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Mapping SPC's Recurring Scientific Outputs to WCPFC to Climate Change Vulnerability

Assessment Framework Requirements

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Executive Summary

The WCPFC Climate Change Vulnerability Assessment (CCVA) framework requires the input of scientific information across four risk components: hazard, exposure, sensitivity, and adaptive capacity. This paper maps existing Scientific Services Provider (SSP) outputs against framework requirements to clarify what information is already available, what could be developed from existing data, and what represents a gap requiring new approaches. It provides a high-level indication of the extent to which fulfilling these gaps would affect SPC's existing work. The analysis is focussed on information available for the key tuna stocks; data for non-target species (e.g. turtles, cetaceans, some shark stocks) are less readily available and where the CMM under consideration referred to those species, additional effort would be required.

The mapping exercise uses a traffic-light categorisation:

- **Green**: Information readily available or easily inferred from current outputs
- **Amber**: Data exists but requires analytical work to compile, process, or apply appropriately
- **Red**: Information not routinely developed or would be difficult to gather through existing processes

Key finding: whilst foundational biological and oceanographic data exists through SSP's recurring work programmes for key tuna stocks (much less so for other stocks or issues that may be the focus of other WCPFC CMMs), answering the framework's specific climate-framed questions requires expansion or reframing of existing analyses. This has implications for discussions about the nature and scope of services provided by SPC to WCPFC.

Introduction

The CCVA framework evaluates specific criteria under hazard, exposure, sensitivity, and adaptive capacity on a Conservation and Management Measure (CMM) by CMM basis to form an overall evaluation of climate risk(s)[1].

The CCVA Framework Assessment Tool presented to SC and TCC was informed by the literature review undertaken as part of the CCVA consultancy. The literature review guided the development of the scientific indicators proposed for inclusion in the framework.[2]

While biophysical criteria are common across CCVA assessments[3], the specific answers are not currently found in routine outputs from the Secretariat's Scientific Services Provider (SSP) to the Commission.

Unlike the data gaps identified as being within the Technical and Compliance Committee's (TCC) remit, which will require more qualitative approaches to address, the gaps relating to species' biology and behaviour are more nuanced.

At Scientific Committee, some Members queried how the criteria, particularly those for which data is not readily available, could be addressed through the SSP's existing processes and outputs.

Some information is currently available and integrated into existing outputs. Other information could potentially be found through scientific literature from the WCPO or other ocean basins and synthesised through SPC's existing work programmes. Other criteria will be substantially harder to address.

Beyond sourcing the information itself, it is also important that technical advice to the Commission, including any advice on climate risks, is reviewed through the Commission's standard processes in its subsidiary bodies. A structured way of reviewing and incorporating this information will ensure that any further work on climate risk assessment (of which climate vulnerability is a part) undertaken is based on the best available science to the Commission.

SPC's Current Recurring Scientific Outputs

SPC provides a range of recurring outputs and advisory services to the WCPFC Scientific Committee, Technical and Compliance Committee and the Regular Commission meeting. While more detail can be found in the regular reporting to the

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[1] NB criteria subject to change subject to discussion by the Commission in 2025.
[2] As noted to TCC, the indicators within its remit were novel.
[3] See Attachment A to WCPFC-SC21-2025/EB-WP-01, particularly tables 4, 5 and 6

Finance and Administration Committee (e.g. Annex 12 of FAC19-5), key elements include:

Core Scientific Services

- General scientific advice
- Scientific data management, compilation and dissemination
- Bycatch and other data summaries
- Ecosystem and climate indicators report card

Stock Assessment Outputs

- Stock assessments for priority species[4]
- Overview of fisheries and stock status of tuna, billfish and sharks in the Western and Central Pacific Ocean (WCPO)

Analytical Services

- Advice and analyses on the performance of measures as directed

Mapping CCVA Indicators to Existing Outputs

The analysis presented at Attachment 1 identifies where existing outputs address CCVA criteria and suggests how integration could be achieved. In some cases this requires new or expanded analysis of existing datasets, whilst in others it may require discrete new outputs on the effects of hazards on WCPO species more generally.

The Traffic-Light Categorisation

The mapping uses a simple traffic-light system to show current coverage:

- **Green:** Some information/data or can infer with some reasonable level of comfort
- **Amber:** Data sets are available, but would take work to pull together/require further thought on what data should be used, how they should be processed, or how they apply to the stock/fishery of interest
- **Red:** Either that information is not routinely developed or is difficult to gather

Important note: The focus is on the key tuna species. The observations below, particularly on exposure and sensitivity, would not apply equally to billfish or sharks, where data coverage is generally more limited.

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[4] For: Oceanic whitetip, pacific bigeye thresher shark, Southern Hemisphere porbeagle shark, whale shark, SP Swordfish, Pacific blue marlin, skipjack, SP blue shark, NP blue Shark, SP Pacific shortfin mako, bigeye, yellowfin, NP albacore tuna, NP Swordfish, NP striped marlin, SP albacore, Pacific bluefin, SW Pacific striped marlin, silky shark, NP shortfin mako

The Commission may wish to consider how it wishes to handle 'red' information (not routinely developed/difficult to gather) and 'amber' information (data sets available but requiring work to pull together) in the context of the services the SSP is engaged to deliver.

Conclusions

At this stage, it is unclear whether integrating answers to the CCVA climate risk questions into existing SSP work would be a minor or major, (or somewhere-in-between) effort. The mapping exercise provides transparency about what exists, what could be developed, and what represents genuine gaps. If the CCVA were pursued, additional evaluation would be needed to better understand the potential impact on the work of the SSP.

The complementary Commission paper outlines pragmatic pathways for progressively improving the Commission's understanding of climate risks, which these mapping findings directly inform. Whether the Commission pursues full framework implementation or alternative approaches, this analysis provides a foundation for realistic planning.

Mapping CCVA Indicators to Existing Outputs

Hazards **Focus is on the key tuna species – observations below, particularly on e.g. exposure/sensitivity, would not apply to e.g. billfish/sharks**. 'Current coverage' key:

Red: either that information is not routinely developed or is difficult to gather

Amber: data sets are available, but would take work to pull together/require further thought on what data should be used, how they should be processed or how they apply to the stock/fishery of interest

Green: we have some information/data or can infer with some reasonable level of comfort

Hazards

CCVA Template		SSP outputs	
Criteria	**Indicator** **(Low/Medium/High applicability]**	**Current coverage** **(None/Limited/Partial/Full)**	**Comments**
Temperature extremes	Temperature extremes (e.g., marine heatwaves) have the potential to significantly affect species distribution and survival if they have narrow thermal		SST data are available, but need to define which data set/location/calculation to use

	tolerances and limited mobility, adaptability to new habitats / areas		
Increased sea surface temperature (SST)	Stock displacement, increased mortality, reduced productivity, reduced prey availability a species is dependent on		SST data are available, but need to understand which data set/location/ calculation to use
Ocean acidification	Can cause harm to exposed systems in acidifying zones by impairing calcification, disrupting food webs and weakening species resilience		Data sets are available, but need to understand which data set/location/ calculation to use
Salinity	Salinity fluctuations can severely impact fish biology, affecting both health and homeostasis. Deviations from optimal salinity can cause mortality, reduced growth and impaired immune function		Data sets are available, but need to define which data set/location/ calculation to use
Deoxygenation	Tropical pelagic species live near or above oxygen minimum zones. Changes in hypoxic or subtoxic zones can affect species physiology, habitat availability and ecosystem function		Data sets are available, but need to define which data set/location/measure to use
Wind stress	Changes in wind strength or direction can disrupt ecological or physical systems e.g., upwelling, larval dispersal and can contribute to other hazard e.g., intensification of tropical cyclones		Data sets are available, but need to define which data set/location/measure to use

			More easily interpreted through the manifestation of other measures e.g. SST
Current change	Changes in strength, direction, timing or vertical structure can disrupt larval dispersal, nutrient delivery, primary productivity; alter species migration routes; affect heat distribution, oxygen levels and acidification patterns, destabilize or shift climate systems		Data sets are available, but need to define which data set/location/measure to use More easily interpreted through the manifestation of other measures e.g. SST
Storms	Wind damage, storm surge, port infrastructure damage, loss of life or injury, damage to vessel infrastructure, loss of fishing days		Modelling of storm patterns and frequency is challenging Projection models are not usually in agreement and ensemble approach is needed to capture full spectrum of future conditions. Forecasting is more reliable
Cyclones	Wind damage, storm surge, port infrastructure damage		Modelling of cyclone patterns and frequency is challenging Projection models are not usually in agreement and ensemble approach is needed to capture full spectrum of

			future conditions. Forecasting is more reliable
Precipitation extremes	Flooding, port infrastructure damage, reduction in port access and service		Projection models are not usually in agreement and ensemble approach is needed to capture full spectrum of future conditions. Forecasting is more reliable
Sea level rise	Flooding, port infrastructure damage, reduction in port access and service		Data sets are available, but need to define which data set/location/measure to use
Wave height	Changes in wave heigh, frequency or intensity can result in disruption to marine operations, infrastructure damage, wave-driven over wash and saline instruction and stress to intertidal ecosystems		Data sets are available, but need to define which data set/location/measure to use

Exposure – not completed as requires the availability and application of the information gathered under the other categories

CCVA Template		SSP outputs	
Criteria	**Question** *(Rarely / Occasionally/Regularly)*	**Current coverage** **(None/Limited/Partial/Full)**	**Comments**
Habitat	How frequently does the habitat of the focus species experience the identified hazards?	-	

Food web	How frequently is the food web of the focus species exposed to the identified hazards? (consider predator and prey relationships)	-	
Species population	How frequently does the focus species population experience the identified hazards?	-	
Spatial boundaries	Do the identified hazards affect any fixed geographic boundaries used to manage the fisheries or set by the CMM?	-	
Scientific assumptions	Are the identified hazards factored into the temporal and spatial assumptions used to define management settings?	-	
Information	How often does the WCPFC receive updated scientific information on these hazards?	-	

Sensitivity

CCVA Template		SSP outputs	
Criteria	Question *(Low/Medium/High sensitivity)*	Current coverage (None/Limited/Partial/Full)	Comments
Thermal range	What is the temperature tolerance of the focus species? (when unknown the breadth of distribution can be used as a proxy for temperature range)		General information available through e.g. SEAPODYM and tagging analyses

Mobility	What is the ability of the focus species to move to a new location if the current location changes and is no longer favourable for growth and / or survival?		Some known behaviour/tagging data/genetic information available for some stocks, but not for all stocks/limited information. Also estimated by SEAPODYM but assumes stocks do not adapt.
Productivity	What is the productivity of the species?		General information available – and fed into/estimated by assessments
Distribution	What is the distributional range of the species?		General information available – and fed into/estimated by assessments
	What is the level of influence of environmental cues on the distribution of the species?		General understanding available based upon e.g. SEAPODYM (with assumptions)
Reproduction	How dependent is reproductive success on specific or complex environmental conditions / triggers?		General understanding available. Specific impacts of environment require new studies

	How sensitive is the spawning cycle and duration to changes in seasonal cues and temperature changes?		General understanding available. Specific impacts of environment require new studies
	What is the age at maturity of the species?		General information available – noting age data are often more limited/uncertain. Values are not routinely updated.
Prey	What is the prey specificity of the focus species?		General understanding available
Competition	What is the level of competition that the focus species has with other species for the same habitat requirements / prey and diet requirements?		Diet studies provide some information
Health status	What is the current health status of the focus species population?		General understanding through assessments/genetic information
	What is the projected health status of the focus species population in 5 years time based on current environmental conditions?		General understanding through assessments and associated projection/harvest strategy analyses, but not specifically climate-based

	What is the variability of the focus species' abundance / CPUE indexes?		Available through abundance indices for key assessed stocks
Harvest strategy	Is there a harvest strategy or equivalent best practice management measure implemented for the species?		For some stocks
	How does the harvest strategy account for increased uncertainty due to climate change?		To be evaluated for all stocks, generally under 'robustness set' analyses
	How quickly can the harvest strategy adjust to new information about stock status or environmental conditions?		Depends on strength of signals (exceptional circumstances) and management decision making in that case
Fishing effort	What is the level of collective fishing effort associated with the focus species?		General understanding through supplied data and assessments (fishing mortality/impact)
Resource and governance	What is the level of resource available to comprehensively assess the health status and distribution of the focus species regularly?	-	Dependent upon Commission funding decisions
	What is the level of confidence to make informed decisions associated with current available information on the focus species?	-	

Information availability	What is the level of availability of climate change information associated with the focus species?	-	Represented by the colour coding in this review

Adaptive Capacity

CCVA Template		SSP outputs	
Criteria	**Question** *(Low/Medium/High adaptability)*	**Current coverage** **(None/Limited/Partial/Full)**	**Comments**
Thermal range	What is the ability of the focus species to adapt to increased temperatures?		Some understanding for some stocks (e.g. skipjack)
Productivity	What is the likelihood of the focus species to maintain or improve its productivity in response to increased temperatures and different environmental conditions?		Some understanding for some stocks (e.g. skipjack)
Distribution	What is the ability for the focus species to change its distributional patterns?		Some understanding through tagging/genetic studies for key tuna stocks
Reproduction	What is the likelihood of the focus species being able to adapt to successfully spawn under differing environmental conditions and changes in seasonal / temperature cues?		Extremely difficult to quantify – qualitative assessment using simulation models only

Prey	What is the likelihood of the focus species being able to change its prey and diet if required in response to environmental changes?	RED	Extremely difficult to quantify – qualitative assessment using simulation models only
Competition	What is the ability of the focus species to adapt to reduce its level of competition with other species for habitat requirements / prey and diet requirements?	RED	Extremely difficult to quantify – qualitative assessment using simulation models only
Health status	Under the current management settings, what is the likelihood of the focus species being able to maintain its current health status or rebuild its health status in response to environmental change (SST, ocean acidification, dissolved oxygen, salinity)	-	Outside SSP scope
Species diversification	What is the level of flexibility to change the focus species (if it is a target species) to another target to reduce the impact of fishing?	-	Outside SSP scope
Fishing gear	What is the level of flexibility to modify gear requirements or implement gear restrictions for fishing gear identified as creating a higher risk to the focus species compared to others?	-	Outside SSP scope
Fishing effort	What is the likelihood of fishing effort associated with the focus species of being significantly affected as a result of not being able to operate at sea due to increased storm events etc.?	-	Outside SSP scope

Observer coverage (human and / or EM)	What is the likelihood of monitoring levels being consistently sufficient for the fisheries associated with the focus species over the next 5 years?	-	Outside SSP scope
Research and technology	What is the level of investment (current and planned) in research and technology of direct relevance to the focus species to improve understanding?	-	Dependent upon Commission funding decisions
Information sharing and cooperation	What is the level of certainty / likelihood of improved cooperation and information sharing between members and internationally, to improve efficiencies and understanding associated with the focus species over the next five years?	-	Outside SSP scope