

# CCVA Report For 2024-07 (Cetaceans)

---

## Executive Summary

The Climate Change Vulnerability Assessment (CCVA) for CMM 2024-07 (Cetaceans) 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.

Priority actions within WCPFC's scope could include: enhanced monitoring of cetacean populations, review of fishing pressure as an adaptable stressor to reduce cumulative impacts, strengthened spatial management informed by better interaction data, and incorporation of expert input to refine future assessments

## Introduction

Conservation and Management Measure (CMM) 2024-07 relates to the protection of cetaceans from purse seine and longline fishing operations across the entire Western and Central Pacific Fisheries Commission (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.

Climate change poses multifaceted threats to cetacean populations through direct impacts such as ocean warming, acidification, and sea-level rise, as well as indirect effects including altered prey distribution, changed migration patterns, and increased disease susceptibility. These climate-driven changes may affect the assumptions underlying current management measures and potentially compromise their effectiveness in protecting cetacean sustainability.

This assessment aims to evaluate the climate change vulnerability of CMM 2024-07 using the WCPFC Climate Change Vulnerability Assessment (CCVA) Framework, providing evidence-based insights to support adaptive management and enhance the climate resilience of cetacean protection measures in the Western and Central Pacific Ocean.

## Method

The climate change vulnerability assessment for CMM 2024-07 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.

## Attachment D1

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

Given that WCPFC does not typically hold comprehensive biological and ecological data on cetacean populations, the majority of data for this assessment was obtained through desktop review of peer-reviewed scientific articles. Data sources included:

- Published literature on cetacean biology, ecology, and climate change impacts
- Global and regional climate vulnerability assessments for marine mammals
- Scientific reports on cetacean-fishery interactions and bycatch patterns
- Climate change projections and oceanographic data relevant to the WCPFC Convention Area
- WCPFC technical reports and meeting documents related to cetacean interactions

## Scope and Limitations

The assessment scope encompasses the entire WCPFC Convention Area and all cetacean species potentially affected by purse seine and longline fishing operations covered under CMM 2024-07. The five-year assessment timeframe focuses on near-term climate change impacts and management responses, recognizing that longer-term climate projections carry greater uncertainty and are generally not available.

Key limitations include reliance on published literature rather than region-specific data, limited spatial resolution of available information on cetacean-fishery interactions, and uncertainty regarding member-specific institutional capacity and governance arrangements that could influence adaptive capacity ratings.

## Results

### Climate Risk Assessment

The CCVA yielded a **HIGH** overall climate risk rating for CMM 2024-07 (Cetaceans), determined by the combination of:

- **Hazard: High**( 42% High indicators, 33% Medium, 25% Low)
- **Exposure: High**(83% High indicators, 17% Medium, 0% Low; 2 Unknown)
- **Sensitivity: High**(30% High indicators, 43% Medium, 26% Low; 1 Unknown)

## Attachment D1

- **Adaptive Capacity: Medium** (50% High indicators, 83% Medium, 42% Low, 9 Unknown)
- **Vulnerability: High** (combination of Medium sensitivity and High adaptive capacity)

## Component Analysis

**Hazard (High Rating)** – The high hazard rating reflects significant climate-related threats that are highly applicable to cetacean populations in the WCPFC Convention Area. Key hazards scoring as "High" include temperature extremes, increased sea surface temperature, ocean acidification, deoxygenation, and current changes. These represent major environmental stressors that directly affect cetacean habitat quality, prey distribution, and physiological stress levels. Ocean warming forces cetaceans to make longer, deeper, and more frequent dives to find food, resulting in increased energetic costs that can reduce reproductive success. Additionally, hazards related to extreme weather events such as storms and cyclones scored highly, as these can disrupt migration patterns and increase mortality risk for air-breathing marine mammals.

**Exposure (High Rating)** – The high exposure rating indicates that cetacean populations across the WCPFC Convention Area frequently encounter identified climate hazards. This reflects the wide-ranging nature of many cetacean species that traverse areas experiencing significant oceanographic changes, including warming waters, altered current patterns, and changing prey distributions. Cetaceans' reliance on specific oceanographic features for feeding and breeding makes them particularly exposed to climate-driven environmental changes. The assessment found substantial exposure across multiple themes, including biological and ecological systems (habitat and food web changes), operations and infrastructure (affecting research and monitoring capabilities), and management systems (spatial boundaries and scientific assumptions underlying current protection measures).

**Sensitivity (High Rating)** – The high sensitivity rating reflects cetaceans' significant susceptibility to climate-related changes. While some cetacean species demonstrate adaptability, many exhibit characteristics that increase their sensitivity to environmental changes, including long generation times, specific habitat requirements, and specialized feeding behaviors. Key sensitivity factors include dependence on environmental cues for reproduction and migration timing, specific thermal ranges and prey dependencies, and relatively low productivity with extended maternal care periods. The assessment identified particular sensitivity in reproduction (with climate change affecting breeding timing and success), prey availability (as climate change alters marine food webs), and habitat suitability (with changing oceanographic conditions affecting critical feeding and breeding areas).

**Adaptive Capacity (Medium Rating)** – The medium adaptive capacity rating reflects a mixed picture of biological and management-related factors affecting cetaceans' ability to respond to climate change. While some cetacean species show high mobility and broad distributions that provide natural adaptive capacity, others have more limited ranges or specialized habitat requirements. The rating acknowledges that WCPFC has institutional frameworks for monitoring and management, but also recognizes significant limitations in cetacean-specific data collection, research capacity, and targeted management measures. Factors contributing to

## Attachment D1

medium rather than high adaptive capacity include limited observer coverage for cetacean interactions, insufficient spatial data on cetacean-fishery overlap patterns, and uncertainty about member-specific institutional capacity for cetacean conservation measures. The assessment highlighted that many adaptive capacity indicators required information about individual member countries' capabilities and resources that was not readily accessible to external assessors.

## Discussion

### Interpretation of Climate Risk Assessment Results

The Climate Change Vulnerability Assessment (CCVA) for CMM 2024-07 (Cetaceans) yielded a **HIGH** overall climate risk rating, driven by **high** ratings for hazard, exposure, and sensitivity, combined with **medium** adaptive capacity. This finding is strongly supported by the growing body of scientific literature documenting the vulnerability of whales and dolphins to climate change impacts across global marine ecosystems.

### Concordance with Scientific Literature

The high climate risk assessment for cetaceans aligns closely with recent global vulnerability assessments. For example, a comprehensive study of U.S.-managed marine mammals found that 72% of cetacean and pinniped stocks are highly or very highly vulnerable to climate change, with 44% receiving "very high" vulnerability scores (Lettrich et al., 2023). Similarly, trait-based vulnerability assessments have identified fin whales, sperm whales, bottlenose dolphins, and Bryde's whales as among the most vulnerable species to climate change, many of which occur within the WCPFC Convention Area. Scientific literature formed the basis of most assessment scores, and reference are noted in the assessment framework sheet.

The high hazard rating identified in this assessment reflects well-documented climate stressors affecting cetaceans globally. Rising sea surface temperatures and reducing sea ice extent have been observed to cause poleward shifts in cetacean distributions, alterations in migration timing, and increased extinction risk for some species. Ocean warming is causing unprecedented changes that affect cetacean foraging behaviour, with some species requiring longer, deeper, and more frequent dives to find food, resulting in increased stress that can reduce reproductive success.

The high exposure rating is consistent with evidence that cetacean species with limited habitat usage face greater challenges in coping with temperature changes, particularly as they approach their thermal threshold (at higher temperatures), while even adaptable species face ecosystem-wide repercussions from habitat shifts.

The high sensitivity rating reflects the cascading effects of climate change through marine food webs. Climate change affects cetacean distribution patterns, migration timing and ranges, and reproductive ability, with some populations potentially unable to adapt quickly enough to survive. Changes in group behaviour have been documented in response to climate variability, with smaller groups observed during periods of lower prey availability.

### Assessment Limitations and Data Gaps

While the overall high climate risk rating is supported by available evidence, several important limitations in the assessment should be acknowledged that may have influenced the precision of component ratings.

#### Hazard Applicability and Extent

There is uncertainty about the specific applicability and spatial extent of various climate hazards to cetacean populations within the WCPFC Convention Area. The assessment framework required evaluating the relevance of hazards such as ocean acidification, deoxygenation, and changing current patterns to cetaceans, but available data was not specific to the WCPO. This uncertainty may have led to conservative scoring approaches that could either underestimate or overestimate actual hazard levels for specific cetacean populations or species within different areas of the Convention Area.

The temporal dimension of hazard exposure also presented challenges, as the five-year assessment timeframe may not capture the full scope of long-term climate trends that are most relevant to long-lived cetacean species. Climate change impacts on cetaceans are expected to be diverse and mediated in various ways, with some direct impacts occurring through distributional shifts, while indirect impacts include increased disease susceptibility and altered prey availability.

#### Member-Specific Adaptive Capacity Information

The moderate rating for adaptive capacity (Medium) may not fully reflect the actual institutional and management capacity available within the WCPFC. Many adaptive capacity indicators were specific to individual Member countries' capabilities, resources, and governance structures—information that was not accessible to the external assessor but would be readily available to WCPFC Members themselves. For example, indicators relating to:

- Diversification of economic interests in response to required changes to reduce risk to the focus species
- Diversification of livelihood reliance away from the focus species if required
- Relative ability for WCPFC members to ensure food security should the focus species require changes to current food supply associated with the fisheries

Members conducting their own assessments would likely have access to detailed information about their institutional capacity, potentially resulting in more nuanced and possibly higher adaptive capacity ratings. This suggests that the current Medium rating may represent a conservative baseline that could be improved through Member-led assessments incorporating country-specific institutional knowledge.

#### Spatial Data Gaps in Interaction Patterns

There was no spatial data available to the assessor about cetacean-fishery interactions across the Convention Area, which limited the assessment. Furthermore, given longline observer coverage is inadequate, available data may not capture the full extent of interactions.

## Attachment D1

This creates uncertainty about:

- Seasonal and spatial patterns of cetacean-fishery overlap
- Areas of highest interaction risk requiring priority attention
- Effectiveness of current spatial management measures
- Opportunities for adaptive spatial management approaches

The absence of comprehensive spatial interaction data directly impacts adaptive capacity scoring, particularly for indicators related to spatial management flexibility, targeted mitigation measures, and area-based conservation strategies. While WCPFC maintains bycatch databases for key species groups, the spatial resolution and taxonomic detail may not be sufficient to support fine-scale adaptive management for cetaceans.

### Strengthening Future Assessments

The current assessment could be significantly strengthened through the incorporation of expert input from cetacean specialists, marine mammal biologists, and regional ecosystem experts.

### WCPFC's Role in a Broader Conservation Context

It is important to recognize that WCPFC is not the primary organization responsible for global cetacean conservation, but rather one component of a broader international governance framework. Organizations such as the International Whaling Commission (IWC) and the Secretariat of the Pacific Regional Environment Programme (SPREP) have explicit mandates for cetacean conservation and protection. However, WCPFC has a critical responsibility for managing the impact of tuna fisheries on cetacean sustainability, which becomes increasingly important under climate change scenarios.

While cetacean conservation requires coordinated action across multiple international bodies, WCPFC's unique position as manager of the world's largest tuna fishery gives it significant influence over a major anthropogenic stressor affecting cetacean populations in the Pacific.

### Management Implications - Fishing Pressure as an Adaptable Stressor

Although the CCVA framework focuses specifically on climate-related stressors, it is crucial to acknowledge that fishing pressure represents a significant non-climate stressor that interacts with climate vulnerability. Unlike climate change impacts, which are largely external to fisheries management control, fishing pressure is a stressor that can be directly adjusted through management intervention. This creates important opportunities for adaptive management responses.

Given the HIGH climate vulnerability identified for cetaceans and their reduced adaptive capacity to respond to climate stressors, there may be compelling reasons to examine more comprehensively the cumulative impact that fishing pressure is having on these species. When species have limited capacity to adapt to climate change, reducing other anthropogenic stressors becomes a critical conservation strategy. The economic and cultural importance of cetaceans to Pacific Island communities, combined with their ecological significance as apex predators and ecosystem engineers, further supports the case for examining potential adjustments to fishing management.

## **Attachment D1**

Specific areas to improve cross-stressor management might include:

- Enhanced spatial and temporal fishing restrictions in critical cetacean habitats
- Strengthened bycatch mitigation measures, particularly for highly vulnerable species
- Adaptive management triggers based on cetacean population status and climate indicators

## References

### WCPFC Documents:

WCPFC. Final Compliance Monitoring Reports (CMRs) 2021, 2022, 2023, 2024.

WCPFC. (2024). Regional Observer Programme Annual Report. WCPFC-TCC20-2024-RPO02.

WCPFC. (2024). Scientific Committee Summary Report. WCPFC-SC20-2024, para 36.

### Academic Journal Articles:

Albouy, C., Delattre, V., Donati, G., Frölicher, T.L., Algar, A.C., Erisman, B., et al. (2020). Global vulnerability of marine mammals to global warming. *Scientific Reports*, 10, 548.

S. Elizabeth Alter, Mark P. Simmonds, John R. Brandon (2010) Forecasting the consequences of climate-driven shifts in human behavior on cetaceans, *Marine Policy*, Volume 34, Issue 5, 2010, Pages 943-954, ISSN 0308-597X, <https://doi.org/10.1016/j.marpol.2010.01.026>.

Barlow, D.R., Torres, L.G., Hodge, K.B., Steel, D., Baker, C.S., Chandler, T.E., Bott, N., Constantine, R., Double, M.C., Gill, P., Glasgow, D., Hamner, R.M., Lilley, C., Ogle, M., Olson, P.A., Peters, C., Stockin, K.A., Tessaglia-Hymes, C.T., & Klinck, H. (2021). Temporal and spatial lags between wind, coastal upwelling, and blue whale occurrence. *Scientific Reports*, 11, 6915.

Bloodgood, J.C.G., Kleinman, S., Turnley, J.G., Lovewell, G., Sawyer, S. & Townsend, F.I. (2023). Physiological Effects of Low Salinity Exposure on Bottlenose Dolphins (*Tursiops truncatus*). *Animals*, 1(1), 5.

Croll, D.A., Marinovic, B., Benson, S., Chavez, F.P., Black, N., Ternullo, R., & Tershy, B.R. (2005). From wind to whales: Trophic links in a coastal upwelling system. *Marine Ecology Progress Series*, 289, 117-130.

Garland EC, Goldizen AW, Lilley MS, Rekdahl ML, Garrigue C, Constantine R, Hauser ND, Poole MM, Robbins J, Noad MJ. (2015) Population structure of humpback whales in the western and central South Pacific Ocean as determined by vocal exchange among populations. *Conserv Biol*. Aug;29(4):1198-1207. doi: 10.1111/cobi.12492. Epub 2015 Apr 7. PMID: 25851618.

Guinn, M.A., Elliott, J.Y., Wittmaack, C.S., Sinclair, C., Abdulla, H.A. & Orbach, D.N. (2024). Stress and Reproductive Hormones of Free-Ranging Dolphins Across a Natural Salinity Gradient. *ACS Omega*, 9(45), 45068-45079.

Izquierdo-Serrano M, Revuelta O, Míguez-Lozano R, Gozalbes P, Ruiz-García D, Raga JA and Tomás J (2022) Assessment of the interactions between cetaceans and fisheries at the south of the Cetacean Migration Corridor and neighboring waters (Western Mediterranean). *Front. Mar. Sci.* 9:981638. doi: 10.3389/fmars.2022.981638

Kebke A, Samarra F, Derous D. (2022) Climate change and cetacean health: impacts and future directions. *Philos Trans R Soc Lond B Biol Sci.* 2022 Jul 4;377(1854):20210249. doi: 10.1098/rstb.2021.0249. PMID: 35574848; PMCID: PMC9108940.

Lettrich, M. D., Asaro, M. J., Borggaard, D. L., Dick, D. M., Griffis, R. B., Litz, J. A., ... & Whitehead, H. R. (2023). Vulnerability to climate change of United States marine mammal stocks in the western North Atlantic, Gulf of Mexico, and Caribbean. *PLOS ONE*, 18(9), e0290643. <https://doi.org/10.1371/journal.pone.0290643>



## Attachment D1

MacLeod, C.D., Santos, M.B., López, A., & Pierce, G.J. (2006). Relative prey size consumption in toothed whales: implications for prey selection and level of specialisation. *Marine Ecology Progress Series*, 326, 295-307.

Magera, A.M., Mills Flemming, J.N., Kaschner, K., Christensen, L.B., & Lotze, H.K. (2013). Recovery trends in marine mammal populations. *PLoS ONE*, 8(10), e75909.

Ortiz, R.M. (2001). Osmoregulation in marine mammals. *Journal of Experimental Biology*, 204(11), 1831-1844.

Palmer EI, Betty EL, Murphy S, Perrott MR, Smith ANH, Stockin KA. Reproductive biology of female common dolphins (*Delphinus delphis*) in New Zealand waters. *Mar Biol*. 2022;169(12):158. doi: 10.1007/s00227-022-04139-3. Epub 2022 Nov 28. PMID: 36466079; PMCID: PMC9705467.

Russell Richards, Jan-Olaf Meynecke, Oz Sahin (2021), Addressing dynamic uncertainty in the whale-watching industry under climate change and system shocks, *Science of The Total Environment*, Volume 756, 43889, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2020.143889>.

Rykaczewski, R.R., & Checkley, D.M. (2008). Influence of ocean winds on the pelagic ecosystem in upwelling regions. *Proceedings of the National Academy of Sciences*, 105(6), 1965-1970.

Simmonds, M.P. (2019). Climate change and cetaceans - an update. *Journal of Marine Animals and Their Ecology*, 12(1), 11-28.

Simmonds, M.P., & Isaac, S.J. (2007). Potential Effects of Climate Change on Marine Mammals. Report for DEFRA Research Contract CR0302.

Sousa, A., et al. (2023). Integrated climate, ecological and socioeconomic scenarios for the whale watching sector. *Science of the Total Environment*, 857(Pt 3), 159589.

Trites, A.W., Christensen, V., & Pauly, D. (1997). Competition between fisheries and marine mammals for prey and primary production in the Pacific Ocean. *Journal of Northwest Atlantic Fishery Science*, 22, 173-187.

van Weelden, C., Towers, J.R., & Bosker, T. (2021). Impacts of climate change on cetacean distribution, habitat and migration. *Climate Change Ecology*, 2, 100009.

Venegas, R.M., Acevedo, J., & Treml, E.A. (2024). Three decades of ocean warming impacts on marine ecosystems: A review and perspective. *Deep Sea Research Part II: Topical Studies in Oceanography*.

Von Hammerstein H, Setter RO, van Aswegen M, Currie JJ and Stack SH (2022) High-Resolution Projections of Global Sea Surface Temperatures Reveal Critical Warming in Humpback Whale Breeding Grounds. *Front. Mar. Sci.* 9:837772. doi: 10.3389/fmars.2022.837772

### Reports and Technical Documents:

IPCC. (2021). Sixth Assessment Report (AR6). Intergovernmental Panel on Climate Change.

IOC Sub-Commission for the Western Pacific (WESTPAC). (2022). Ocean Deoxygenation. <https://ioc-westpac.org/ocean-deoxygenation/>

Williams, T.M., et al.(2024) Travel at low energetic cost by swimming and wave-riding bottlenose dolphins. "Whales and Dolphins" ocean.si.edu.

WWF. (2022). Protecting Blue Corridors Report.

## Attachment D1

### Online Resources and Websites:

Bégin Marchand, C. (2020). Do tides have an influence on whales? *Baleines en direct*. <https://baleinesendirect.org/en/do-tides-have-an-influence-on-whales/>

Biology Insights. (2025). Whale migration: Patterns, currents, and communication. <https://biologyinsights.com/whale-migration-patterns-currents-and-communication/>

GEMM Lab. (2021). Wave riders or deep divers: What do cetaceans do in stormy weather? *Geospatial Ecology of Marine Megafauna Laboratory*. <https://blogs.oregonstate.edu/gemmlab/2021/05/03/wave-riders-or-deep-divers-what-do-cetaceans-do-in-stormy-weather/>

International Union for Conservation of Nature (IUCN). IUCN Red List of Threatened Species. <https://www.iucnredlist.org/>

NOAA Fisheries. (n.d.). Whales and climate change: Big risks to the ocean's biggest species. <https://www.fisheries.noaa.gov/national/climate/whales-and-climate-change-big-risks-oceans-biggest-species>

NOAA Fisheries. (n.d.). Spinner Dolphin Conservation Management. <https://www.fisheries.noaa.gov/species/spinner-dolphin/conservation-management>

Ocean Processes: Whales and Climate. (2020). <https://whalesandclimate.org/ocean-processes/>

World Cetacean Alliance. (2024). Celebrating Cetaceans in Indigenous Cultures. <https://worldcetaceanalliance.org/2024/08/09/celebrating-cetaceans-in-indigenous-cultures/>