed if the SC wishes to reduce document length; it is not essential to the technical content and can be adjusted depending on the intended audience and their level of familiarity with these methods.

Stakeholder roles

Rather than mandating a specific role for stakeholders or prescribing the form of consultation — which we agree would improve buy-in and understanding — we have framed this as a matter for the Meeting of the Parties to determine. These are frameworks being implemented by an international organisation whose members are states, and it is for states to determine what consultation and involvement looks like. This keeps the framework within SIOFA's normal rules of procedure and governance structure.

Transboundary arrangements

The framework's treatment of transboundary arrangements has been noted as cursory. It states that where transboundary stocks are involved, arrangements must be compatible, identifies where in the process consultation should occur, and requires that consultation takes place — but it does not prescribe formal procedures. This is intentional, as the nature

of SIOFA's engagement with neighbouring organisations is a political decision outside the scope of this work. SIOFA already has arrangements in place — with CCAMLR, for example — and the framework articulates what needs to occur while leaving the how to those political and institutional processes.

Integration of PAM-02 and PAM-03 advice into the framework

We have integrated relevant advice from PAM-02 and PAM-03 into the Conceptual Framework and Technical Guidelines — for example, proxy and default limit reference points, which was the specific task of PAM-02. We included that advice rather than generating our own values, which would have been pointless and without foundation. We flagged this clearly so that the SC could see what kinds of information would sit within these governance frameworks and how that advice would operate in practice.

Some reviewers suggested we remove this material and simply refer to those project outputs instead. We understand the logic, but our overriding principle is that everything needed to guide a management decision should be in one place. Governance documents that require readers to locate advice from consultant reports produced for specific meetings, in specific years, create significant problems over time — particularly as institutional memory fades and documents become harder to trace. We have seen this cause real difficulties in other organisations. The SC is of course free to remove any of this material; but there may be value in having it remain in the guidelines as an integrated, accessible, and updatable resource.

Some reviewer comments related specifically to the work in PAM-02 and PAM-03 — both technical and presentational. We have not made substantive changes to those sections, as they are for the Scientific Committee to consider in light of its response to those outputs. We have, however, inserted placeholders flagging that those sections may need to be revisited depending on decisions taken about those projects.

For sections drawing on PAM-02 and PAM-03 — such as default values — we have presented those as consistent with the advice from those workstreams. We agree with reviewers that the values themselves are matters to be discussed by the SC and decided by the Meeting of the Parties; the documents as drafted are intended to be working drafts for those committees to review and agree, after which the agreed values would be reflected as the standing defaults.

Document structure

On balance, we would recommend against ending up with four separate documents, which is effectively what some reviewer suggestions would produce. Two is a logical structure: the Conceptual Framework, which is the document managers and the Meeting of the Parties need to understand; and the Technical Guidelines, which are the operational document for the Scientific Committee, and which should be complete in themselves rather than referring to outputs of specific consultancies which may or may not accord with the recorded advice of the SC on those issues. The framework should ultimately reflect decisions made on those issues.

Species priority tiers

The question of which species to include and in what sequence is ultimately a decision for the Meeting of the Parties. We adopted SIOFA's existing primary and secondary species classification as an organising framework because it is already in use, reflects established priorities, and is referenced in the MOP report. Reviewers commented on it, but we did not amend it, as that was not within our scope.

For the question of sequencing, we proposed a way of thinking about which species to bring into scope first — beginning with all primary species is likely to be too large a task, so there may be value in identifying a first tranche and subsequent tranches. If that framing proves confusing, that paragraph can simply be deleted; it was intended to be helpful rather than prescriptive. The MOP is free to decide how many and at what rate it brings species under the PAM framework.

Operational checklists

We recommend that the Scientific Committee be the body to finalise the operational checklists. We have developed a starting point — drawing on what information a high-information stock might be expected to have — but have been explicit that some criteria will need to be stock-specific and will depend on information we do not currently have. The reviewers' feedback was to consider whether the checklists are appropriate for SIOFA, given that some stocks may never reach the high-information category. Our view is that this is the kind of question that deserves dedicated workshopping by the Scientific Committee.

Terminology consistency across workstreams

Reviewers raised concerns about terminology — particularly where the same terms are used differently across different consultants' work. The tier terminology we introduced for the management procedure classification (Tier 1, Tier 2, Tier 3) was also used by other consultants in the context of reference points and performance indicators. It is not for us to change their terminology, nor for them to change ours. This is something SIOFA will need to resolve — whether by standardising the terms, adjusting descriptions, or finding another organising framework. What to call these things is ultimately a decision for the SC and MoP.

Length, graphics, and tables

We have taken on board the feedback about length and have shortened the documents. On graphics, we have produced new figures for the content within our scope, updated those figures to reflect reviewer input, and included graphics illustrating the rebuilding framework.