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WCPFC Climate Change Vulnerability Assessment Framework: Progress Report and Pathways Forward

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EXECUTIVE SUMMARY

This paper provides the Commission with the final update on the Climate Change Vulnerability Assessment (CCVA) Framework consultancy, including delivery of all contractual requirements, key learnings from the development and pilot testing process, and recommendations for moving forward.

While the framework represents a significant theoretical advancement in how WCPFC might systematically assess climate risks in CMMs, the consultancy process has revealed important insights about data availability, institutional readiness, and the practical challenges of implementation within existing WCPFC processes.

Mapping of framework indicators against existing Scientific Service Provider (SSP) outputs (see the companion information paper 'Mapping SSP outputs to the CCVA Framework') demonstrates that whilst foundational data exists, the specific climate-framed questions the framework asks are not currently answered by routine processes, and would be difficult to answer while attracting new costs. Therefore, implementing the framework as envisaged in the Terms of Reference (TOR), and as designed, would require substantial new analytical work, expanded scope beyond current assessments, and sustained additional resources—confirming the legitimacy of concerns raised at SC21 and TCC21 regarding workload and data availability. It may, however, be a useful tool for the future.

Rather than viewing the framework narrowly as a binary 'adopt or reject' decision, this paper proposes instead focussing on the underlying objective articulated in the TOR: improving the Commission's understanding of climate risks in WCPFC fisheries, including their sources and potential management responses.

This paper identifies pragmatic pathways for progressively integrating climate considerations into existing workstreams, recognises that qualitative methods successfully used in other climate vulnerability assessments may be more appropriate for certain indicators (particularly operational and compliance-related questions where quantitative data is scarce), and recommends incremental approaches that build institutional capacity over time rather than requiring immediate comprehensive implementation.

1. CONSULTANCY DELIVERABLES

The consultancy has successfully completed all deliverables specified in the Terms of Reference. These are described in detail in **Annex 1: *WCPFC CMM Climate Change Vulnerability Assessment – Final Assessment Report*.** Each deliverable has been updated throughout the duration of the contract to address feedback received from the NC, SC and TCC meetings.

Key deliverables included:

- **Comprehensive Literature Review:** A systematic review of 536 sources following PRISMA 2020 guidelines, examining global approaches to climate vulnerability assessment and establishing the theoretical foundation for WCPFC-specific indicators (see Attachment A of Annex 1)
- **WCPFC-Relevant Definition of Vulnerability:** Adopted the IPCC AR6 risk-based approach, defining climate risk as a function of hazard, exposure, and vulnerability (determined as a function of sensitivity and adaptive capacity). This definition is described in detail in Annex 1 and is graphically illustrated in Appendix 1 of this paper
- **Draft CCVA Framework:** An Excel-based rapid assessment tool with comprehensive indicator systems aligned with IPCC AR6 standards, designed for practical implementation within existing WCPFC processes. This framework is designed to answer the questions that would enable the Commission to eventually form a view about climate risk (see Attachment B of Annex 1)
- **Guidance and Procedural Documentation:** Comprehensive documentation supporting understanding, operation, and refinement of the framework (see Attachment C of Annex 1)
- **Pilot Assessments:** Five CMM assessments completed (Cetaceans, Mobulid rays, Sharks, Marine Pollution, and NP Striped Marlin – See Annex 1, Attachments D and E) demonstrating framework application and revealing practical implementation challenges. A summary overview of each assessment is provided in Appendix 2 of this paper
- **Identification of Data Gaps:** Systematic documentation of MCS and scientific information gaps, with TCC-relevant indicators representing the greatest unknowns in the current assessment process (see Annex 1)
- **Mapping of Existing Outputs:** Detailed analysis of how current SSP outputs relate to framework indicators, revealing significant gaps between what currently exists and what the framework requires (see the companion information paper ‘Mapping SSP outputs to the CCVA Framework’).

Information papers presenting progress updates and draft deliverables were provided to NC21, SC21, and TCC21 throughout 2025.

2. KEY LEARNINGS FROM THE PROCESS

2.1 Multiple Pathways to Understanding Climate Risk

The literature review revealed a fundamental insight: there is no single 'correct' way to assess climate vulnerability. Successful assessments across different sectors and regions have used diverse methodologies, each with particular strengths depending on context, data availability, and institutional capacity.

At their core, all robust climate vulnerability assessments share a common foundation: they systematically consider hazard (what climate changes are occurring), exposure (who or what is affected), sensitivity (how susceptible assets, species or systems are to those changes), and adaptive capacity (ability to respond). These fundamental components provide a framework for asking the right questions, regardless of the specific methodological approach employed.

This realisation is important. It shifts focus from 'adopting a framework' to 'improving our understanding of climate risks' through whatever pragmatic means are available and appropriate within WCPFC's context.

2.2 The Real Objective: Understanding Climate Risk

Stepping back to examine what the TOR truly sought to achieve, the framework itself is a potential output—a means to an end. The substantive objective is to improve the Commission's understanding of climate risks in WCPFC fisheries: what are they, where do they originate, and what can be done to manage them effectively.

Viewing the consultancy as an exploratory exercise allows the Commission to extract maximum value from the work whilst acknowledging practical constraints.

2.3 Legitimate Implementation Challenges

Feedback from NC21, SC21, and TCC21 raised legitimate considerations that warrant careful attention.

Existing Workload

The SSP and subsidiary bodies face substantial existing commitments. Adding a comprehensive new assessment process requires realistic consideration of capacity constraints.

Data Availability

A systematic mapping exercise (see Section 3 of this paper) highlighted significant data gaps with many of the framework indicators (particularly for TCC-relevant operational questions and SC-relevant adaptive capacity indicators) showing red or amber status, indicating information is either not routinely developed or would require substantial work to generate.

This was also reflected in the pilot assessment results, meaning that while useful as part of the exploration process, they may not necessarily be reliable at this time. Furthermore, while some data may be accessible through published scientific literature on these species in the WCPO or other ocean basins, it has not been reviewed through the WCPFC scientific processes to verify if it is applicable, or an appropriate proxy within the context of the WCPFC.

Cost Considerations

Ongoing assessment of all CMMs would require sustained resources for data collection, analysis, reporting and maintenance.

Integration with Current Processes

The framework, as structured, asks fundamentally different questions than existing processes currently answer, potentially creating parallel workstreams rather than integrated workflows.

These considerations, validated by the detailed mapping exercise (see Section 3 below), indicate that whilst the framework is sound in theory, the Commission may not yet be ready to implement it as originally envisaged in the TOR.

2.4 Alternative Methodological Approaches

The literature review identified qualitative and semi-quantitative methods that have been successfully employed in other climate vulnerability assessments, particularly where quantitative data is scarce. These include:

- Expert elicitation and structured stakeholder engagement
- Participatory vulnerability assessments
- Scenario-based qualitative analysis
- Risk matrices based on likelihood and consequence.

These approaches may be particularly relevant for assessing operational and compliance risks where quantitative information is unlikely to become available through existing data collection systems, and for adaptive capacity indicators that require judgment about future potential rather than measurement of current conditions.

3. THE GAP BETWEEN EXISTING WORK AND FRAMEWORK REQUIREMENTS

An important finding from this exercise is that whilst WCPFC's existing scientific processes generate substantial foundational data, they do not currently answer the specific climate-framed questions the framework asks. This section examines this gap systematically.

3.1 What the Framework Asks vs. What Currently Exists

The framework poses specific questions across four risk components. A systematic mapping of these questions against existing SSP outputs revealed significant gaps – see the companion information paper 'Mapping SSP outputs to the CCVA Framework'. Key gaps are discussed below.

Hazard: Climate Change Projections

Framework questions: What are the specific temperature extremes, SST trends, ocean acidification levels, deoxygenation patterns, and extreme weather projections relevant to WCPFC fisheries?

Current situation: Whilst global climate data sets exist, they require significant work to define which specific data sets, locations, and calculations are appropriate for WCPFC stocks. The Scientific Committee discusses climate change generally but does not routinely produce the specific hazard metrics the framework requires. For extreme weather events (storms, cyclones), projection models show poor agreement, making this information particularly challenging to develop.

Assessment: Data sources exist but substantial analytical work would be required to produce the information needed to accurately answer with confidence specific indicators.

Exposure: Frequency of Climate Impacts

Framework questions: How frequently do species habitats, food webs, and populations experience climate hazards? Do hazards affect fixed geographic boundaries? How often is updated hazard information provided to the Commission?

Current situation: These questions fundamentally depend on having the hazard indicators defined first (see above), then overlaying them with species distribution

and fishing effort data. Whilst catch, effort, VMS, and observer data exist, they are not currently analysed through this specific climate exposure lens.

Assessment: Cannot be assessed without first verifying the applicability of the hazard indicators, then conducting new analyses combining hazard and distribution/effort data.

Sensitivity: Species Vulnerability

Framework questions: What are thermal tolerances, mobility, productivity, distribution patterns, reproductive dependencies on environmental cues, prey specificity, competition levels, and adaptive capacity of target and bycatch species under climate change scenarios?

Current situation: General biological information exists for key tuna stocks (growth rates, distributions, productivity) through stock assessments, SEAPODYM, and tagging studies. However, climate-specific sensitivities require different biological and behavioural analyses:

- **Green:** Basic life history parameters, general distributions, productivity estimates
- **Amber:** Thermal ranges (can be inferred from distributions), mobility (some tagging/genetic data), general understanding of reproduction
- **Red:** Specific reproductive sensitivity to temperature/seasonal cue changes, ability to adapt prey/diet under environmental shifts, competition dynamics under climate change, confidence in assessment information availability.

Notably, for non-tuna species (billfish, sharks, bycatch species), even basic information is more limited.

Adaptive Capacity: System Responsiveness

Framework questions: Can species adapt their thermal tolerance, productivity, distribution, reproduction, prey selection, and competitive strategies? Can management respond through species diversification, gear modifications, effort adjustments? Are observer coverage, research investment, and international cooperation sufficient?

Current situation: This is the most data-poor area:

- Some understanding of species adaptability for key tuna stocks (e.g., skipjack) from existing research
- Most adaptive capacity questions - particularly regarding reproductive adaptation, dietary flexibility, competitive adaptation, operational flexibility (species diversification, gear modification, effort adjustments affected by extreme weather), monitoring resilience, and international cooperation trends. Many of these are explicitly 'outside SSP scope.'

3.2 Why This Matters: Workload Implications

The mapping exercise revealed why concerns about workload and data availability raised at SC21 and TCC21 are legitimate. The framework does not simply synthesise existing outputs - it asks fundamentally different questions that would require:

- **New analytical approaches:** Defining and calculating climate hazard metrics from global data sets; overlaying these with fisheries data to assess exposure; conducting climate-specific vulnerability analyses
- **Expanded scope:** Moving beyond current stock status assessments to examine species-environment interactions, adaptive potential, and system responsiveness
- **Novel methodologies:** Developing qualitative or semi-quantitative approaches for data-poor indicators, particularly operational and compliance-related questions
- **Sustained effort:** Not a one-time exercise but ongoing assessment as conditions and understanding evolve.

In short: implementing the framework as designed would represent a substantial expansion of SSP and subsidiary body work, not a simple repackaging of existing outputs.

3.3 The Implication: What This Means Moving Forward

This honest assessment leads to two possible options:

Option A: Accept that comprehensive climate vulnerability assessment as envisaged by the framework requires substantial new capacity, resources, and time. If the Commission determines this is a priority, plan accordingly with realistic resourcing and phased implementation.

Implementation NOW of the CCVA Framework as envisaged in the TOR

Requirements:

- Substantial expansion of SSP analytical work
- New data collection systems for operational and adaptive capacity indicators
- Sustained additional resources for ongoing CMM-by-CMM assessment
- Development of novel methodologies for data-poor areas
- Capacity building across subsidiary bodies

Timeline: Long-term commitment (5-10 years)

Outcome:

Systematic climate vulnerability assessments for all CMMs, but with varied confidence in the results if data and science review processes are not updated to address identified information gaps and identified issues. High resource intensity to establish required processes and to undertake analysis. Risk of overwhelming existing processes.

Option B: Recognise that the Commission may not currently be positioned to implement comprehensive vulnerability assessments and instead focus on a pragmatic, gradual approach: progressively integrating climate considerations into existing processes where feasible, using qualitative methods for data-poor areas, leveraging external partnerships, and selectively addressing high-priority questions rather than comprehensive CMM-by-CMM assessment.

Pragmatic, incremental steps to improve knowledge of climate risks

Approaches:

- Develop species climate profiles as information assembly mechanism
- Cross-cutting operational risk assessments (rather than CMM-by-CMM)
- Explore new approaches for oceanographic data collection (FVON)
- Leverage partnerships (PACCSAP, PCCC, academic institutions)
- Selective adoption of framework elements where feasible

Timeline: Immediate start, progressive build (3-5 years)

Outcome:

Meaningful progress in climate risk understanding without overwhelming existing capacity. Builds institutional capability incrementally. Maintains flexibility to expand as data and resources develop.

On balance, Option B appears to be a better option for the Commission at this time, not because comprehensive assessment lacks value, but because pragmatic incrementalism better matches institutional capacity, and is more likely to produce meaningful progress in the near term whilst building toward more comprehensive capability over time.

4. PATHWAYS FORWARD: IMPROVING UNDERSTANDING OF CLIMATE RISKS

This section outlines pragmatic approaches for progressively improving the Commission's understanding of climate risks without requiring wholesale adoption of the CCVA Framework or creation of parallel assessment processes. These pathways leverage existing workstreams whilst building capacity to address identified gaps.

4.1 Science Perspective: Integrating Climate Considerations

The mapping exercise presented in the companion information paper ‘Mapping SSP outputs to the CCVA Framework’ demonstrates at a high level how existing SSP outputs can address — or be adapted to address — the CCVA framework's information requirements. This systematic analysis categorised indicators using a traffic-light system: 'green' for information readily available or easily inferred, 'amber' for data that exists but requires work to compile or process appropriately, and 'red' for information that isn't routinely developed or would be difficult to gather.

The mapping reveals that whilst foundational data exists through current SSP work programmes, translating this into climate-specific answers requires expansion or reframing of existing analyses. Whether the Commission adopts the full framework or pursues alternative approaches, the consultations with the SSP on the nature of services it provides to WCPFC should address how to handle both 'red' indicators (requiring new approaches or qualitative methods) and 'amber' indicators (requiring additional analytical effort to synthesise existing data sets).

The Commission may also wish to develop species profiles: Creating standardised profiles for priority species that assemble current information on climate-relevant biological and ecological parameters (thermal tolerances, distribution patterns, productivity responses to environmental conditions, reproductive dependencies on environmental cues) could serve multiple purposes, including:

- providing a structured way to capture 'amber' information that exists but isn't routinely compiled
- identifying 'red' gaps where information is genuinely lacking
- establishing a mechanism for the Scientific Committee to review and confirm profiles as representing best available science.

The implementation of the Fishing Vessel Observation Network (FVON) (separate paper) also offers a practical pathway to contribute to closing information gaps associated with assessing climate risk[1].

4.2 TCC Perspective: Operational and Compliance Considerations

TCC21 correctly identified that many climate-related operational risks are common across CMMs, relating primarily to vessel operations, crew safety, and equipment functionality during extreme weather. This suggests a cross-cutting approach rather than CMM-by-CMM assessment (see Appendix 3 for a graphic depiction of a cross-cutting approach).

Cross-CMM risk assessment: Rather than assessing each CMM separately for operational climate risks, develop a general assessment of fleet operational challenges under increasing extreme weather conditions. This would identify common vulnerabilities (waste management during storms, observer safety, VMS reliability, communication systems) that affect implementation of multiple CMMs.

Qualitative risk assessment: Given that quantitative data on operational climate risks is unlikely to become available through routine data collection, consider employing qualitative assessment methods. This could include structured consultation with vessel operators, port authorities, and MCS practitioners to understand vulnerabilities and adaptive responses, overlayed with weather hindcasting and forecasting information to provide some indication of whether and to what extent climate risk factors are likely to affect vessel operations.

Integration with existing processes: Incorporate climate considerations into existing TCC processes, such as:

- Annual CMM implementation reviews: explicitly consider whether extreme weather events affected compliance
- MCS system reviews: assess vulnerability of monitoring infrastructure to climate hazards
- Safety protocols: ensure observer and crew safety procedures account for increasing extreme weather frequency.

[1] FVON equips commercial tuna vessels with oceanographic sensors to collect environmental parameters (temperature, salinity, oxygen) during routine fishing operations. The FVON will improve data on and fill gaps in key oceanographic variables for specific (fished) areas of the Pacific, thereby improving the oceanographic and mereological models that are based upon that information, and provide a way of monitoring ocean changes.

Targeted data collection: Identify specific, high-priority operational indicators where systematic data collection would be feasible and valuable (e.g., weather-related compliance challenges, infrastructure damage, operational disruptions).

Emergency response planning: Ensure search and rescue protocols, force majeure provisions, and reporting requirements adequately account for climate-related operational disruptions.

Recommended Approach For TCC

Cross-CMM Operational Risk Assessment

Develop a general assessment of fleet operational challenges under increasing extreme weather conditions, rather than assessing each CMM individually. This identifies common vulnerabilities (waste management during storms, observer safety, equipment reliability) that affect implementation of multiple measures simultaneously

Qualitative Assessment Methods

Given that quantitative data on operational climate risks is unlikely to become available through routine data collection, employ structured consultations with vessel operators, port authorities and MCS practitioners to understand vulnerabilities and adaptive responses. The literature review identified numerous successful assessments that used qualitative methods to capture experience and perception (including traditional knowledge) where quantitative data was scarce.

4.3 Existing Initiatives and Partnerships

The Commission should also leverage relevant climate initiatives already underway:

- **Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP):** Provides downscaled climate projections for Pacific Island Countries and support for adaptation planning
- **Pacific Climate Change Centre (PCCC):** Coordinates regional climate services and may offer relevant data and expertise
- **Framework for Resilient Development in the Pacific (FRDP):** Provides overarching structure for climate and disaster resilience that fisheries management could align wit.
- **Academic partnerships:** Universities and research institutions conducting climate-fisheries research in the region represent untapped potential for collaboration without additional Commission cost.

4.4 Incremental Implementation of Framework Elements

Should the Commission decide not to proceed with full adoption and implementation of the CCVA Framework, elements could be selectively adopted:

- **Indicator framework as guidance:** The comprehensive set of indicators of the CCVA framework could serve as a reference — a structured way to think about climate risks—without requiring formal assessment processes
- **Gap identification tool:** Use the framework primarily as a diagnostic tool to systematically identify where information gaps exist, informing research priorities without requiring comprehensive vulnerability scoring
- **Periodic strategic assessments:** Rather than annual assessment cycles, aim to be in a position to conduct more climate risk assessments in the next 3-5 years, allowing time for data collection and institutional development in the interim.

5. RECOMMENDATIONS

In the context of its Climate Change Workplan, the Commission is invited to:

- **Acknowledge the consultancy deliverables** as fulfilling the Terms of Reference and note the substantial theoretical and methodological foundation now available to support climate-informed decision-making.
- **Recognise the legitimate constraints** identified through detailed mapping of framework requirements against existing outputs, confirming that implementation as designed would require substantial new investment in resources and capacity.
- **Reframe the approach** from 'framework adoption' to 'progressive improvement of climate risk understanding', recognising that multiple pathways exist to achieve this objective.
- **Consider how subsidiary bodies** could explore pragmatic approaches for integrating climate considerations into existing processes, rather than creating parallel assessment mechanisms.
- **Prioritise gap identification** over comprehensive assessment, using the framework's indicator structure to systematically identify where additional information would most improve understanding.
- **Explore qualitative approaches** for operational and compliance-related climate risks, recognising that these may be more appropriate than quantitative methods where systematic data is unavailable.
- **Consider cross-cutting assessment** of fleet operational challenges under climate change, rather than CMM-by-CMM analysis, given that many operational risks affect multiple measures.

6. CONCLUSION

The CCVA Framework consultancy has delivered significant value: a robust theoretical foundation, a comprehensive methodological approach, systematic identification of data gaps, and important insights about the practical challenges of assessing climate risks in a complex, data-constrained fisheries management context.

The detailed mapping presented in Section 3, however, reveals an honest truth: whilst foundational data exists through current SSP work, the specific climate-framed questions the framework asks are not currently answered by existing processes.

This confirms the legitimacy of concerns raised at SC21 and TCC21 about workload and data availability. Implementing the framework as designed would require substantial new analytical work, expanded scope, and sustained additional resources.

This finding is valuable learning and the Commission should be commended for its willingness to explore new directions. It prompts consideration of how to improve WCPFC's understanding of climate risks using pragmatic, incremental approaches that work within existing capacity and processes, rather than requiring wholesale transformation of assessment systems.

The fundamental questions the framework asks are the right questions: What climate changes are occurring? Who and what is exposed? How sensitive are our fisheries and management systems? What capacity exists to adapt? These questions provide a valuable conceptual structure for thinking about climate risks, even if answering them comprehensively through formal assessment processes exceeds current institutional capacity.

Moving forward, the Commission has multiple pragmatic pathways available. It can strengthen climate integration into existing assessment processes, employ qualitative methods for operational risks where quantitative data is scarce, leverage regional partnerships and initiatives, selectively adopt elements of the framework, and progressively build capacity whilst maintaining realistic expectations about what can be achieved with available resources. This is a significant step forward in WCPFC's engagement with climate change as a management challenge.

Appendix 1 – Graphic illustration of IPCC AR6 Risk-Based Framework adapted for WCPFC

Hazard
- What climate changes are occurring?
- Temperature extremes and SST trends
- Ocean acidification levels
- Deoxygenation patterns
- Extreme weather projections (storms, cyclones)

Exposure
- Who or what is affected?
- How frequently do species habitats experience climate hazards?
- Do hazards affect fixed geographic boundaries (e.g., CMM areas)?
- How often do food webs and fishing operations encounter changing conditions

Sensitivity
- How susceptible are species and systems to these changes?
- Thermal tolerances and mobility
- Productivity and distribution patterns
- Reproductive dependencies on environmental cues
- Prey specificity and competition levels

Adaptive Capacity
- What ability exists to respond and adjust?
- Can species adapt thermal tolerance, diet, reproduction?
- Can management respond through species diversification, gear modifications, effort adjustments?

Are monitoring, research investment, and international cooperation sufficient?

Note: As part of addressing the Terms of Reference, the consultants examined how climate change vulnerability and climate risk are defined. That literature review identified these four components as the fundamental questions that must be answered to understand climate risks in fisheries: what climate changes are occurring, who or what is affected, how susceptible they are, and what capacity exists to respond. The CCVA Framework is a tool designed to systematically address these questions when comprehensive data is available. However, in WCPFC's current situation where information is limited, these remain the things you would want to understand to progressively build knowledge of climate risks—what they are, where they originate, and what can be done about them—regardless of whether formal quantitative assessment is immediately feasible.

Appendix 2 – Summary overview of the CMM climate risk pilot assessments

CMM	Title	Summary description	Climate risk and management implications
CMM 2024-07	Conservation and Management Measure for Protection of Cetaceans from Purse Seine and Longline Fishing Operations	CMM 2024-07 relates to the protection of cetaceans from purse seine and longline fishing operations across the entire WCPFC Convention Area. The principal aim of this measure is to minimize impacts on the sustainability of cetaceans from fishing activities. Key provisions of CMM 2024-07 include the prohibition of intentionally setting a net on cetaceans and requirements for safe release procedures in cases of accidental encirclement.	The CCVA for CMM 2024-07 reveals a **HIGH** overall climate risk rating, driven by high hazard, exposure, and sensitivity ratings combined with medium adaptive capacity. This finding aligns with global scientific literature showing that 72% of marine mammal stocks are highly vulnerable to climate change. The assessment indicates that cetaceans face significant climate-related threats including ocean warming, acidification, and altered prey distribution that may compromise the effectiveness of current protection measures. Paragraphs 1-7 of the CMM are not a direct source of climate risk under the assessment. However, the assessment results are directly relevant to the CMM in general, which sets out specific requirements to prevent and minimise fishing (a non-climate stressor) impacts on these species.

CMM	Title	Summary description	Climate risk and management implications
CMM 2019-05	Conservation and Management Measure on Mobulid Rays caught in association with fisheries in the WCPFC Convention Area	CMM 2019-05 relates to the protection of mobulid rays including all species of the family Mobulidae, including manta rays and mobula rays in the WCPFC Convention Area. The principal objective of this measure is to ensure the long-term conservation of mobulid rays in the recognition that they are classified as vulnerable or endangered under the IUCN. The CMM specifically sets out prohibition requirements of targeted fishing, intentional setting with mobulid rays in the area, onboard retention, transhipping or landing any part or whole carcasses of mobulid rays caught in the Convention Area. In addition, specific reporting and handling requirements are set out for landing mobulid rays in the case it is required, and best handling practices for the safe release of mobulid rays when fishing.	The CCVA for CMM 2019-05 reveals a **HIGH** overall climate risk, driven by high exposure and sensitivity ratings, coupled with a low adaptive capacity rating. This outlook reflects the current largely unknown state of knowledge of WCPFC mobulid rays, particularly in regards to their biological and ecological traits, which makes it difficult to implement effective adaptive management beyond prohibitive protection measures. The high climate risk rating reflects current global concern for mobulid rays in general, and in the knowledge that climate change is likely to impact these species into the future. Although paragraphs 1-11 of CMM 2019-05 are not a source of climate risk under this assessment, the HIGH climate risk rating is directly relevant to the CMM in general, which sets out appropriate requirements to prevent and minimize impacts of fishing (a non-climate stressor) on these species, noting their current vulnerable or endangered IUCN status.

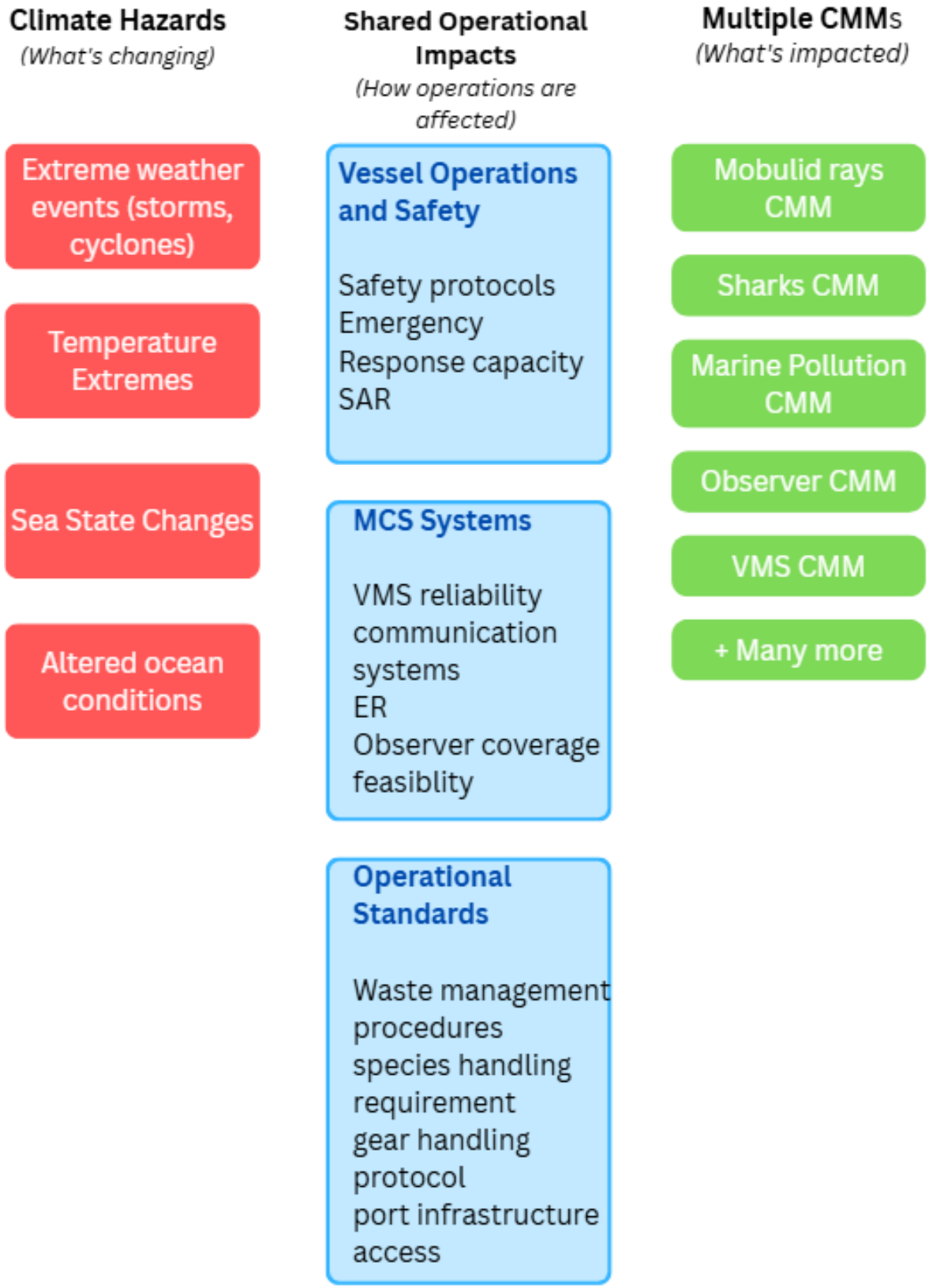
CMM	Title	Summary description	Climate risk and management implications
CMM 2024-05	Conservation and Management Measure for Sharks	CMM 2024-05 relates to the conservation and management of Sharks including all species of sharks, skates, rays and chimaeras (Class Chondrichthyes) in the WCPFC Convention Area. The principal objective of this measure is to ensure the long-term conservation and sustainable use of WCPO sharks through science-based management approaches. The CMM specifically sets out prohibition requirements (e.g., shark finning and retention of key species), mitigation, bycatch and handling requirements, along with reporting, research and capacity building requirements.	The CCVA for CMM 2024-05 reveals a **MEDIUM** overall climate risk, driven by high hazard and exposure ratings, offset by a low vulnerability rating. This outlook aligns with scientific literature that Pacific sharks are under direct threat from climate change, but they have a high adaptive capacity through natural biological traits and with support under current management and research plans to reduce the overall level of climate change risk. However, the medium rating demonstrates that more work is required to both fill indicator information gaps and increase wider understanding of Pacific shark species in general (both key and non-key species) to better understand with greater certainty the level of climate risk faced by individual species. Paragraphs 1-34 of the CMM are not the source of climate risk to sharks. However, paragraphs 26-32 set out data reporting, research and capacity development provisions that are relevant to strengthen the collection of information required to effectively fill information gaps to better understand the level of climate risk faced by sharks. Ongoing efforts under these provisions will help inform appropriate management settings for both target and non-target fisheries, including whether direct targeting of sharks through longline fishing (paragraph 19) remains sustainable in the face of climate change.

CMM	Title	Summary description	Climate risk and management implications
CMM 2017-04	Conservation and Management Measure on Marine Pollution	CMM 2017-04 relates to marine pollution arising from fishing vessels, including oil or fuel products, oily residues, garbage (including dumped fishing gear), food waste, domestic waste, incinerator ashes, cooking oil, and sewage discharged into the ocean across the WCPFC Convention Area. The principal aim of this measure is to prevent and reduce pollution from fishing vessel operations that could impact marine ecosystems and sustainability. The CMM specifically sets out requirements for aligning with MARPOL and the London Protocol, prohibitions, research requirements, abandoned and lost gear requirements, communication, training and awareness program requirements.	The CCVA for CMM 2017-04 reveals a **MEDIUM** overall climate risk rating, driven primarily by a high exposure score and a medium vulnerability score that is driven by low adaptive capacity. This finding demonstrates that while marine pollution from fishing vessels is primarily driven by operational practices rather than climate factors, extreme weather events significantly increase pollution risk by compromising vessel safety systems and waste management procedures. The assessment identifies the immediate need for strengthened management provisions that could include the development of: 1. extreme weather waste management protocols based on research conducted under Paragraph 4 of the CMM 2. enhanced vessel waste storage system resilience requirements based on research undertaken in accordance with Paragraph 4 of the CMM 3. improved crew training for emergency waste handling procedures in accordance with Paragraph 11 of the CMM 4. strengthened port waste reception facility climate protection in accordance with Paragraphs 6 and 8.

CMM	Title	Summary description	Climate risk and management implications
CMM 2024-06	Conservation and Management Measure for the North Pacific Striped Marlin	Conservation and Management Measure (CMM) 2024-06 relates to the conservation and management of North Pacific striped marlin (*Kajikia audax)* in the North Pacific Ocean portion of the WCPFC Convention Area. The principal aim of this measure is to ensure the long-term sustainability of the North Pacific striped marlin stock through science-based management approaches. The CMM specifically sets catch limits, monitoring requirements, and data collection standards. The stock is currently overfished and subject to overfishing.	The CCVA for CMM 2024-06 (North Pacific Striped Marlin) reveals a **LOW** overall climate risk rating, driven by medium hazard and sensitivity ratings, high exposure rating, but notably high adaptive capacity that reduces overall vulnerability to low. This finding suggests that while North Pacific striped marlin face significant climate-related exposures and moderate sensitivity to environmental changes, the species' inherent biological characteristics and existing management framework provide substantial adaptive capacity to respond to climate challenges. The low climate risk rating suggests current management settings under the CMM are likely to remain effective under projected climate scenarios. However, the current stock assessment and data provision requirements (paragraph 13 of the CMM), which underpins the catch limit (paragraph 4 of the CMM), do not currently consider the range of factors (e.g., environmental and biological relationships) raised in the CCVA, which are necessary to best support ensuring sustainable management and rebuilding of the stock in the face of climate change.

Appendix 3 – Graphic illustration of approach to assessing multiple CMMs using a cross-cutting climate risk approach

The below approach showcases how common operational vulnerabilities can be identified and addressed simultaneously across a range of CMMs.



Annex 1 – WCPFC CMM Climate Change Vulnerability Assessment Report: Final Assessment Report