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SC13 – ECO 10
Proposal for an Ecosystem Status Profile Framework for the SPRFMO Scientific Committee

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1. Background

The South Pacific Regional Fisheries Management Organisation (SPRFMO) is mandated to ensure the long-term conservation and sustainable use of fishery resources and to safeguard the ecosystems in which they occur. Meeting this mandate requires advancing towards an ecosystem-based fisheries management (EBFM) approach, in line with commitments under the United Nations Fish Stocks Agreement and the FAO Code of Conduct for Responsible Fisheries. This approach recognizes that the sustainability of fisheries is inseparable from the health of the ecosystems that support them.

The development of Ecosystem Status Profiles (ESPs) responds to this mandate by providing a structured synthesis of ecological, environmental, and human-use information across the SPRFMO Convention Area and adjacent exclusive economic zones. ESPs integrate the best available scientific evidence to describe ecosystem condition, drivers of change, and interactions among species, fisheries, and the environment. By compiling indicators across multiple ecological and socioeconomic dimensions, ESPs serve as a baseline for monitoring change, identifying risks, and evaluating cumulative impacts.

Climate variability, ocean warming, and human pressures are reshaping South Pacific species and habitats, creating uncertainties for management, especially where data are limited. An ESP offers a transparent, science-based foundation for adaptive, precautionary decision-making, while aligning scientific advice with SPRFMO's objectives of sustainable stocks, ecosystem integrity, and socio-economic benefits.

By documenting ecosystem status in a consistent and accessible format, ESPs are intended to become a practical tool for advancing ecosystem-based management within SPRFMO, strengthening the integration of ecological considerations into fisheries governance, and guiding coordinated monitoring and research efforts across member states.

- **The Scientific Committee is invited to review this proposal and contribute recommendations to refine its structure, scope, and applicability for future use.**

2. Purpose of Developing an Ecosystem Status Profile (ESP) for Ecosystem-Based Management in SPRFMO

The purpose of developing an Ecosystem Status Profile is to synthesize the best available scientific information on the condition and dynamics of ecosystems under SPRFMO's jurisdiction and the exclusive economic zones of the coastal countries. The ESP provides an essential foundation for ecosystem-based fisheries management by characterizing key ecosystem components and processes, identifying pressures and cumulative impacts, establishing baselines for monitoring, and supporting adaptive, precautionary management decisions. It is a practical tool to help the SPRFMO Scientific Committee and Commission integrate ecological considerations into the conservation and sustainable use of marine living resources.

3. Proposed Structure for the ESP

a. Executive Summary

- Concise synthesis of the current state of the ecosystem.
- Highlights of major trends (e.g., warming, species shifts).
- Key risks to ecosystem structure and fisheries.
- Management implications and recommended actions.
- Overall ecosystem condition and confidence level.

b. Introduction

- Purpose of the ESP (e.g., to support EBFM within SPRFMO).
- Geographic scope: description of the SPRFMO Convention Area.
- Overview of key species and fisheries.
- Alignment with SPRFMO's Ecosystem Approach to Fisheries Management (EAFM) objectives.

c. Environmental and Oceanographic Drivers

- Sea Surface Temperature (SST)

SST is a primary indicator of ocean warming and a key environmental variable influencing species distribution, spawning success, and larval development. Anomalies in SST, especially during events like El Niño, can shift suitable habitats for key species such as jack mackerel and jumbo squid.

- ENSO and other climate indices (e.g., PDO, SAM)

Large-scale climate modes such as the El Niño–Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and Southern Annular Mode (SAM) modulate ocean conditions (temperature, productivity, circulation) over seasonal to decadal timescales. These influence recruitment, migration patterns, and ecosystem productivity across the SPRFMO area.

- Upwelling indices and frontal zones

Coastal and offshore upwelling systems supply nutrient-rich waters that fuel primary productivity. Indices measuring upwelling strength, as well as the position and intensity of thermal fronts, help assess foraging habitat quality and early life-stage survival.

• Chlorophyll-a and productivity

Satellite-derived chlorophyll-a is a proxy for phytoplankton biomass and overall ocean productivity. Interannual fluctuations influence food availability for zooplankton and fish larvae, thereby affecting trophic energy transfer and recruitment success.

• Oxygen Minimum Zone (OMZ) dynamics

The vertical extent and intensity of OMZs shape the habitable volume for midwater and deep-sea species. OMZ shoaling can compress fish habitat, increase competition, and elevate vulnerability to fishing for species like jumbo squid and jack mackerel.

• Ocean circulation and eddy activity

Surface and subsurface currents, including the South Equatorial Current, Peru–Chile Countercurrent, and mesoscale eddies, influence larval dispersal, connectivity among stocks, and productivity hotspots. These features affect spatial overlap between predators and prey.

4. Lower Trophic Levels

• Phytoplankton biomass and composition

Phytoplankton form the base of the marine food web and drive primary production. Changes in total biomass and shifts in species composition can alter food quality and energy transfer efficiency to zooplankton and fish larvae.

• Zooplankton abundance and size structure

Zooplankton serve as the key intermediary between phytoplankton and higher trophic levels. Their abundance and size distribution determine prey availability for early life stages of small pelagic fish and squid. A dominance of smaller or less nutritious zooplankton can reduce growth and survival rates in larval fish.

• Spatial and temporal variability in productivity

Primary and secondary production fluctuate seasonally and interannually, particularly in response to oceanographic drivers (e.g., ENSO, upwelling). Understanding the timing and location of productivity peaks is essential for predicting match/mismatch dynamics with spawning and larval development of key species.

5. Status of Key Species

• Jack mackerel (*Trachurus murphyi*): Biomass trends, distribution, habitat.

A transboundary pelagic species central to the SPRFMO mandate, jack mackerel exhibits wide-ranging distribution across the South Pacific. Monitoring biomass trends and spatial shifts in habitat use is critical to assessing stock health, recruitment variability, and responses to environmental changes such as ocean warming or shifting productivity regimes.

- Jumbo squid (*Dosidicus gigas*): Abundance, migration, environmental sensitivity.

Jumbo squid is a highly mobile, short-lived predator with strong responses to oceanographic variability (e.g., temperature, oxygen levels). Its abundance and migratory range can change rapidly, often expanding westward during El Niño events. Understanding its dynamics is important both ecologically and for evaluating ecosystem impacts.

- Orange roughy (*Hoplostethus atlanticus*): Age structure, habitat conditions, vulnerability.

A long-lived deep-sea species with slow growth and late maturity, orange roughy is particularly vulnerable to overfishing and environmental change. Key indicators include age composition, biomass trends, and the stability of cold, low-oxygen habitat layers on seamounts and slopes where the species aggregates.

- Other species

While the ESP focuses on the above, it may also track trends in other ecologically or economically relevant species such as **euphausiids** or **mesopelagic fishes**. Including these can help capture broader ecosystem patterns or emerging management concerns.

- Main source of uncertainty

6. Fisheries and Human Use

• Total catch and effort (by species and gear)

Tracking catch and fishing effort over time provides insights into fishery intensity and stock pressure. Disaggregating by species and gear type (e.g., purse seine, midwater trawl) helps assess selective pressure and supports gear-specific management strategies.

• Spatial footprint of fishing effort

Mapping the geographic distribution of fishing activity helps identify pressure hotspots, overlaps with sensitive habitats or species, and temporal shifts in fleet behavior (e.g., due to climate events or stock movements).

• Discards and bycatch (e.g., seabirds, sharks)

Non-target species interactions, including discards and incidental catch of vulnerable taxa (e.g., seabirds, sharks, deep-sea corals), are key indicators of ecosystem impact. Quantifying and minimizing bycatch supports ecosystem-based fisheries management and meets conservation mandates.

• Fleet dynamics and economic indicators

Changes in fleet composition, capacity, and technological advancement (e.g., range, gear efficiency) affect exploitation levels. Economic indicators such as landings value, fuel use, and employment provide context on the socioeconomic role of the fishery and its resilience to environmental or market shifts.

• Compliance and monitoring effort

Effective governance relies on observer coverage, logbook reporting, VMS (Vessel Monitoring Systems), and port inspections. Tracking these metrics supports assessments of rule compliance, data quality, and enforcement capability across SPRFMO members.

7. Ecological Interactions and Trophic Dynamics

• Predator–prey relationships

Understanding trophic linkages, such as predation on fish larvae by zooplankton or cephalopods, and top-down control by large predators (e.g., tuna, marine mammals), is essential for assessing recruitment success, biomass variability, and ecosystem balance.

• Interspecific competition

Key species like jack mackerel, anchoveta, and sardine may compete for overlapping prey (e.g., zooplankton) or habitat, especially during environmentally constrained periods. Identifying the nature and intensity of this competition helps interpret alternating population trends.

• Role of key species in food web

Small and medium size pelagic fish and squid function as energy conduits from plankton to higher trophic levels (e.g., seabirds, marine mammals). Their central position makes their abundance and availability critical to ecosystem functioning and resilience.

• Results from multispecies models

Dynamic models, such as size-spectrum models, *Ecopath with Ecosim*, and end-to-end frameworks, simulate food web interactions, energy transfer, and the cascading effects of fishing and climate variability across trophic levels. Additionally, species distribution models (SDMs) provide spatially explicit insights into the environmental drivers of species presence and abundance, helping predict range shifts under changing ocean conditions. Together, these modeling approaches support ecosystem-based management by identifying keystone species, ecological thresholds, spatial overlap among species, and indirect effects of exploitation or environmental change.

8. Vulnerability and Risk Assessment

• Cumulative pressures

Marine ecosystems in the SPRFMO area are subject to multiple overlapping stressors, including fishing pressure, habitat disturbance, and environmental variability. Assessing cumulative impacts helps evaluate the compounded effects on species, habitats, and ecosystem functioning.

• Exposure to climate events

Recurring climate anomalies such as **El Niño**, **La Niña**, and long-term trends in ocean warming expose key species to shifts in temperature, oxygen, and productivity. Exposure metrics help identify which components of the system are most at risk under climate variability and change.

• Sensitivity of key stocks

The biological characteristics of key species, such as lifespan, reproductive rate, trophic level, and habitat specificity, determine their sensitivity to external pressures. Highly sensitive species (e.g., long-lived, slow-growing) require special attention in management strategies.

• Potential regime shifts

Ecosystems can experience abrupt and persistent changes in structure and function, known as regime shifts, driven by external forcing (e.g., overfishing, oceanographic change). Early detection of indicators (e.g., shifts in species dominance or trophic structure) is critical for anticipating transitions and implementing precautionary measures.

9. Ecosystem Services and Socioeconomic Importance

• Role in food security and trade

Key SPRFMO-managed species, such as **jack mackerel** and **jumbo squid**, contribute significantly to national and regional food security, either directly through human consumption or indirectly via fishmeal production for aquaculture and livestock. These species also support international trade, with several SPRFMO members being major exporters, particularly to Asia , Africa and Europe.

• Employment and income from fisheries

Fisheries targeting SPRFMO species support thousands of jobs across harvesting, processing, logistics, and vessel servicing. These fisheries are often vital to coastal communities, and fluctuations in resource availability or market access can have substantial social and economic impacts.

• Resilience and adaptation

This section describes the capacity of fisheries-dependent communities, fleets, and supply chains to cope with and adapt to environmental, economic, and social changes affecting the SPRFMO-managed ecosystem. Understanding resilience helps identify vulnerabilities and opportunities for strengthening adaptive capacity in the face of climate variability, market fluctuations, and resource shifts.

• Ecosystem service valuation (optional)

Quantifying the economic value of ecosystem services, including provisioning (e.g., fish biomass), regulating (e.g., carbon cycling), and cultural (e.g., heritage fishing practices), can enhance recognition of the full benefits provided by marine ecosystems and inform trade-offs in policy decisions. While complex, such valuation can support arguments for ecosystem-based management and conservation investment.

10. Management Context and Responses

• Current management measures

This includes regulations and conservation measures adopted by SPRFMO, such as catch limits, spatial closures, gear restrictions, and bycatch mitigation rules. These measures form the foundation for sustainable resource use and help maintain ecosystem integrity.

• EBFM implementation status

Describes the extent to which EBFM principles have been integrated into SPRFMO's decision-making. This may include multispecies considerations, habitat protection, incorporation of environmental variability, and cross-sectoral coordination. Progress, gaps, and milestones toward EBFM can be summarized here.

• Monitoring programs

Outlines existing efforts to collect data on fisheries (e.g., logbooks, observer coverage), the environment (e.g., satellite and oceanographic observations), and biological indicators (e.g., stock assessments, ecosystem surveys). The effectiveness and scope of these programs are key to supporting evidence-based management.

• Adaptive management opportunities

Highlights areas where SPRFMO and member states could improve responsiveness to change, such as updating reference points based on new science, integrating forecast tools, or piloting precautionary measures in data-limited contexts. Flexibility and learning are central to managing uncertainty under changing environmental conditions.

11. Knowledge Gaps and Recommendations

• Research and monitoring needs

Highlights key areas where additional scientific work is required, such as understanding species life histories, climate sensitivity, ecological interactions, or socioeconomic dynamics. Improved long-term and regionally coordinated monitoring of environmental and biological variables is essential for tracking change and informing decisions.

• Data and modeling gaps

Points to missing or fragmented data (e.g., on non-target species, deep-sea habitats, larval stages) and the need to expand or refine ecosystem models (e.g., end-to-end, size-spectrum, SDMs). Enhanced data-sharing and collaboration among SPRFMO members can address spatial and taxonomic gaps.

• Indicator refinement and reporting

Recommends improving existing ecosystem indicators (e.g., distribution shifts, trophic indices, habitat quality) and developing protocols for their regular reporting. Well-defined, policy-relevant indicators support transparent status assessments and adaptive management under an ecosystem approach.

12. Annexes and References

- Methodologies and indicator definitions
- Maps, figures, and data sources
- References and contributors

Contributor Identification Table Template (example)

Element	Details
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