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Implementing Ecosystem Approach to Fisheries Management in the Western and Central Pacific Fisheries Commission: Challenges and Prospects

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Abstract: The ecosystem approach to fisheries management (EAFM) is considered one of the key management approaches for addressing global resource decline and promoting the health and resilience of ecosystems. This paper explores how the Western and Central Pacific Fisheries Commission (WCPFC), which manages tuna fisheries, has incorporated the ecosystem approach into its management and decision-making system. This study finds that (1) the WCPFC lacks incentives to adopt EAFM as a whole due to its management priorities on target species and some key bycatch species; (2) inadequate scientific information on associated species and the environment hinders ecosystem risk assessments, leading to delays in EAFM-related decisions; and (3) the organization has given little consideration to human factors. The authors suggest developing an EAFM vision with a clear roadmap to guide the implementation of EAFM and applying area-based management tools in cases where there is limited data and scientific information. The proposed coordination mechanism aims to address growing concerns about labor issues by involving multiple stakeholders in the development of a management measure on labor standards.

Keywords: ecosystem approach; tuna fisheries; conservation and management measures; human factor; WCPFC

Key Contribution: This paper proposes the problems and potentials of incorporating the human factor in the implementation of EAFM in a regional fisheries management organization.



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1. Introduction

Conventional fisheries management prioritizes the maximization of catches of specific target species through measures such as total allowable catch and quota management. There has been a growing concern that single species-based approaches often fail to address the complexity of marine ecosystems, which is essential for the long-term sustainability of marine resources [1]. To tackle the global decline of fishery resources, one of the solutions proposed by scientists is the adoption of an ecosystem approach to fisheries management (EAFM). In marine fisheries, EAFM refers to a comprehensive management strategy that integrates approaches to ecosystem management and fisheries management to balance diverse societal objectives without precluding other existing conservation and management approaches such as single-species conservation, marine protected areas, biosphere reserves, etc. [2]. In the year 2020, 3/4 of FAO's member states are reported to have adopted the ecosystem approach to fisheries, with appropriate management actions and established ecological, social-economic, and governance objectives [3]. EAFM has been embraced and included in management policies and measures by Regional Fisheries Management

Organizations (t-RFMOs) as a way to link the concepts of sustainable development and biodiversity to fisheries and environmental protection [4].

The Western Central Pacific Fisheries Commission (WCPFC) is one of the five RFMOs responsible for managing tuna fisheries, and it was established in 2004, making it the most recently established RFMO. This was around the time that international instruments related to fisheries, such as the United Nations Convention on the Law of the Sea (UNCLOS), the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement), and the Code of Conduct for Responsible Fisheries, were already in force or well accepted, the concepts within which had been adopted as norms for modern fisheries management. Although the WCPFC Convention has not explicitly taken the ecosystem approach into its management framework, it states at the very beginning that “(we) must be conscious of the need to avoid adverse impacts on the marine environment, preserve biodiversity, maintain the integrity of marine ecosystems and minimize the risk of long-term or irreversible effects of fishing operations [5].” This indicates that it considers the impacts of fishing on marine environments, associated species, and the whole ecosystem, in addition to the management of target species.

This paper starts with a literature review of the ecosystem approach and identifies five dimensions to assess the application of EAFM. Then, we conduct a policy analysis on how the WCPFC has incorporated the ecosystem approach in its tuna fisheries management on five identified dimensions by reviewing existing literature and policy documents and identifying challenges and missing elements that hindered the implementation of EAFM in the commission. Consequently, it concludes with suggestions to address the challenges and fill in the missing piece to bridge the EAFM concept to the implementation gap in WCPFC.

2. The Ecosystem Approach to Fisheries Management

The concept of the ecosystem approach (EA) is not new. It is a comprehensive term to describe a strategy for the integrated management of land, water, and living resources with the purpose of promoting sustainable use of resources in an equitable way [6]. The ecosystem approach to fisheries (EAF) has been formally raised by FAO since 2003. In one of its Technical Guidelines for Responsible Fisheries, the term EAF has been adopted as a way to embrace resource conservation and address environmental, social, and economic concerns in fisheries management [7]. It is given to seek a pragmatic balance among diverse societal objectives, including biotic, abiotic, and human concerns within the same ecosystem [8]. Based on this concept, some derivatives follow, i.e., ecosystem-based fisheries management (EBFM), and EAFM, both taking into account ecosystem conservation in the practice of fisheries management. The development and differentiation of these concepts are shown in Table 1.

Table 1. Development and differentiation of EA and its derivatives.

Terms	Concept	Note
EA	A strategy for the integrated management of land, water, and living resources that equitably promotes conservation and sustainable use, promotes sustainable development and reaches a balance of conservation, sustainable use, and fair and equitable sharing of the resource utilization [6].	–Require adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning [6].

Table 1. Cont.

Terms	Concept	Note
EAF	A way to embrace resource conservation and address environmental, social, and economic concerns in fisheries management is to balance diverse societal objectives by taking into account the knowledge and uncertainties about biotic, abiotic, and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries [7].	–Move away from the focus on the sustainable harvest of target species to comprehensive consideration of the major components in the same ecosystem [9].–Intend to foster the use of existing management frameworks, improving their implementation, and reinforcing their ecological relevance to achieve sustainable development [10].
EBFM	A comprehensive EBFM approach would require managers to consider all interactions that a target fish stock has with predators, competitors, and prey species; the effects of weather and climate on fisheries biology and ecology; the complex interactions between fishes and their habitats; and the effects of fishing on fish stocks and their habitat [11]. A combination of the following: 1. avoid degradation of ecosystems, as measured by indicators of environmental quality and system status; 2. minimize the risk of irreversible change to natural assemblages of species and ecosystem processes; 3. obtain and maintain long-term socioeconomic benefits without compromising the ecosystem; and 4. generate knowledge of ecosystem processes sufficient to understand the likely consequences of human actions [14].	–Require thinking of various resources as interrelated parts of systems rather than as individual components to be separately managed [12]. –Overlook the social and institutional dimensions that ecosystem-based management is also meant to include [13]. –Each criterion is open to interpretation regarding both specific definitions and practical implications, i.e., the lack of specific definitions for each indicator [15].–Requires broader performance indicators for the development and testing of economic, social-cultural, and institutional/human dimensions [16].
EAFM	A holistic way of managing fisheries, considering the complex dynamics between target and non-target species and the greater social-ecological system [17]. It could be categorized into four distinct types: bycatch mitigation, multi-species management, protection of vulnerable ecosystems, and an integrated approach, with the goal of recovering the ecosystem balance [9]. An integrated approach to managing fisheries within ecologically meaningful boundaries that seeks to manage the use of natural resources, taking account of fishing and other human activities, while preserving both the biological wealth and the biological processes necessary to safeguard the composition, structure, and functioning of the habitats of the ecosystem affected, taking into account the knowledge and uncertainties regarding biotic, abiotic, and human components of ecosystems [21]. A practical way to implement sustainable development for the management of fisheries tends to balance ecological benefit and human well-being through good governance of open water resources [23]. A policy-driven but science-based process that requires an effective relationship between science and policy-making in order to succeed [4]	–A conceptual term, lack of consensus and clarity over the operational objectives and the actual implementation process, and how to integrate specific ecosystem principles into existing management systems [18]. –Move away from only single or target species [19]. –Identify the ecosystem approach to be parallel to sustainable management [2]. A lack of inclusion of all participants in the development process [20]. –Mixes a notion of systems thinking with the formulation of a policy goal. Hence the confusion between policy and methodology [2].–It is important to establish the institutional structures that allow for an appropriate science-policy-society interaction and facilitate stakeholder involvement in the advisory processes [22]. –Recognize that human and ecological well-being are tightly coupled such that sustainability only occurs when pursued in both arenas [24]. –Consideration of socio-economic aspects and inclusion of a broader representation of society in advice and decision-making.

In general, EAFM is conceived as an integrated approach that seeks to manage the use of natural resources, taking account of fishing and other human activities, while preserving both the biological wealth and the biological processes necessary to safeguard the structure and functioning of the habitats of the affected ecosystem [21]. It differs from EBFM by balancing societal economic needs with ecological function [25]. Fletcher [22] notes that EAFM deals with not only the ecological consequences of fishing but also the social and economic implications related to fisheries. Thus, EAFM is to ensure the sustainable use of all ecological, social, and economic systems related to fisheries. As a science-based policy-driven process [4], it should heed the abundance, productivity, population, and composition of target species. Additionally, it also associated species with ecological factors such as key habitats, environment, and climate change, as well as social and economic factors, especially the human factor, such as fishermen, observers, coastal communities, and other stakeholders within the fishery sector. Taking into account the above-mentioned factors, we discuss the implementation of EAFM in the WCPFC from the following five dimensions: target species, associated species, habitats, environment and climate consideration, and social-economic consideration. However, as pointed out by some scientists [4,8,9,26], this specific component, the human factor, which plays an essential role in the implementation of EAFM, has always been downplayed in the discussion of EAFM. Therefore, special attention is given to the human factor in social-economic consideration.

3. Implementing EAFM in the WCPFC

The WCPFC Convention does not explicitly incorporate an ecosystem approach into its management framework. However, there are expressions of ecosystem concerns as follows: calling for actions to assess the impacts of fishing on ecosystems (Article 5d); adopting measures to minimize pollution originating from fishing vessels; catching non-target species; promoting the development and use of selective, environmentally safe fishing gears and techniques (Article 5e); protecting biodiversity in the marine environment (Article 5f); and recognizing the special requirements of developing states (Article 30) [5]. These articles provide WCPFC with the mandate to take measures to protect the marine environment and biodiversity that could have been impacted by tuna fisheries [27]. Moreover, it also provides the sustainability of fishing communities and the livelihood and welfare of the local workforce in those communities dependent on tuna fisheries.

Even though the concept of EAFM has been generally accepted, the priority of WCPFC has always been the conservation and management of target species and key bycatch species (e.g., marine mammals, sea turtles, seabirds, sharks, and in recent years, rays), as can be seen in most of its legally binding documents. Progress has been made in implementing all ecological components of EAFM, including target species, bycatch species, ecosystem properties, trophic interactions, and habitats [28], but gaps and limitations remain. Of the 42 conservation and management measures (CMM) currently in force, only 1/3 of them (14 CMMs) are directly for target species, with the rest mainly being on bycatch species, vessel management, monitoring, and compliance (Figure 1). Most consideration of ecosystems has been on the scientific side. Additionally, in such discussions, the social-ecological dimension, i.e., the human factor, has rarely been mentioned.

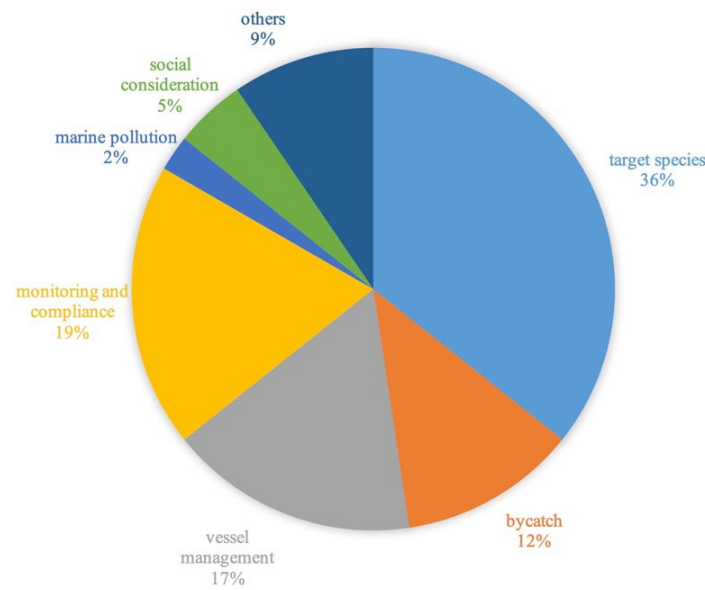


Figure 1. WCPFC Conservation and Management Measures are currently in force as of January 2023.

3.1. Management of Target Species

Generally, the WCPFC has achieved notable progress in its management of tuna fisheries. While the other four tuna RFMOs have one or more tuna stocks that are overfished or experiencing overfishing, WCPFC is the only tuna RFMO with key tuna stocks in a healthy status (Figure 2) and a 0% probability of breaching the Target Reference Points [29].

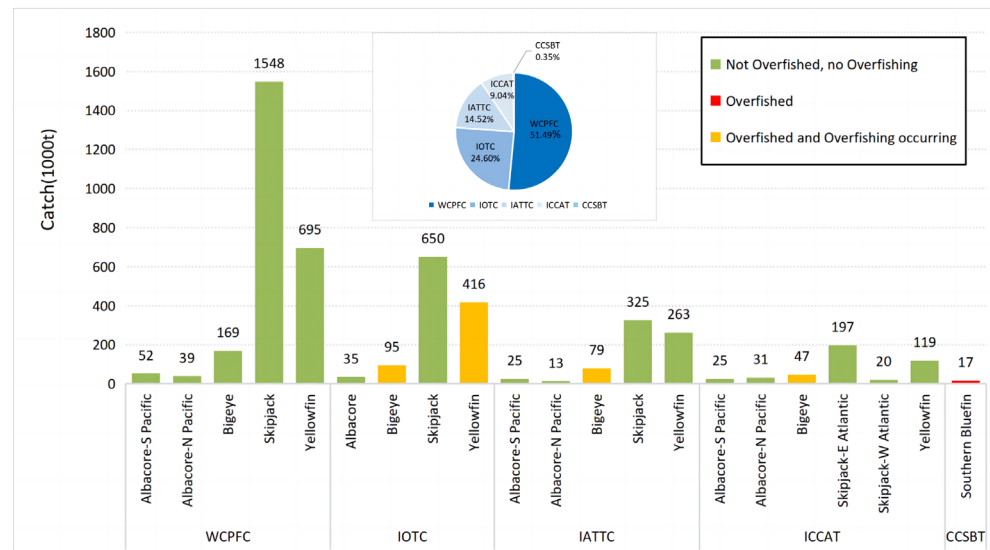


Figure 2. Catch and stock status in tuna RFMOs. Abbreviations: WCPFC, Western and Central Pacific Fisheries Commission; IOTC, Indian Ocean Tuna Commission; IATTC, Inter-American Tropical Tuna Commission; ICCAT, International Commission for the Conservation of Atlantic Tunas; CCSBT, Commission for the Conservation of Southern Bluefin Tuna. Data sources: WCPFC [30], IOTC [31], IATTC [32], ICCAT [33], CCSBT [34]. Information about stock status is given at [35,36].

WCPFC can control fishing capacity and enhance monitoring of fishing activities via measures on fishing vessels, daily catch and effort reporting, and a compliance monitoring scheme. Additionally, WCPFC has developed a harvest strategy approach for each key tuna stock, i.e., skipjack (*Katsuwonus pelamis*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), and albacore tuna (*Thunnus alalunga*) since 2014, which specifies the predetermined management actions in a fishery for specific species to achieve defined

biological, ecological, economic and/or social management objectives [37]. The performance of the management actions is measured by a range of quantitative performance indicators, such as spawning biomass and the average expected catch from fish efforts. The implementation of the harvest strategy is supported by data collection and reporting requirements, a vessel monitoring scheme, and a regional observer program to ensure the sustainability of tuna stocks and fisheries.

Since 2009, the WCPFC has also closed high sea areas between 20 °S and 20 °N for Fish Aggregating Devices (FADs) fishing to reduce the catch of aggregated fish, including juvenile tunas [38]. Later, in addition to a three-month FAD closure for all purse seine vessels fishing in the exclusive economic zones (EEZs) and the high seas, purse seine vessels are prohibited to deploy, service, or set on FAD in the high seas for two additional sequential months of the year [39], as a way to protect tuna fisheries.

However, despite the fact that the WCPFC Convention applies to all highly migratory stocks (except for sauries) within the convention area, little or no stock assessments or preliminary population studies have been carried out on neritic tunas, which are also exploited commercially or recreationally. Catch estimates for these species are usually poorly documented. To date, there are no management measures in WCPFC related to these tuna species, such as frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*), and mackerel tuna (*Euthynnus affinis*).

3.2. Management of Associated Species

Bycatch mitigation measures are always part of the policy priorities in WCPFC's decision-making, which require vessels to take measures on minimizing fishing impacts on seabirds (CMM 2018-03) and no-retention and prompt safe release for sharks, cetaceans, and sea turtles (CMM 2019-04, CMM 2011-03, CMM 2018-04). Bycatch-related CMMs have been updated several times with the advancement of fishing technologies. As to seabird bycatch, fishing vessels longer than 24 m are required to take at least two precautionary measures in areas north of 23° N and south of 30° S since 2006 [40]. Later, the seabird mitigation measure was extended to all longline vessels [41] and broader areas [42]. In addition to areas north of 23° N and south of 30° S, vessels operating in areas between 25° S and 30° S shall take at least one bycatch mitigation measure since 2020. Meanwhile, with the support of the *Agreement on the Conservation of Albatrosses and Petrels* (ACAP), the Commission has distributed seabird identification manuals and seabird safe release guidelines [43] to fishermen to minimize the mortality rate of seabird bycatches.

More efforts have been devoted to shark conservation in recent years. The WCPFC is the first t-RFMO to set up a formal research plan for sharks, which was first adopted in 2010 for 4 years, for the evaluation of the exploitation status of three key shark stocks: the North Pacific blue shark (*Prionace glauca*), the West and Central Pacific silky shark (*Carcharhinus falciformis*), and the oceanic whitetip shark (*Carcharhinus longimanus*) [44]. A few more shark species have been introduced to the bycatch population management and assessment. In addition to reporting requirements on shark data, the fin ratio should be no more than 5% of the weight of sharks onboard [45]. Since 2020, vessels have also had to land sharks with fins naturally attached to the carcasses to ensure the prohibition of shark finning practices [46]. Longline vessels shall either stop the carrying and use of wire leaders or stop the use of shark lines to minimize bycatch and practice safe release [46]. Meanwhile, shark species listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), including the Oceanic Whitetip Shark, Silky Shark, and Whale Shark (*Rhincodon typus*), are not allowed to retain on board, transship, or land any part or the whole carcass on ports [46]. The commission also works with other t-RFMOs to improve shark data and assessment methods as part of the Common Oceans Area Beyond National Jurisdiction (ABNJ) Tuna Project. Shark data have been recorded in the Bycatch Management Information System (BMIS), a system developed by the WCPFC as an open resource to provide fishery managers, researchers, fishermen, and the public with information about bycatch species [47]. WCPFC requires vessels to use

non-entangling FADs since 2023 to reduce the rise of entangling sharks, sea turtles, and other species [39] and to reduce the possibility of the targeting of aggregated fish or the discard of small fish [38].

The WCPFC has adopted a CMM on cetaceans (CMM 2011-03) and provided guidelines for the safe handling and release of cetaceans, including whales and dolphins. Since 2021, vessels are prohibited from targeting fishing, retaining on board, transshipping, or landing mobula rays caught in the Convention Area [48].

On the other hand, the management of prey species, the redistribution of which would ultimately affect the activities of tuna stocks, has not been under discussion in any WCPFC meetings. Climate change poses challenges for small pelagic fishes, which are especially vulnerable to the impacts of rising ocean temperatures [49]. The changing biomass of prey species, such as mackerel, sardine, crustaceans, and squid, has a great influence on the abundance of tuna stocks. Yet to date, in the case of being caught as bycatch in industrial purse seine fisheries, prey species estimates are not available in WCPFC [50].

3.3. Conservation of Key Habitats

The ecosystem approach requires that, in addition to target species and bycatch, fishery managers also take into consideration, in the policy-making process, the impacts of environmental changes on target stocks and the impact of fishing on non-target, associated, and dependent species, as well as habitats. The WCPFC has not adopted specific CMMs for key habitats, such as tuna spawning grounds, areas with a high abundance of vulnerable species, seabird foraging hotspots, turtle aggregating sites, mangroves, etc. However, CMM2008-04, which prohibits the use of large-scale driftnets, aims to minimize the detrimental effects of ghost fishing on concerned species and the marine environment [51].

3.4. Environment and Climate Considerations

The Commission has adopted a CMM on marine pollution (CMM2017-04) in 2017. Since January 2019, fishing vessels operating in WCPFC convention waters are prohibited from discharging any plastics, petroleum/fuel products, or oily residues, as well as garbage and sewage. Meanwhile, member states are encouraged to conduct research on marine pollution related to fisheries in the WCPFC convention area. This will help to further develop and refine measures to reduce marine pollution, as well as take actions to retrieve abandoned, lost, or discarded fishing gear [52]. Due to growing concern about the abandoned, lost, and discarded FADs drifting in the ocean and potentially contributing to marine litter, the WCPFC has mandated the use of non-entangling FADs starting since January 2024. Additionally, the use of biodegradable materials in the construction of FADs is encouraged by the organization [39].

The warming temperature has impacted the abundance, recruitment, and distribution of pelagic fish, including tuna stocks. In 2018, ecosystem modeling provided by the Secretariat of the Pacific Community (SPC) on tuna species under climate change scenarios predicted significant decreases in tuna biomass in the western Pacific Ocean due to a shifting of the biomass of tropical tunas to the west and some declines in overall biomass. Under a high greenhouse gas emission scenario, about 13% of tuna biomass could shift from the combined EEZs of the Pacific Small Island Developing States (SIDS) to international waters by 2050 [53]. The redistribution of tuna would lead the SIDS dependent on tuna into an unfavorable economic condition since access fees and revenues generated from the tuna industry are a major source of income for those SIDS. In 2019, a resolution on climate change was adopted to support further research on the interactions between climate change and target species, non-target species, and other associated species [54].

Other than the CMMs and resolutions, a few models have been presented and discussed in the scientific committee's (SC) regular sessions. For example, methods to assess fishing impacts on the environment, such as the spatial ecosystem and population dynamics model (SEAPODYM) and the Ecopath with Ecosim (EwE) model, have been introduced to measure the ecological impacts of fishing on the ecosystem and the environment [28].

3.5. Social and Economic Considerations

Article 30 of the WCPFC convention mandates giving full recognition to the special requirements of SIDS, including the need to avoid adverse impacts on and ensure access to fisheries by subsistence, small-scale and artisanal fishers and fish workers, as well as indigenous people [5]. The implementation of CMMs shall not undermine SIDS' rights to develop fisheries for their own benefit. This provision, to a certain extent, supports the development of the fishing industry in coastal countries in the convention area. In addition, the commission calls for cooperation to enhance the ability of states to develop their own tuna fisheries [55]. The percentage of purse seiners flagged to Pacific Island states has witnessed an increase from 0 in 1979 to 45% (125 out of 277) in 2018 [56]. There may be foreign-invested vessels flagged by SIDS, though.

Other than this, few measures on social or economic aspects of tuna fisheries management have been adopted or discussed by the Commission. The knowledge about other social impacts of tuna fisheries is still limited [57]. Assistance for infrastructure and capacity building is usually provided through agencies and foundations by distant water fishing nations at the national level, rather than at the commission level [29].

4. Challenges

4.1. Lack of Clear Ecosystem-Based Objectives

The slow progress in applying EAFM is mainly due to the lack of explicit ecosystem-based objectives in the management mandate. Ever since the 1st regular session of the SC1, there have been discussions on developing ecosystem indicators, as the first step in implementing an ecosystem approach to fisheries is to identify the "place" to be managed [58–61]. Ecosystem and bycatch mitigation has been one of the key themes in SC meetings for discussion. However, while some efforts were directed toward mitigating bycatch, other ecosystem components were largely overlooked. It was not until SC18 in 2022 that the committee adopted "ecosystem and climate indicators" as a permanent agenda item of the ecosystem and bycatch mitigation theme session. Nonetheless, it will take significant time to develop and agree on appropriate indicators for adoption, especially in the absence of direct guidance from the WCPFC.

Reasons for such reluctance are multifaceted. As a fisheries management organization, WCPFC's priorities have been given to fish stocks with high commercial value and associated bycatch species of key ecological significance. With more than 50% of its water in the convention area and a majority of tuna fishing grounds within the national jurisdiction of coastal states, the burden of environment and habitat protection falls on the shoulders of coastal nations, mostly SIDS. They are keen to ensure the sustainability of living resources and a balanced Pacific ecosystem. However, since their economies are highly dependent on fisheries resources, these countries often grant other states extra access to fisheries resources through bilateral or multilateral agreements in exchange for economic benefits. They also make efforts to develop their own fishing fleets to secure fiscal revenues. To a certain extent, measures and policies on ecosystem protection come at the sacrifice of short-term profit for the long-term sustainability of all relevant resources. As for fishing nations, such measures would be interpreted as less harvest but higher costs in the short term. Hence, the lack of incentives to set out clear ecosystem-based objectives and to adopt EAFM as a whole.

4.2. Limited Scientific Information on Associated Species and Environment

Without full knowledge of the ecosystem, especially with insufficient data and limited knowledge of the food web and trophic relations, this may become an obstacle to EAFM modeling. Most of the WCPFC's data are collected either via records of fishing vessels (e.g., logbooks) or by observers on board. However, it is worth noting that in the WCPFC convention area, only purse seine vessels have full observer coverage [39], while for longline fishing vessels, the requirement for observer coverage is a minimum of 5% [62], and data from artisanal and small-scale fisheries (including pole-line fishing) are rare. Theoretically, data could be otherwise collected via electronic monitors and electronic observers, which

usually require more advanced technology and are more expensive, hence not a common practice among fishing vessels. While reporting requirements exist for data on target and key bycatch species, data on other associated species such as dolphins, cetaceans, and porpoises, which are also crucial for improving ecosystem modeling and monitoring, are not fully collected during fishing activities.

WCPFC has agreed to prioritize discussion of how to incorporate climate change information and analyses into its work. Further guidance is needed on how to incorporate information on the impacts of climate change into the status of stock reporting and to facilitate further research on addressing the impacts of climate change on tuna stocks and economies of SIDS [63]. This includes studying the impact of ocean acidification and warming water temperatures on the distribution of stocks and other living resources.

4.3. The Missing Human Factor

EAFM calls for consideration of the human factor in the social-economic dimension. The WCPFC Convention does not explicitly provide the mandate for the WCPFC to adopt CMMs on labor issues, but its Article 10(h) provides that the WCPFC may “adopt generally recommended international minimum standards for the responsible conduct of fishing operations [5].” According to FAO, “responsible fishing” means, *inter alia*, ensuring safe, healthy, and fair working and living conditions and internationally agreed standards adopted by relevant international organizations [64]. In other words, WCPFC has the responsibility to ensure that fishing operations have been carried out in a “responsible way” and that its actions would not potentially obstruct labor officials from doing their work [65]. Some members of the commission regard the elimination of human rights abuse against fishing vessel crews as part of establishing standards for the responsible conduct of fishing operations. They state that WCPFC has the mandate to adopt minimum standards for the responsible conduct of fishing operations [29]. However, some have expressed doubts about the legal basis for the WCPFC to adopt a CMM on labor standards. They argue that as a tuna RFMO, the WCPFC may only adopt measures related to fisheries management and not labor management. Furthermore, some WCPFC delegations expressed concern that their fishery delegations had no authorization to agree to any compulsory decision on labor issues [29], which falls into the competence of the labor department.

Nevertheless, the human factor has been taken into account in some of the WCPFC conservation and management measures. For example, during the safe release of cetaceans and sharks, the safety of the crew shall be taken into account [66,67]. WCPFC also regulates labor conditions for onboard observers. The observer program guarantees that observers have access to food, accommodations, medical facilities, and sanitary facilities of a reasonable standard and equivalent to those normally available to an officer on board the vessel. It also guarantees the freedom of observers to carry out their duties without being assaulted, obstructed, resisted, delayed, intimidated, or interfered with in the performance of their duties [68,69]. In the event of identifying a potential violation that involves assault or harassment of an observer while on board a fishing vessel, the observer provider is required to notify the flag members, cooperating non-members, or participating territories (CCMs), as well as the Secretariat. They are then responsible for investigating the incident based on the information provided by the observer provider and taking any necessary action in response to the findings of the investigation [70]. In addition, WCPFC has a regional observer program (ROP) vessel safety check to ensure that conditions on board are suitable for observers to carry out their duties.

It was not until Indonesia proposed a binding CMM on labor standards, following the case of unpaid salary disputes on fishing vessels [71], that the WCPFC started to acknowledge the human factor in its tuna management. The organization now encourages CCMs to implement measures that ensure fair and safe working conditions for the crew on fishing vessels. After FFA’s draft proposal on labor standards for the crew on fishing vessels [72], the WCPFC has adopted a non-binding resolution on labor standards to encourage CCMs to take measures for the safety and fair working condition of crews on

board [73]. In response to consistent calls from CCMs, particularly non-governmental organizations (NGOs), for the establishment of labor standards for crew in the WCPFC, the organization is currently in the process of drafting a CMM on labor standards. However, it is still uncertain whether the WCPFC will be able to adopt such a CMM in 2023 as scheduled in the small working group working plan, given the current state of progress.

5. What Are the Future Prospects

With its management priorities for target species and some key bycatch species, most of the EAFM efforts in the WCPFC to date belong more to the realm of scientific discussions than an established practice. Its measures and resolutions on the marine environment and marine pollution are mostly non-legally binding, resulting in moderate or minor effectiveness, not to mention the limited attention given to the human factor in the organization. However, as was the case with the Commission for the Conservation of Antarctic Marine Living Resources, which introduced EAFM at a time when there was very little knowledge of ecosystem interaction, its implementation of the ecosystem approach began with the identification of several key indicators, followed by an adaptive process to address ecosystem challenges [74].

5.1. Development of an EAFM Vision

The WCPFC scientific committee has included ecosystems and bycatch as one of its themes in regular meetings, though most of the discussions focused on minimizing impacts on bycatch species. The development of an EAFM vision would provide a formal mandate to include ecosystem considerations in the agendas of both scientific and decision-making bodies. Such a vision consists of clearly defined ecosystem objectives and a clear roadmap to guide the implementation of EAFM, allowing for long-term planning initiatives. Support from intergovernmental organizations in the Western and Central Pacific region, such as FFA, SPC, and Parties to Nauru Agreement (PNA), would provide the commission with the joint diplomatic efforts of those member countries.

Meanwhile, based on current scientific management dialogue, an open and inclusive consultation process with the involvement of all stakeholders in the fishery industry, including fishing, processing, marketing, and other private sectors, would facilitate communication between science and management, and contribute to the drafting of an EAFM vision. In other words, to transform scientific discussions on EAFM into policies and measures. Yet, scientific studies are still an indispensable part of the process, especially studies on prey species, sensitive habitats, and the impacts of climate change on spawning and feeding grounds. Such studies call for international cooperation among research institutes, management organizations, and, to some extent, environmental organizations, and provide scientific evidence for the management of comprehensive ecosystems in the Western and Central Pacific region.

5.2. Adoption of Area-Based Management Tools

Area-based tools for the management of fisheries and the protection of marine ecosystems provide an example of easing the tensions between modern fisheries standards and traditional legal frameworks and principles [75] and achieving a variety of ecosystem management objectives [76]. In addition to marine protected areas, other area-based management tools, such as time and area closures for a specific area or a particular fishing gear, contribute to the enhancement of target species and the protection of associated species. For example, the seasonal closures of fishing on FADs by tuna purse-seine vessels in the WCPFC waters have been estimated to have great impacts on the rebuilding of bigeye tuna stock [77]. In areas that cannot be protected by FAD seasonal closures, spatial management can significantly reduce FAD beaching by prohibiting the deployment of FADs in beaching hotspots, which are not coincident with high dFAD deployment activities and thus have relatively minimal impacts on fisheries [78]. Additionally, the vessel day scheme established by the PNA is another example of spatial management for fishing effort control, which

sets limits on the number of fishing days and determines which vessels can be licensed to fish in the EEZs of the PNA member nations [79]. It contributes to the social and economic benefits of coastal countries by generating revenues from access fees paid by distant water fishing nations in the WCPFC waters.

Area-based closures and fishing effort control have been effective in maintaining the sustainability of fishery resources and protecting sensitive habitats. This approach could also be extended to the protection of vulnerable habitats such as spawning and feeding grounds, bycatch hotspots, and others, by incorporating dynamic ecosystem monitoring and risk assessments. These assessments can help build an understanding of ecosystem impacts, including food web structure, the effects of fishing on habitats and species, climate change, and other relevant factors. Such assessment requires comprehensive data collected from observers, logbooks, and vessel monitoring systems. Given the low observer coverage, especially on longline fishing vessels and other supplementary vessels, the installation of electronic monitoring systems on fishing vessels allows for extensive data collection that would cover a range of ecosystem aspects to help scientists and decision-makers get robust knowledge of the ecosystem.

Scientific studies and data collection are beneficial to facilitate the adoption of area-based management tools. To support decision-making, information sharing is of essential importance. Building a database platform at the regional level to mobilize data and information would greatly promote the sharing and disclosure of information from monitoring, reporting, and assessment and provide incentives and scientific evidence for policymakers to take appropriate actions.

5.3. Coordination Mechanism for Labor Issue

Despite the controversy over whether a tuna RFMO has the mandate to adopt CMMs on human management, the International Commission for the Conservation of Atlantic Tunas (ICCAT), another tuna RFMO, has established an ad hoc working group on labor standards in early 2022, following a resolution to establish a process to address labor standards [80]. Meanwhile, there are developments on labor issues in the seafood sector. In 2015, the European Union (EU) issued a “yellow card” to Thailand due to its illegal, unreported, and unregulated fishing and forced labor issues, which was not lifted until 2019 when Thailand had improved its management and worked on human rights abuses and forced labor in the fisheries sector [81]. In 2020, the International Seafood Sustainability Foundation implemented the Public Policy on Social and Labor Standards, which requires participating companies to have policies to address matters including forced labor, remuneration, working conditions, and grievance mechanisms [82]. The Marine Stewardship Council (MSC) published its first version of MSC Labor Eligibility Requirements in October 2022, incorporating third-party labor auditing schemes and introducing transparency measures into its fishery certification programs [83]. Given the drives, a binding CMM on labor standards is necessary, if not required, within WCPFC.

In the Western and Central Pacific Oceans, there are precedents for labor standard requirements. In 2019, the FFA amended the Harmonized Minimum Terms and Conditions for Access by Fishing Vessels. These terms were amended to incorporate minimum standards for labor conditions that vessels must adhere to in order to obtain a fishing license to fish in FFA waters. These standards include proper medical services, regular rest, appropriate accommodation, and suitable food and water. Moreover, they strictly prohibit any deduction from crew wages for any work-related expenses [84]. The terms and conditions apply to all vessels operating in FFA waters, i.e., most of the purse seine vessels in WCPFC, but not to longliners regulated by WCPFC since a majority of them fish on the high seas.

However, with reduced fisheries resources and unit effort, accompanied by increasing fisheries access fees, the fishing industry was trying to lower labor standards to increase profits. As cultures, living conditions, and dining habits vary among regions and countries, it would be quite a problem to reach an agreement on “proper,” “suitable,” and

“appropriate” conditions when drafting labor standards. Given the diversified interests and considerations in tuna fisheries in this region, a unified minimum labor standard would be the most possible outcome the members of WCPFC could reach a consensus on.

The implementation of a CMM on minimum labor standards on fishing vessels calls for a coordination mechanism, possibly including:

(1) Coordination among international/regional bodies, such as the FFA, International Labor Organization (ILO), and International Maritime Organization (IMO). The ILO Convention No.188 on labor standards for fishing vessels provides some insights into addressing the complex labor issues. The ILO is also developing forced labor indicators in the fisheries sector, which would be taken as references in drafting the CMM on minimum labor standards. Pilots and training from the ILO could be launched together with the FFA on the inspection of labor conditions and working conditions of vessels fishing in the FFA waters. The WCPFC could also work with the IMO to improve the safety of fishing vessels by establishing safety standards for vessels and offering training programs to fishermen.

(2) Coordination in the regulation of fishing activities. The labor issue in the fishing sector calls for the involvement of multiple stakeholders regionally. A set of compatible and coordinated regulations on fishing vessels and fishing activities can help deter labor abuse. Such regulations may include stipulating labor rights in fishing agreements and fishing licenses between coastal states and fishing states, periodic reporting requirements on working and living conditions to flag states, and provisions of boarding and inspection on the high seas of labor conditions in addition to fishing activities in regional high seas boarding and inspection management measures. Currently, vessels suspected of illegal, unreported, and unregulated (IUU) fishing activities are not allowed to use ports and land catches in port states, according to the Agreement on Port State Measures (PSMA) [85]. Given the fact that labor abuse and IUU fishing are closely related to each other [86], it is worth considering whether any revision to the PSMA could allow suspected vessels to receive inspection on board by the port state rather than being denied access. This could involve allowing such vessels to enter a specific area of the port for the inspection to take place.

(3) Coordination to develop a grievance mechanism. Apart from the measures taken to regulate and prevent the crew from labor abuse, it is also important to establish an administrative office at the regional level. The office would be responsible for addressing complaints and resolving problems related to labor issues through mediation among workers, staffing agencies, the labor exporting state, and the flag state. Such a grievance mechanism provides fishermen on board an opportunity to communicate with their staffing agencies regularly and get a chance to get off the board in case of mistreatment.

6. Conclusions

Many elements required for the application of EAFM have already been put in place, for instance, the harvest strategy for target species, mitigation measures for the conservation of bycatch species, and resolutions on climate change and environment protection. However, despite the increasing attention on the impact of marine pollution and climate change, few legally binding measures have been drafted yet. The lack of clear ecosystem-based objectives and limits on scientific information about associated species and environments hinder the effectiveness of EAFM. The development of an EAFM vision and the adoption of area-based management tools would holistically facilitate the implementation of EAFM. These area-based approaches may include time and area closures of fishing gear, spatial fishing effort control, and area-based scientific studies, to protect marine species, mitigate marine pollution, and get access to more scientific evidence for decision-makers. While there is an increasing concern about labor issues in the fishery sector, more consideration should be given to the human factor, especially in the development of management measures. Coordination among international and regional bodies, coordination in the regulation of fishing activities, and coordination to develop a grievance mechanism would contribute to better working conditions and welfare for laborers in fishing vessels. Sustain-

ability cannot be achieved unless adequate attention is given to fishery resources, associated species, habitats, the marine environment, as well as the social-economic dimension fairly and equitably.

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