

CCVA Report for CMM 2024-06 (North Pacific Striped Marlin)

Executive Summary

The Climate Change Vulnerability Assessment (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 assessment indicates that current management approaches are likely to remain effective under projected climate scenarios, though targeted enhancements could further strengthen resilience.

Priority actions within WCPFC's scope could include: enhanced monitoring of stock distribution and abundance patterns, strengthened data collection on environmental-biological relationships, improved integration of climate considerations into stock assessments, and maintenance of flexible management measures that can adapt to changing conditions.

Introduction

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, including catch limits, monitoring requirements, and data collection standards. The stock is currently overfished and subject to overfishing.

Climate change poses various threats to billfish species through direct impacts such as ocean warming, changes in ocean chemistry, and altered current patterns, as well as indirect effects including shifts in prey distribution, changes in spawning and migration patterns, and altered ecosystem productivity. These climate-driven changes may affect the biological assumptions underlying current stock assessments and management measures.

This assessment aims to evaluate the climate change vulnerability of CMM 2024-06 using the WCPFC Climate Change Vulnerability Assessment (CCVA) Framework, providing evidence-based insights to support adaptive management and enhance the climate resilience of North Pacific striped marlin conservation measures.

Method

The climate change vulnerability assessment for CMM 2024-06 was conducted using the WCPFC Climate Change Vulnerability Assessment (CCVA) Framework, an Excel based assessment tool. The assessment followed the approach and methodology outlined in the CCVA Framework guidance and information document.

Each of the four climate risk components (Hazard, Exposure, Sensitivity, and Adaptive Capacity) was evaluated using specific indicators grouped by theme. Indicators were scored using a five-point scale (High, Medium, Low, Unknown, N/A) based on available evidence.

For each indicator, supporting rationale was documented to justify scoring decisions and to identify information gaps. Where data were insufficient or uncertain, indicators were scored as "Unknown" to highlight areas requiring further research or assessment.

The assessment employed the standard five-year time horizon provided in the framework to evaluate potential climate change impacts and management responses within a policy-relevant timeframe.

Data Sources and Approach

The assessment drew upon multiple data sources to evaluate climate vulnerability across the four risk components:

- Peer-reviewed scientific literature on striped marlin biology, ecology, and climate change impacts
- WCPFC stock assessment reports and scientific committee documents
- Regional climate change projections and oceanographic data for the North Pacific
- International scientific reports on billfish responses to environmental variability
- WCPFC technical reports and meeting documents related to North Pacific striped marlin management

Scope and Limitations

The assessment scope encompasses the North Pacific Ocean portion of the WCPFC Convention Area where North Pacific striped marlin occur and are managed under CMM 2024-06. The five-year assessment timeframe focuses on near-term climate change impacts and management responses.

Key limitations include reliance on primarily North Pacific-focused data sources, limited spatial resolution of some climate projections, and uncertainty regarding region-specific biological responses that may vary across the species' range within the WCPFC area.

Results

Climate Risk Assessment

The CCVA yielded a **LOW** overall climate risk rating for CMM 2024-06 (North Pacific Striped Marlin), determined by the combination of:

- **Hazard: Medium** (45% High indicators, 9% Medium, 45% Low)
- **Exposure: High** (56% High indicators, 33% Medium, 11% Low; 8 Unknown)
- **Sensitivity: Medium** (21% High indicators, 42% Medium, 38 Low, 3 Unknown)
- **Adaptive Capacity: High** (62% High indicators, 23% Medium, 15% Low, 10 Unknown)
- **Vulnerability: Low** (combination of Medium sensitivity and High adaptive capacity)

Component Analysis

Hazard (Medium Rating) – The medium hazard rating reflects moderate levels of climate-related threats relevant to North Pacific striped marlin. Key hazards scoring as "High" include temperature extremes, increased sea surface temperature, ocean acidification, deoxygenation, and current changes. These represent significant environmental stressors that could affect striped marlin habitat and prey availability. However, hazards related to extreme weather events and infrastructure impacts generally scored lower, reflecting the pelagic nature of the species and its habitat.

Exposure (High Rating) – The high exposure rating indicates that North Pacific striped marlin populations and their ecosystems frequently encounter identified climate hazards. This reflects the species' broad distributional range across areas experiencing significant oceanographic changes, including warming waters and shifting current patterns. The high proportion of "Unknown" scores (36%) highlights substantial data gaps regarding specific exposure patterns across the species' range.

Sensitivity (Medium Rating) – The medium sensitivity rating suggests moderate susceptibility to climate-related changes. While striped marlin show some sensitivity to environmental changes, their biological characteristics—including broad thermal tolerance, high mobility, and opportunistic feeding behaviour—provide resilience to climate stressors. Areas of higher sensitivity include potential impacts on reproduction and prey availability.

Adaptive Capacity (High Rating) – The high adaptive capacity rating reflects both biological and management-related factors that enable effective responses to climate change. Striped marlin's high mobility, broad distribution, and opportunistic feeding behaviour provide natural adaptive capacity. Additionally, WCPFC's flexible management framework, scientific monitoring programs, and capacity for responsive decision-making contribute to institutional adaptive capacity. However, the high proportion of "Unknown" scores (43%) indicates uncertainty about some adaptive capacity elements.

Discussion

Interpretation of Climate Risk Assessment Results

The **LOW** overall climate risk rating for North Pacific striped marlin represents a relatively positive outlook compared to other species assessments, reflecting both the inherent resilience of this highly mobile pelagic species and the adaptive management framework in place. This finding aligns with scientific understanding of billfish as generally resilient to environmental variability due to their life history characteristics.

Concordance with Scientific Literature

The low climate risk assessment is consistent with existing literature on billfish responses to climate variability. Striped marlin are known to be highly mobile, wide-ranging predators capable of tracking favourable environmental conditions and prey availability. Their broad thermal tolerance and opportunistic feeding behaviour provide natural buffering against climate-related changes.

Studies have shown that billfish species like striped marlin can adjust their distribution patterns in response to environmental changes, particularly temperature and prey availability shifts. The species' capacity for long-distance movements and flexible habitat use supports the high adaptive capacity rating identified in this assessment.

Assessment Strengths and Limitations

Strengths

The assessment benefits from a relatively robust knowledge base for North Pacific striped marlin compared to some other species, including regular stock assessments, biological research, and monitoring through fisheries data collection. The WCPFC's established management framework provides a solid foundation for evaluating institutional adaptive capacity.

Key Limitations and Data Gaps

Spatial Resolution of Climate Impacts – While the assessment utilized the best available information, there remains uncertainty about how climate impacts may vary spatially across the North Pacific striped marlin's range. Different areas within the WCPFC Convention Area may experience varying degrees of climate change impacts, potentially creating spatial heterogeneity in vulnerability that the current assessment may not fully capture.

Ecosystem-Level Interactions – The assessment focused primarily on direct impacts on striped marlin, but climate change effects on prey species and broader ecosystem dynamics could have significant indirect impacts. Changes in food web structure and prey availability represent important pathways for climate impacts that require further investigation.

Long-term Projections – The five-year assessment timeframe, while appropriate for management planning, may not capture longer-term climate change impacts that could become more pronounced over decades. Striped marlin's longevity means that some climate effects may manifest over longer time scales than the current assessment window.

Member-Specific Capacity Variations – The adaptive capacity assessment relied on general WCPFC-level information, but individual member capacity for monitoring, research, and management response may vary significantly. Some members may have greater or lesser capacity to implement adaptive management measures, potentially affecting overall system resilience.

Management Implications

Maintaining Management Effectiveness – The low climate risk rating suggests that current management approaches are likely to remain effective under projected climate scenarios. However, this should not lead to complacency, as continued monitoring and adaptive management will be essential to maintain this positive status.

Addressing Data Gaps – The significant number of "Unknown" scores, particularly for exposure (36%) and adaptive capacity (43%), highlights the importance of targeted research and monitoring to reduce uncertainty. Priority areas include:

- Enhanced monitoring of environmental-biological relationships
- Improved understanding of climate impacts on prey species and food webs
- Better characterization of spatial variability in climate impacts
- Assessment of member-specific adaptive capacity

Strengthening Adaptive Management – While the current management framework shows high adaptive capacity, there are opportunities to further enhance climate resilience:

- Integration of environmental indicators into stock assessment and management procedures
- Development of climate-informed reference points and harvest control rules
- Enhanced early warning systems for detecting climate-related changes
- Improved coordination with other RFMOs managing billfish species

Proactive Conservation Approaches – The relatively low vulnerability provides an opportunity to take proactive conservation measures that could help maintain this favourable status:

- Maintenance of rebuilding efforts towards healthy stock status to maximize resilience to climate impacts
- Protection of critical habitats and migration corridors
- Minimization of other stressors that could compound climate impacts
- Investment in research and monitoring infrastructure

Future Assessment Needs

Regular reassessment using the CCVA framework will be important to track changes in vulnerability status and ensure management measures remain appropriate. Future assessments should prioritize:

- Incorporation of new climate research and projections
- Integration of ecosystem-level impact assessments
- Enhanced spatial analysis of vulnerability patterns
- Updated evaluation of adaptive capacity as management evolves

Conclusions

The Climate Change Vulnerability Assessment for North Pacific striped marlin reveals a **LOW** overall climate risk, driven primarily by the species' high adaptive capacity and moderate sensitivity to climate stressors. This positive outlook reflects both the biological resilience of this highly mobile pelagic species and the effectiveness of current management arrangements.

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Attachment D5

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Attachment D5

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