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**Report of the Joint Meeting of tuna RFMOs on the implementation of the Ecosystem
Approach to Fisheries Management**

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IMPROVING MANAGEMENT

Report of the Joint Meeting of Tuna RFMOs on the Implementation of the Ecosystem Approach to Fisheries Management

12 – 14 December 2016

FAO HEADQUARTERS
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PROCEEDINGS



Cover photograph: A Pacific bluefin tuna swims among bonito in the outer bay display at the Monterey Bay Aquarium by Gerick Bergsma 2010/Marine Photobank

The views expressed in this report are those of the workshop participants and do not necessarily reflect the views or policies of FAO or of the t-RFMOs.

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Table of Contents

Table of Contents	1
1. Executive summary.....	2
2. Ecosystem approaches to fisheries – background	6
2.1 EAF and EBFM.....	6
2.2 EAF and EBFM and tuna fisheries.....	9
3. Current status of EAF and EBFM in t-RFMOs.....	10
3.1 Commission for the Conservation of Southern Bluefin Tuna.....	10
3.2 Inter-American Tropical Tuna Commission.....	12
3.3 International Commission for the Conservation of Atlantic Tunas	14
3.4 Indian Ocean Tuna Commission	16
3.5 Western Central Pacific Fisheries Commission	17
3.6 Report on progress of t-RFMOs in applying EBFM	20
4. Examples of national EAF and EBFM implementation	22
4.1 Australia.....	22
4.2 USA	30
5. Barriers to EAF and EBFM implementation in t-RFMOs and potential solutions.....	33
6. Draft conceptual guidance for EAF and EBFM.....	38
6.1 Themes and components to be considered for inclusion	38
6.2 Operational objectives for consideration.....	40
7. Conclusions and next steps	42
7.1 Main conclusions from the workshop	42
7.2 Areas for collaboration between t-RFMOs.....	44
7.3 Draft work plan for EAF and EBFM implementation including elements of communication with the Commission.....	45

1. Executive summary

The Ecosystem Approach is a widely accepted concept for the management of living resources and its principles can be traced back to several international instruments. Although different definitions and conceptual approaches for integrating ecosystem considerations into management decisions exists, e.g. EAF and Ecosystem Based Fisheries Management (EBFM), in general terms all of them are holistic approaches, that takes into consideration impacts not only the target stocks but also the impacts on the broader ecosystem arisen from the fishing activity as well as their social and economic outcomes and the conditions that supports achievement of set objectives.

FAO's definition of EAF (FAO, 2003¹) states that: the Ecosystem Approach to Fisheries (EAF) strives to *balance diverse societal objectives, by taking account of 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*. The above clearly addresses both the human and ecological well-being aspects of the approach.

The various definitions and conceptual approaches in use for holistic approaches may nevertheless create uncertainty as regards how EAF and EBFM may be implemented, and there are challenges in its operationalization because of the potential complexity that may arise from its multidisciplinary nature and the need to reconcile different objectives.

The implementation of EAF and EBFM should not only result in the sustainable utilization of healthier marine ecosystems, but also bring several gains and benefits such as:

1. Helping to identify trade-offs among resources, their habitat and the fishery's bycatch;
2. Providing a better understanding of the cumulative impact of a management action beyond just a single species;
3. Helping to better understand and articulate the risks, benefits and effectiveness of management alternatives, as well as the trade-offs;
4. Ensuring more transparent decision processes, and outcomes; and
5. Maintaining ecosystem function and fishery sustainability, which support economic and social stability and fishing community well-being.

In addition, the risk-based processes that underpin the implementation of EAF and EBFM are considered to provide the suitable strategic planning tools that can assist agencies to generate a clear understanding of how to prioritize their activities and appreciate the degree to which their organization is structured to support a more integrated mandate.

Furthermore, the development and adaptive implementation of the EAF and EBFM encourages active participation of key stakeholders and subsequent buy-in, facilitating its continuation and expansion.

t-RFMOs are increasingly examining their governance systems to adopt EAF and EBFM related measures that enhance the management of their fisheries to be more compliant to mitigating impacts on target and bycatch species, their trophic relationships and habitat requirements. In this

¹FAO Fisheries Department. 2003. The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 2. Rome, FAO. 112 p.

context, *the Joint Meeting of tuna RFMOs on the Implementation of the Ecosystem Approach to Fisheries Management* represented an opportunity to better understand common challenges and opportunities in advancing the EAF and EBFM, and to bring this shared knowledge to the attention of the memberships of each t-RFMO.

This meeting, initiated by ICCAT and supported by the Common Oceans ABNJ Tuna Project implemented by FAO and funded by the GEF, brought together scientists from the five t-RFMOs and national experts. The goals of the meeting were to (1) establish a sustained dialogue across t-RFMOs on the issues of EAF and its implementation, (2) understand common challenges in its implementation and (3) identify case specific solutions

During the meeting, participants from each of the t-RFMOs presented a summary of the progress towards implementation of the EAF and EBFM and FAO presented the work of the organization on EAF. A comparative assessment of progress across the five t-RFMOs in implementing the ecological component of EBFM was also presented. In addition, Australian and US experiences in implementing the EAF and EBFM within their national jurisdictions were presented. It was noted that many of the elements necessary for an operational EAF or EBFM are already present in most t-RFMOs but challenges remain in implementing a holistic and integrative view of EAF and EBFM.

Below are listed some of the key points discussed during the meeting:

1. A common definition and understanding of how to operationalize EAF and EBFM in the context of tuna fisheries management and conservation will be key before developing further steps. For example, the degree of consideration of ecological as well as socio-economic aspects in management advice for tuna fisheries.
2. EAF and EBFM are management tools and can only be initiated at a Commission level. The process cannot be delegated for completion by the Scientific Committee or dedicated technical sub-committees or working groups. It requires identification of a vision, goals and explicit operational objectives. The process will, however, be informed by science and will be an adaptive and iterative process among the different groups.
3. A review of progress in implementing EAF and EBFM in the five t RFMOs showed that many elements required for EAF and EBFM implementation are already in place, but may not be in line with a long-term vision of what needs to be achieved or is part of a formalized implementation plan.
4. Implementation of EAF and EBFM will not involve a substantial amount of additional work and/or data and initially requires a compilation and evaluation of existing data.
5. The design and implementation of an EAF and EBFM plan is a participatory process involving managers, science and stakeholders.
6. t-RMFOs will face some particular challenges:
 - a. The areas over which the t-RFMOs have jurisdiction are large and span multiple national jurisdictions (EEZs) as well as areas beyond national jurisdiction leading to complex

stakeholder relationships, which can constrain the nature and effectiveness of management actions.

- b. Decision making within each t-RFMO is subject to the approval of multiple contracting parties (e.g., 51 in ICCAT) which affects the speed with which decisions are taken and measures are implemented.
 - c. While in most cases, the mandate of the Commissions don't explicitly exclude looking at other ecosystem components (i.e., socio-economic and governance issues), they typically translate into an ecological bias with a focus on conserving target and bycatch species.
 - d. There are limited resources available, both in terms of capacity and funds, to contend with the short-term demands of designing and implementing an EAF or EBFM plan.
 - e. Most examples for EAF and EBFM implementation are currently at the national level. Full implementation, in particular stakeholder consultation processes and prioritization exercises are expected to become more complex in a multinational framework with limited time for meetings which may be held only annually.
 - f. The lack or ambiguity of mandates for non-target species might be an issue in some t-RFMOs.
 - g. In t-RFMOs' multilateral contexts, many of the discussions and consultations will still need to take place at the national level. However, prioritization process at the RFMO level will support decision-making at the national level.
7. The group also discussed challenges related to data, science and communication, including:
- a. The need for scientists to find an effective way of communicating and visualizing EAF and EBFM concepts to commissioners and to support the process subject to the needs of the managers.
 - b. Working parties are often facing time constraints due to large numbers of thematic issues they have to deal with. Thematic splits and re-arrangements of working groups and/or the t-RFMO organizational structure might be required in some cases. EAF and EBFM implementation will likely require additional expertise and increased cross-sectoral collaboration. Initially, some extra work and funding will be required to establish the process, but this is expected to be a one-time investment which should not be required once a routine has been developed.
 - c. Ecosystem report cards could be considered as a tool to facilitate communication of the status of the components contained within the themes of the EAF and EBFM framework. It can reflect the interdependencies between species (e.g. those species caught in association should be managed as such) or simply report the impacts of fleets and/or gear groups on species within regions. For example, if one species in a multi-species fishery (Figure 7 illustrates the concept) has a problem, the resulting management action will need to act upon all the associated species.

- d. Selection of appropriate boundaries for a bioregion can be based on abiotic factors, stock boundaries, or other ecological factors, as appropriate, and can be adjusted at later stages.
 - e. Information and data collection efforts need to be aligned with their relevance for management (i.e., focus first on high risk and high value issues). Data needs will not necessarily increase under EAF or EBFM implementation, but become more focused on priority issues and facilitation of management decisions.
 - f. Indicators for ecosystem properties do not necessarily have to be complicated and require huge amounts of additional data collection, but will require some validation prior to widespread implementation
8. Finally, the group discussed some mechanisms and processes to move the implementation of ecosystem approaches in tuna-RFMOs forward. These included:
- a. Bringing EAF and EBFM to the attention of decision makers in the respective Commissions and getting their commitment is considered crucial in moving forward towards EAF and EBFM implementation. Managers will need to be the drivers of the process. EAF and EBFM is first and foremost a management process.
 - b. Action will need to focus on high risk issues in line with established operational objectives.
 - c. Science-management dialogues which are already established in t-RFMOs to convey scientific findings to managers could be used as a forum to discuss EAF and EBFM matters as is already happening in ICCAT and IATTC.
 - d. Several steps to progress the implementation of the EAF and EBFM were identified by all participants (Table 5, page 46). Identifying champions in each Commission was considered a key factor for future progress.
 - e. Several thematic areas would benefit from collaboration among t-RFMOs (see chapter 7.2). EAF and EBFM could be part of the agenda of a future Kobe meeting (tentatively planned for 2018). A joint working group to deal with EAF and EBFM issues (similar to the ones on MSE, FADs, bycatch) could be a way to formalize collaboration between RFMOs to work on common elements.
 - f. The Common Oceans ABNJ Tuna Project pledged its support for an additional meeting, tentatively in Mid December 2017 or beginning of 2018. This meeting might need to be different in terms of participants engaging commissioners. Participants proposed a three day meeting, including one or two days with commissioners and one additional day for scientists to process and elaborate).

2. Ecosystem approaches to fisheries – background

2.1 EAF and EBFM

During the past decades, the world community has largely recognized the importance of the ecosystem approach as a framework to meet the challenges of sustainable development in relation to utilization of renewable resources, including fisheries. The Reykjavik conference “on Sustainable Fisheries in the Marine Environment” in 2001, provided a political commitment to the EAF as a reference framework for managing the fisheries sector, which was further reinforced by the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002. The WSSD implementation plan called for an ecosystem approach to be implemented by 2010, and the rebuilding of depleted stocks by 2015.

The key principles that underpin EAF and EBFM are not new and can be traced back to earlier international instruments, agreements and declarations, such as, *inter alia*, the 1995 Code of Conduct for Responsible Fisheries (CCRF), the 1982 Convention on the Law of the Sea (UNCLOS), the 1995 Fish Stock Agreement, the 1992 United Nations Conference on Environment and Development (UNCED), and the 1992 Convention on Biological Diversity (CBD).

Although there are different definitions and conceptual approaches for integrating ecosystem considerations into fisheries management decisions stemming from different perspectives or entry points, e.g. EAF and Ecosystem Based Fisheries Management (EBFM), in general terms all of them are holistic approaches that takes into consideration impacts not only the target stocks but also the impacts on the broader ecosystem arisen from the fishing activity as well as their social and economic outcomes and the conditions that supports achievement of set objectives. Transparency and participation of stakeholders in the decision making process are important elements.

FAO’s definition of EAF (FAO, 2003¹) states that *the Ecosystem Approach to Fisheries strives to balance diverse societal objectives, by taking account of 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.*

This definition addresses both human and ecological well-being aspects, and recognizes that EAF means to implement sustainable development concepts in fisheries. As such basic objectives of EAF include: maintaining ecosystem integrity / ecological well-being, improving human well-being and equity and promoting/enabling good governance (which includes addressing supporting structure and external impacts).

The Ecosystem Approach to fisheries as promoted by FAO provides a risk based management framework for addressing the wide range of issues in relation to the fishery you are managing relating across the dimensions mentioned above. Inspired by Australia’s experience in developing practices consistent with the principles of ecological sustainable development (Fletcher et al., 2002²), the existing

²Fletcher WJ et al. 2002. *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Wild Capture Fisheries*. FRDC Project 2000/145, Canberra, Australia. 120pp.

FAO guidelines (FAO, 2003¹, 2005³ and 2008⁴) provide a broad overview of the fundamentals of EAF and a basic process for planning and implementing the approach.

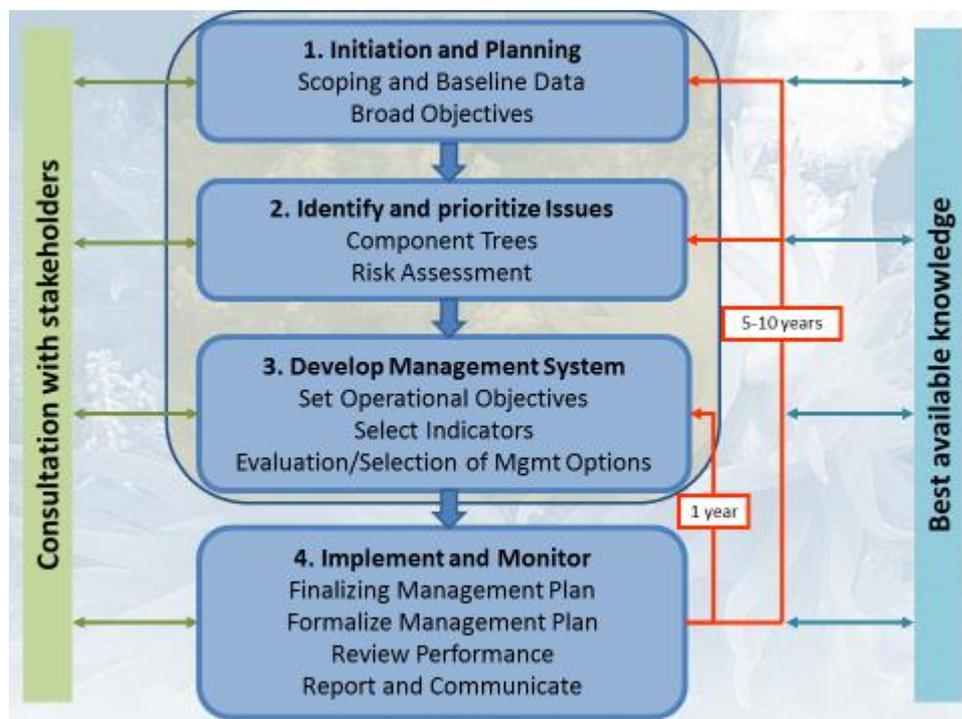


Figure 1: The four steps of the EAF management process based on the FAO EAF toolbox⁵

The overall EAF process is divided into four main steps; all with specific outcomes that supports the development and monitoring of a management plan, a key implementation tool under an EAF as shown in Figure 1. The four steps allow for the (i) definition of broad objectives for the fisheries; (ii) identification and prioritization of the issues to be addressed; (iii) development of effective management systems and measures; and (iv) formalization of a management plan with appropriate monitoring of performance and communication. These steps apply whether the fishery is new, moving from a different type of management system or managed consistently with EAF, but undergoing changes. The process can also generate other important outcomes, such as a plan of action to address key capacity development needs that affect management performance or an overarching strategy or framework for a fishery system. The approach is adaptive, and builds on existing frameworks and procedures. Communication and consultation with stakeholders and use of best available knowledge throughout the different steps are key elements. In many cases, sufficient capacity and information will not be available to address all points. However, the process outlined can also be used data-poor situations and even when there is need for substantial capacity building. The output of the process will still provide guidance on how management can start implementing the policy goals outlined in national/international agreements. In practice, just applying the process will facilitate better fisheries management. FAO has developed a ‘toolbox’ for facilitating the implementation of EAF that makes available best practices to fisheries management practitioners and stakeholders. The toolbox,

³FAO. 2005. Putting into practice the ecosystem approach to fisheries. Rome, FAO. 76p.

⁴De Young C, Charles A, and Hjort A. 2008. Human dimensions of the ecosystem approach to fisheries: an overview of context, concepts, tools and methods. *FAO Fisheries Technical Paper*. No. 489. Rome, FAO. 152 p.

⁵<http://www.fao.org/fishery/eaf-net/en>

structured following the main steps of the fisheries planning and implementation processes, is available online⁵ and complements the information available in the existing FAO Guidelines and other available FAO material that share experience in implementing different elements associated with the approach.

The various definitions and conceptual approaches in use for holistic approaches may create uncertainty as regards how EAF and EBFM may be implemented, and there are challenges in its operationalization because of the potential complexity that may arise from its multidisciplinary nature and the need to reconcile different objectives.

While elements of EAF and EBFM are being implemented to a greater or lesser degree by countries or competent regional organizations, addressing issues such as: multi-species management, mitigation of bycatch and mortality incidental to fishing operations, protection of vulnerable habitats and ecosystems, and holistic governance approaches where social and economic elements are explicitly considered in management objectives, challenges still remain.

From a scientific point of view, a shift from single-species to more holistic ecosystem management approaches often implies a substantial increase in the number of variables that may need to be considered when informing management decisions. This is particularly critical when targeting tuna and tuna-like species, which are highly migratory, spreading through large areas and various ecosystems, and exploited by multiple gears and fleets from different countries. Finally, poor understanding and lack of identification of specific and sometimes conflicting management objectives often hinders the application of the ecosystem approach. An additional challenge therefore is the need to translate general objectives into operational and effective goals that can be effectively implemented through the development of suitable harvest strategies and their associated management control settings.

The implementation of the EAF and EBFM should not only result in the sustainable utilization of healthier marine ecosystems, but also bring several gains and benefits such as:

1. Helping to identify trade-offs among resources, their habitat and the fishery's bycatch;
2. Providing a better understanding of the cumulative impact of a management action beyond just a single species;
3. Helping to better understand and articulate the risks, benefits and effectiveness of management alternatives, as well as the trade-offs;
4. Ensuring more transparent decision processes, and outcomes; and
5. Maintaining ecosystem function and fishery sustainability, which support economic and social stability and fishing community well-being.

In addition, the risk-based processes that underpin the implementation of EAF and EBFM are considered to provide the suitable strategic planning tools that can assist agencies to generate a clear understanding of how to prioritize their activities and appreciate the degree to which their organization is structured to support a more integrated mandate.

Furthermore, the development and adaptive implementation of the EAF and EBFM encourages active participation of key stakeholders and subsequent buy-in, facilitating its continuation and expansion.

2.2 EAF and EBFM and tuna fisheries

Given the existing international commitments to implement an ecosystem approach and that several international instruments require to increasingly bring ecosystem considerations into fisheries management decision-making, t-RFMOs are examining their governance systems to adopt EAF and EBFM related measures that enhance the management of their fisheries to be more compliant to mitigating impacts on target and bycatch species, their trophic relationships and habitat requirements.

In this context, on the initiative of ICCAT, the Common Oceans ABNJ Tuna Project implemented by the Food and Agriculture Organization of the United Nations (FAO) and funded by the GEF, organized a *Joint Meeting of tuna RFMOs on the Implementation of the Ecosystem Approach to Fisheries Management*. The meeting took place from 12-14 December in FAO HQ in Rome and brought together representatives of the scientific communities of the five t-RFMOs (list of participants in Annex 1). This report reflects the opinions and perceptions of the workshop participants, and not necessarily of the respective t-RFMOs.

Alexander Hanke, Co-convenor of the ICCAT Sub-committee on Ecosystems, chaired the meeting.

The specific objectives of the meeting were to:

- a. To establish a sustained dialogue across t-RFMOs on the challenges as well as potential benefits of implementing EAF and EBFM.
- b. To review t-RFMO EAF and EBFM experiences (where are we? What is the understanding of EAF and EBFM in the different RFMOs?)
- c. To understand common challenges in EAF and EBFM implementation and identify case specific solutions (what's slowing down the process and what can we do to accelerate it?)
- d. To identify the themes, components and elements which might be included in a draft guidance for EAF and EBFM for tuna and tuna-like species that suits each t-RFMO (what's relevant? What elements should be prioritized? What indicators should be used for monitoring?).
- e. To identify a step-wise approach (i.e., develop a work plan) that will facilitate the implementation of EAF or EBFM within each of the five t-RFMOs.

Desired outcomes of the meeting

- a. A synopsis of progress on the implementation of the EBFM and EAF in each t-RFMO.
- b. A table identifying the main challenges, bottlenecks and potential short- and long-term solutions (both at the technical and process level).
- c. A draft guidance including the themes, components and elements to be considered for a draft EAF or EBFM framework suitable for tuna and tuna like fisheries (e.g., components, indicators and reference points).
- d. A draft work plan or roadmap to move forward on the implementation of EAF and EBFM

3. Current status of EAF and EBFM in t-RFMOs

3.1 Commission for the Conservation of Southern Bluefin Tuna

On 20 May 1994, the then existing voluntary management arrangement between Australia, Japan and New Zealand was formalized when the Convention for the Conservation of Southern Bluefin Tuna, which had been signed by the three countries in May 1993, came into force. The Convention created the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). CCSBT has no Convention Area, it covers fishing for Southern Bluefin tuna (SBT) wherever it occurs which historically has been within the Convention Areas of WCPFC, IOTC and ICCAT.

All CCSBT members and Cooperating Non-Members (CNMs) are also members or CNMs of the other RFMOs in which they fish (except for the Fishing Entity of Taiwan which is not able to be a member of IOTC). All CCSBT members must also comply with any binding management measures adopted by the RFMO within whose convention area they are fishing.

The CCSBT Convention has a single objective, which is “to ensure, through appropriate management, the conservation and optimum utilization of the SBT.” There is no explicit reference to EBFM in the CCSBT Convention. The Convention predates international agreements that set modern principles and/or standards for fisheries management (e.g. UNFSA).

There is, however, reference to “ecologically related species” (ERS) which are defined as “living marine species which are associated with SBT, including but not restricted to both predators and prey of SBT”. ERS matters are dealt with by the Ecologically Related Species Working Group (ERSWG) which meets every 18 months to 2 years.

No specific objectives for ERS have been defined, but under Article 5 members are required to:

- Provide fishing catch and effort statistics and other data relevant to the conservation of SBT and, as appropriate, ERS; and to
- Cooperate in the collection and exchange of data and samples relevant for scientific research on ERS.

Article 8 states that the commission shall collect and accumulate scientific information, statistical data and other information relating to ERS.

Article 9 states that the CCSBT’s Scientific Committee shall report to the Commission its findings or conclusions, including consensus, majority and minority views, where appropriate, on the status of ERS

The ERSWG was formed in 1995 with the following Terms of Reference:

1. To provide information and advice on issues relating to ERS
2. To monitor trends and review existing information and relevant research on ERS
3. To provide recommendations on data collection programs and research projects
4. To provide advice on measures to minimize fishery effects on ERS
5. To provide advice on other measures which may enhance the conservation and management of ERS
6. To co-operate and liaise with relevant experts, scientists (from Convention parties and elsewhere) and inter-governmental and non-governmental organizations, in data collection and analysis on ERS.

In this context a key *Recommendation to Mitigate the Impact on Ecologically Related Species of Fishing for Southern Bluefin Tuna*, updated at the Eighteenth CCSBT Annual Meeting – 10-13 October 2011, includes:

“The Extended Commission and/or its subsidiary bodies as appropriate will undertake an assessment of the risks to ecologically related species posed by fishing for southern bluefin tuna. The Extended Commission will consider how these risks are mitigated by the adoption of measures described at section 2 [those of the IOTC, the WCPFC and the ICCAT], and will consider whether any additional measures to mitigate risk are required.”

In terms of bycatch, catches of marine mammals, rays, and billfish are not believed to be important ERS for SBT fisheries. For this reason, the focus of the ERSWG has been on seabirds and sharks. The Extended Commission has recognized that there is an opportunity to incorporate modern principles and/or standards of fisheries management (e.g. precautionary approach, ecosystem-based management).

The CCSBT Strategic Plan contains several items that recognize the need to incorporate the ecosystem approach to fisheries in the Convention text, the Commission’s decisions, the Management Procedure, and other aspects of the Scientific Committee’s work.

For the ERSWG, seabird bycatch has been given a priority.

The ERSWG has been directed to

- a. examine current seabird bycatch mitigation measures in other RFMOs;
- b. the distribution and population status of seabirds;
- c. advise whether these mitigation measures should be strengthened, and if so how.

Currently, there is no overall framework for EBFM implementation other than the measures contained in the Strategic Plan. No indicators or reference points have been agreed for any ecosystem components other than the target species. There are specific reporting requirements for members but no elements of these that specifically concern ecosystem components. It is too early to say what impediments might be encountered within the CCSBT in developing and implementing any EBFM framework.

Historically, there has been a lack of consensus among members as to the role of CCSBT in addressing issues beyond those stated in its single objective to “ensure, through appropriate management, the conservation and optimum utilization of southern bluefin tuna”.

There is now acceptance, however, that is articulated in the Strategic Plan, of the need for more modern fisheries management standards to be incorporated into the Extended Commission’s decision making.

3.2 Inter-American Tropical Tuna Commission.

The IATTC is responsible for the conservation and management of tuna and other marine resources in the eastern Pacific Ocean. The IATTC also has significant responsibilities for the implementation of the International Dolphin Conservation Program (IDCP). The Convention Area comprises the area of the Pacific Ocean bounded by the coastline of North, Central and South America from the parallels of 50°N to 50°S to the 150°W meridian. The current mandate of the IATTC is the 2003 Antigua Convention, which entered into force on 27 August 2010. This was negotiated to strengthen and replace the 1949 Convention establishing the Inter-American Tropical Tuna Convention. The objective of the Antigua Convention is “to ensure the long-term conservation and sustainable use of the fish stocks covered by this Convention, in accordance with the relevant rules of international law.” Currently, the IATTC has 21 members and four Cooperating Non Members.

Ecosystem considerations have been a part of the Commission’s agenda since at least 2003 and are explicitly detailed under two main Articles of the Convention:

Article VII. Functions of the Commission

“1. The Commission shall perform the following functions, giving priority to tunas and tuna-like species:

- (a) promote, carry out and coordinate scientific research concerning the abundance, biology and biometry in the Convention Area of fish stocks covered by this Convention and, as necessary, of associated or dependent species, and the effects of natural factors and human activities on the populations of these stocks and species;
- (f) adopt, as necessary, conservation and management measures and recommendations for species belonging to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered by this Convention, with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened;
- (g) adopt appropriate measures to avoid, reduce and minimize waste, discards, catch by lost or discarded gear, catch of non-target species (both fish and non-fish species) and impacts on associated or dependent species, in particular endangered species;”

Article IV. Application of the Precautionary Approach

“3. Where the status of target stocks or non-target or associated or dependent species is of concern, the members of the Commission shall subject such stocks and species to enhanced monitoring in order to review their status and the efficacy of conservation and management measures. They shall revise those measures regularly in the light of new scientific information available.”

Ecosystem research activities that support the fulfillment of the IATTC’s obligations under the Convention is primarily conducted by the *Ecosystem Group* within the Biology and Ecosystem Program of the IATTC, although other groups within the program focus on specific ecosystem components; primarily population assessments of target species and prominent bycatch species. The research is guided by the “*Scientific Advisory Committee*” that is tasked by the “*Committee for the Review of Implementation of Measures Adopted by the Commission.*” The research is broad in scope incorporating various ecosystem components. IATTC undertakes single species monitoring & population assessments for principal target and bycatch species.

Following a review of IATTC in 2016, a 5-year strategic research plan is currently in development, which will incorporate several ecosystem components and improved integration of existing research programs. Currently, numerous research and management activities of the IATTC address relevant elements of the Convention and EBFM including:

1. Ongoing monitoring of target species (catches, discards, and length frequency) and stock assessments.
2. Monitoring of retained and discarded bycatch species
 - Species that are protected, listed or of conservation concern (dolphins, turtles, sea birds, sharks). Measures adopted under the Agreement on the International Dolphin Conservation Program (AIDCP) and the La Jolla Agreement framework (since 1993) include a Dolphin Mortality Limit (DML), actions by the IATTC and AIDCP addressing ecosystem components include resolutions on sea turtles, seabirds, sharks, rays, and collection and analysis of data on FADs.
 - Byproduct (i.e. retained non-target species) - tuna-like species (e.g. billfishes, dorado, wahoo),
 - Priority species or ‘indicator’ species identified through ecological risk assessment and ecosystem models.
3. Ecological risk assessments to identify and prioritize potentially vulnerable species
 - Large purse-seine, longline, ‘coastal’ artisanal, and small purse-seine fisheries,
 - Quantitative cumulative risk assessment for the eastern Pacific Ocean (e.g. SAFE).

Currently, there is no formal framework for EBFM implementation, but several Resolutions pertain to non-target species. Mortality limits have been set for dolphins, target and limit reference points are in place for principal target species (bigeye tuna, yellowfin tuna, skipjack, albacore tuna, swordfish, and Pacific bluefin tuna), and CPUE trends are being monitored for key bycatch species (silky shark, dorado, sailfish, striped and blue marlin) and vulnerable bycatch species. Trophic level of the catch for three purse-seine fishing modes and the pole-and-line fishery are also being monitored as a proxy of ecosystem integrity.

Management responses are well established for target and protected/listed species (e.g. harvest control rules for tunas, DML for dolphins), but there are currently no explicit management responses for non-target species.

A section entitled “Ecosystem Considerations” has been included in the IATTC Fishery Status Report since 2003 and is presented at the annual Scientific Advisory Committee meeting. It reviews concepts, recent data, and research with a focus on the ecosystem as a whole but does not address social/cultural or economic components.

3.3 International Commission for the Conservation of Atlantic Tunas

The International Commission for the Conservation of Atlantic Tunas (ICCAT) is responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and adjacent seas. The Convention entered formally into force in 1969. Currently, there are 51 contracting parties and five cooperating non-contracting parties.

Through the Convention, it was established that ICCAT is the only fisheries organization that can undertake the range of work required for the study and management of tunas and tuna-like fishes in the Atlantic, including research on biometry, ecology, and oceanography, with a principal focus on the effects of fishing on stock abundance. This work requires the collection and analysis of statistical information relative to current conditions and trends of the fishery resources in the Convention area. Additionally, data is compiled for other species that are caught during tuna fishing ("bycatch", principally sharks, sea turtles and seabirds) in the Convention area, and which are not investigated by any other international fishery organization.

EBFM is not included in the ICCAT Convention. The current Convention predates the concept, however it is in the process of being amended. The revised amendment includes specific reference to the Ecosystem Approach to Fisheries Management. In 2016 ICCAT adopted "Resolution by ICCAT on Ecosystems that are Important and Unique for ICCAT Species". The Standing Committee on Research and Statistics (SCRS) adopted the 2015-2020 Science Strategic Plan for the functioning and orientation of the SCRS at its meeting in 2014. Therein are objectives related to ecosystems associated with data collection, research opportunities, stock assessments and advice and communication. This document was the basis for the Sub-Committee on Ecosystems to develop its own short term and long term EBFM related objectives in 2016.

In ICCAT, all items related to Ecosystems are addressed by the Subcommittee on Ecosystems. The Sub-Committee meets annually and since 2012 has:

- a. Devoted time to understanding the requirements of EBFM;
- b. Reviewed cases where EBFM was being implemented;
- c. Discussed the obstacles to implementing EBFM in ICCAT;
- d. Reviewed how to operationalize conceptual management objectives within an EBFM;
- e. Defined the components for an EBFM framework based on the Sargasso Sea;
- f. Developed conceptual objectives for 4 ecological elements of a reporting framework that would align with ICCAT's organizational structure;
- g. Provided examples showing how the higher order objectives relate to operational objectives and relevant state indicators, reference levels and management actions.
- h. Initiated a dialogue with managers at the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers to engage them in the process and obtain feedback;
- i. Evaluated the progress of applying the EBFM approach in ICCAT and WCPFC;
- j. Developed proposal to conduct this meeting;
- k. Held a joint meeting with the Small Tuna Group in order to develop indicators for data poor species so that they could be involved in an EBFM framework;
- l. Provided a draft EBFM framework for ICCAT species;

- m. Outlined short, mid and long term objectives with regards to EBFM; and
- n. Reviewed a report on the t-RFMO's progress implementing EBFM.

Plans for further EBFM development include in the short term:

- a. Development of an Ecosystem Report Card that will be reviewed by the Ecosystems subcommittee in 2017;
- b. Request for an agenda item in the next Dialogue Meeting between Scientists and Managers and present the ecosystem report card and framework;
- c. Implementation of new mechanisms or improve current mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the ICCAT Species Working Groups and within the SCRS;

And in the medium-term:

- a. Development of an Ecosystem Considerations Report (or Ecosystem Synthesis Report) to be incorporated in the Ecosystems subcommittee work plan and for inclusion in the ICCAT manual in a section on Ecosystems Based Fisheries Management.
- b. Conduct of a quantitative Ecosystem Risk Assessment (ERA) of the important ecological, human and institutional interactions occurring within the ICCAT ecosystem that could have implications for fisheries management with the input and participation from the main stakeholders/Commission.

The subcommittee on Ecosystems has a draft framework in place, which focuses on the Ecological dimension given the realization that the institutional, social/cultural and economic themes were beyond the ICCAT mandate. The Ecological dimension is restricted to components for target species, bycatch species, habitats and trophic relationships. In 2005 ICCAT created a specific working group for shark species. An ecological risk assessment has been conducted for 16 elasmobranch species, resulting in multiple recommendations and resolutions. ICCAT is also in the process of conducting an ERA on sea turtles and is implementing bycatch mitigation strategies for seabirds. In 2011, an ecological Risk assessment was conducted for species caught in Atlantic tuna fisheries (Arrizabalaga et al 2011⁶, Tuck et al 2011⁷).

Conceptual management objectives were proposed by the Subcommittee on Ecosystems for each element of each component including interim operational objectives. Most target species have an indicator and if they are assessed they have a reference point. There are procedures (e.g. length based indicators) being developed for data limited stocks but these have not been formally accepted by the Working Groups. Simple management responses (like control fishing mortality) have been proposed for the various elements of each component. A reporting framework is on the work plan for 2017.

⁶Arrizabalaga H, de Bruyn P, Diaz GA, Murua H, Chavance P, Delgado de Molina A, Gaertner D, Jon Ruiz JA and Kell LT. 2011. Productivity and susceptibility analysis for species caught in Atlantic tuna fisheries. *Aquat. Living Resour.* 24, 1–12

⁷Tuck GN, Phillips RA, Small C, Thomson RB, Klaer NL, Taylor F, Wanless RM, Arrizabalaga H. 2011. An assessment of seabird–fishery interactions in the Atlantic Ocean. *ICES J Mar Sci* 68, 1628-1637

3.4 Indian Ocean Tuna Commission

The IOTC was formally established in 1993, with the Agreement entering into force on 27th March 1996, and is the direct successor of the work conducted under Indo-Pacific Tuna Development and Management Programme (IPTP). There are currently 31 contracting parties, as well as 4 Cooperating non-contracting countries, and membership is open to all Indian Ocean coastal countries and to countries or regional economic integration organizations which are members of the UN and which actively conduct harvesting activities in the IOTC Area of Competence. The objective of the Commission is to “promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilization of stocks covered by this Agreement and encouraging sustainable development of fisheries based on such stocks.”

The Agreement was negotiated prior to the conclusion and entry into force of the 1995 United Nations Fish Stocks Agreement (UNFSA), which provide a global framework for the implementation of the provisions of the 1982 United Nations Convention on the Law of the Sea (UNCLOS) for straddling and highly migratory fisheries resources.

The Commission has four key functions and responsibilities drawn from the United Nations Convention on the Law of the Sea (UNCLOS):

- a. to keep under review the conditions and trends of the stocks and to gather, analyse and disseminate scientific information, catch and effort statistics and other data relevant to the conservation and management of the stocks and to fisheries;
- b. to encourage, recommend, and coordinate research and development activities in respect of the stocks and fisheries covered by the IOTC, and such other activities as the Commission may decide appropriate, having due regard to the need to ensure the equitable participation of Members of the Commission in the fisheries and the special interests and needs of Members in the region that are developing countries;
- c. to adopt, on the basis of scientific evidence, conservation and management measures to ensure the conservation of the stocks covered by the Agreement and to promote the objective of their optimum utilization throughout the Area;
- d. to keep under review the economic and social aspects of the fisheries based on the stocks covered by the Agreement bearing in mind, in particular, the interests of developing coastal States.

IOTC does not implicitly adhere to the precautionary approach to fisheries management. Moreover, the Agreement does not require that the Commission take into account the impact of fishing on the broader ecosystem, nor the ecosystem itself. Rather the Agreement sets out basic functions and responsibilities of the Commission that are more consistent with the UNCLOS, but do not take into account the additional details provided in UNFSA⁸. However, in practice, both are accounted for

- a. through Resolutions⁹ and Management actions;
- b. IOTC WPEB and Scientific Committee.

⁸IOTC-2016-PRIOTC02-R. Report of the 2nd IOTC Performance Review. Seychelles 2–6 February & 14–18 December 2015. *IOTC-2016-PRIOTC02-R[E]*: 86 pp.

⁹E.g. IOTC Resolutions 12/01, 13/04, 13/05, 13/06, 12/04, 12/06, 12/09 (www.iotc.org/cmms)

Since 2007, the Working Party on Ecosystems and Bycatch (WPEB) meets annually to review and analyse matters relevant to bycatch, byproduct and non-target species which are affected by IOTC fisheries for tuna and tuna-like species (i.e. sharks, marine turtles, seabirds, marine mammals and other fishes), as well as the ecosystems in which they operate; and to develop mechanisms which can be used to better integrate ecosystem considerations into the scientific advice provided by the Scientific Committee to the Commission.

A Strategic Research Plan including EBFM is currently under development¹⁰.

EBFM short-term plans have focused on by-catch and sensitive species affected by fishery activities and to mitigate the impacts of fisheries on non-target species. A discussion on how to report Ecosystem Considerations took place in 2016 during the meeting of the WPEB and the Scientific Committee. An indicator-based ecosystem report card with the aim of testing a new approach for linking ecosystem science to management and increasing the communication and reporting of the state of the different components of the Indian Ocean ecosystem to the Commission was proposed¹¹. The SC thanked the authors for this work and agreed that this would be a useful approach to explore further for the Indian Ocean tuna fisheries. The SC notes that there is a need for a clear strategy to be developed, identifying temporal and spatial components. The SC further noted that there has been little work on ecosystem indicators by the WPEB to-date and requested that experts on EBFM are invited to the next WPEB to discuss the development of this approach.

A working party dedicated to Ecosystem Considerations and bycatch was proposed to be separated from the sharks, which require a huge amount of the available time, but the SC agreed that the WPEB should be maintained as a single working party for the next few years.

3.5 Western Central Pacific Fisheries Commission

The Western and Central Pacific Fisheries Commission (WCPFC) was established in 2004 to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the Western Central Pacific Ocean in accordance with the 1982 Convention on the Law of the Sea and the UN Fish Stocks Agreement. Currently, the WCPFC has 26 WCPFC Members, seven Participating Territories and seven Cooperating Non-Members. The area covered by the Convention covers almost 20 per cent of the Earth's surface.

The EBFM-based concept in the WCPFC is included in the *Article 5* of the Convention which implies *principles and measures for conservation and management* that covers target species, non-target species, other dependent species within the ecosystem, minimizing waste and pollution, endangered species, biodiversity, optimum utilization, the welfare of the various states involved including the interests of artisanal and subsistence fishers, etc. The WCPFC Scientific Committee had at first an *Ecosystem and Bycatch Scientific Working Group* (2005-2009) and a dedicated *Ecosystem and Bycatch*

¹⁰Murua H, Santiago J, Merino G, Martin S. and Anganuzzi A. 2016. Proposal for the development of a Strategic Research Plan for the IOTC Scientific Committee IOTC-2016-SC19-16.

¹¹Juan-Jordá .J, Murua H, and Arrizabalaga H. 2016. A template for an indicator-based ecosystem report card for the Indian Ocean Tuna Commission. IOTC-2016-SC19-12.

Mitigation Theme Session in the plenary since 2010, which currently takes around 25% time of the key theme sessions. The first Commission (2004) meeting explicitly asked the Scientific Committee for EBFM advice which includes estimates of the mortality of non-target species with an initial focus on seabirds, turtles and sharks. Since then, WCPFC adopted over 20 fishery-related conservation and management measures (CMMs) for target species; and non-target, associated or dependent species (NTADS) including CMMs on: (i) FADs and catch retention; (ii) sharks in general; (iii) oceanic whitetip, whale shark, silky shark; (iv) seabirds; (v) sea turtles; and (vi) cetaceans.

Although there is no explicit overall framework specifically for EBFM implementation, the current five-year Strategic Research Plan (2012-2016) includes explicit EBFM considerations:

“The Commission has four overall research and data collection priorities:

- *Monitoring of fishing activities through the collection, compilation and validation of data from the fishery*
- *Monitoring and assessment of target stocks*
- ***Monitoring and assessment of NTADS and of the pelagic ecosystems of the WCPO***
- *Evaluation of existing Conservation and Management Measures (CMMs) and of potential management options”*

Currently, EBFM considerations are not separated out for a specific plan of their own, but are rather integrated into the general planning. The ***Monitoring and assessment of the ecosystem*** section under Strategic Research Plan specifies details of relevant researches which will lead to a more integrated approach in the future:

- a. Undertaking periodic ecological risk assessments, using productivity-susceptibility analysis or other approaches, to identify priorities for enhanced monitoring, biological research, stock assessment and management intervention;
- b. Developing and undertaking the Shark Research Plan, including assessments to determine the status of WCPO shark stocks and the impacts from tuna fisheries; research to better understand shark biology and ecology; and improvement of shark catch data from commercial fisheries;
- c. establishing ecosystem indicators to monitor the effects of fishing, other anthropogenic effects and natural variability on ecosystem structure, function and biodiversity;
- d. identifying habitats of special significance,
- e. quantify fishery impacts, other anthropogenic impacts and the effects of environmental and climate variability and change on ocean ecosystems;
- f. estimating maximum aggregate yield of all species that can be safely removed from the ecosystem without disrupting ecosystem structure and function;
- g. identifying oceanographic features, processes and fishing practices that influence the distribution and abundance of fish stocks and their vulnerability to fishing gear;
- h. investigating trophic (predator/prey) relationships ;
- i. synthesizing data and ideas across disciplines into ecological and ecosystem-based models; and
- j. conducting bycatch mitigation research including technical options to minimize bycatch and discards, including undesirable sizes of target species, and investigating depredation.

- k. Use of ecosystem models and related tools to assess the combined effects of fishing, oceanographic variability and socioeconomics in the context of multispecies fisheries and multiple management objectives.
- l. Assessment of the discards of food fish in industrial fisheries and evaluation of implications for food security.

In relation to economic data, the WCPFC Scientific Committee in its 12th Session recommended that:

- a) *An annual update of “Analyses and projections of economic conditions in WCPO fisheries”, in a similar manner to SC12-ST-WP-04¹², continue to be provided at SC meetings.*
- b) *These economic analyses be made available to, and be used by, the Commission in the development of harvest strategies and management measures.*
- c) *SC13 considers Guidelines for the voluntary submission of economic data to the Commission by CCMs, recognizing the value of economic data to the work of the Commission.*

In the future, some of the EBFM-related elements, if applicable, may be considered through the management strategy evaluation process. Ecosystem indicators, which are under consideration, should enable more precise specification of the range of decisions leading to desired or effective outcomes, and reduce the risk of bad outcomes from decisions.

¹²<https://www.wcpfc.int/node/27426>

3.6 Report on progress of t-RFMOs in applying EBFM

Maria-José Juan-Jordá presented the work¹³ she carried out in collaboration with co-authors to evaluate the progress of t-RFMOs in implementing EBFM. The development of international policy and instruments regarding the protection and management of highly migratory fish species including tunas and tuna-like species and associated ecosystems (Figure 2) have risen the standards and now there is an increasing recognition and further expectations of the need for t-RFMOs to account for ecosystem impacts (Lodge et al., 2007¹⁴, de Bruyn et al., 2013¹⁵). This work specifically focused on reviewing the ecological component, rather than the socio-economic and governance components of an EBFM approach.

The authors first developed a Conceptual Ecological Model and used it as a template to develop a “role model” t-RFMO of EBFM implementation (Figure 3). In a second step, they developed criteria to evaluate progress in each t-RFMO in applying EBFM against the role model t-RFMO. In their evaluation, they assessed progress of the following four ecological components: targeted species, bycatch species, ecosystem properties and trophic relationships, and habitats, and reviewed 20 elements that ideally would make EBFM more operational. Following this approach, they found that many of the elements necessary for an operational EBFM are already present, yet they have been implemented in an *ad hoc* manner without a long term vision of what needs to be achieved and a formalized implementation plan. In global terms, t-RFMOs have made considerable progress within the ecological component of target species, moderate progress in the ecological component of bycatch, and little progress in both the components of ecosystem properties and trophic relationships, and habitats, although their overall performance varies across the ecological components.

All the t-RFMOs share the same challenges of coordinating effectively all ecosystem research activities and developing a formal mechanism to better integrate ecosystem considerations into management decisions and communicating them to the Commission. While they consider t-RFMOs are at the early stages of implementing EBFM, they believe its implementation should be seen as a step-wise adaptive process which should be supported with the best ecosystem science and an operational plan as a tool to set the path to advance towards its full implementation. With this comparative review of progress they hope to create discussion across the t-RFMOs to inform the much needed development of operational EBFM plans.

¹³Juan-Jordá MJ, Murua H, Arrizabalaga H, Dulvy NK, Restrepo V. 2016. Progress of tuna regional fisheries management organizations in applying ecosystem-based fisheries management. IOTC IOTC-2016-WPEB12-14.

¹⁴Lodge, M.W., Anderson, D., Lobach, T., Munro, G., Sainsbury, K., Willock, A. (2007) Recommended Best Practices for Regional Fisheries Management Organizations. Report of an Independent Panel to Develop a Model for Improved Governance by Regional Fisheries Management Organizations. The Royal Institute of International Affairs, Chatham House, London.

¹⁵De Bruyn P, Murua H, Aranda M. 2013. The Precautionary approach to fisheries management: How this is taken into account by Tuna regional fisheries management organisations (RFMOs). *Marine Policy* 38, 397–406.

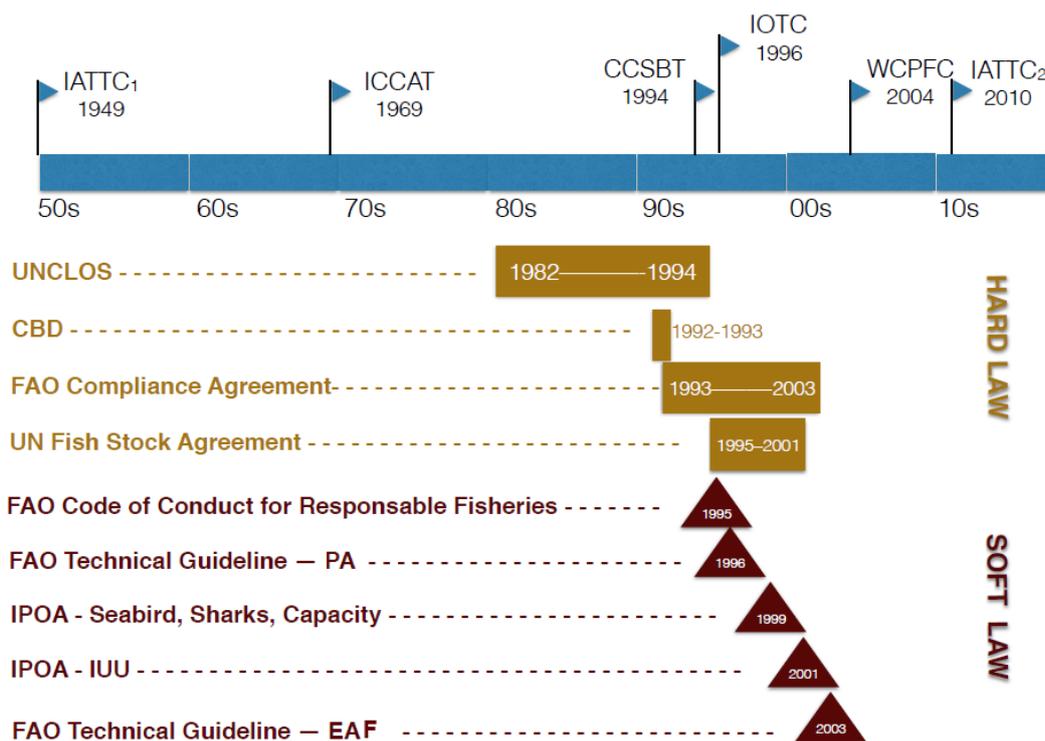


Figure 2: t-RFMOs and international policy context. The development of major international legal instruments pertaining to the conservation and management of highly migratory marine species including tunas and tuna-like species and the conservation of marine biodiversity and ecosystems.

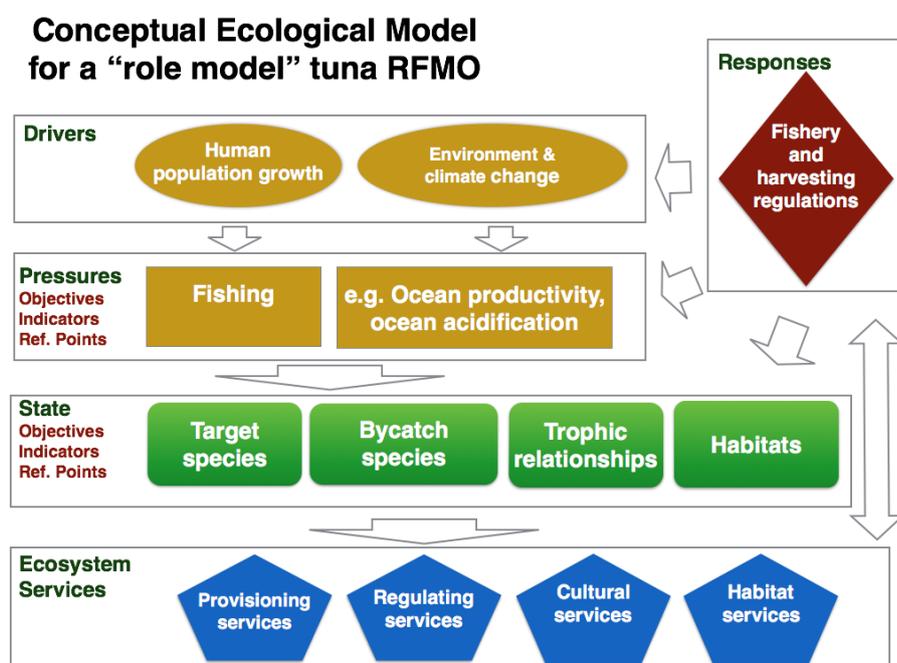


Figure 3 - Conceptual Ecological Model for a role model t-RFMO based on the Driver-Pressure- State-Ecosystem Services -Response framework to monitor the effects of fishing and climate change on the state of tuna species and associated ecosystems.

4. Examples of national EAF and EBFM implementation

4.1 Australia

Rick Fletcher presented the EAF and EBFM approaches developed in Australia during the last 20 years and particularly the Department of Fisheries in Western Australia. Over this period a series of ‘ecosystem based’ frameworks and tools have been developed and these have been used as the basis for FAO’s EAF and the WCPO’s EAFM frameworks (e.g. Fletcher, 2008¹⁶; 2010¹⁷; Fletcher and Bianchi, 2014¹⁸).

Background – Single fishery ecosystem frameworks

A key reason for the significant progress made by Australia in implementing ‘ecosystem approaches’ was that in 1992 all Australian jurisdictions signed onto principles of sustainable development (in Australia this was called Ecologically Sustainable Development –ESD). Furthermore, in order to meet the requirements of new 1999 federal environment legislation, in 2000 a national fisheries ESD subprogram began development of frameworks to enable practical adoption of ESD principles for both fisheries (Fletcher et al, 2002¹⁹); Figure 4) and aquaculture (see Fletcher et al., 2004²⁰).

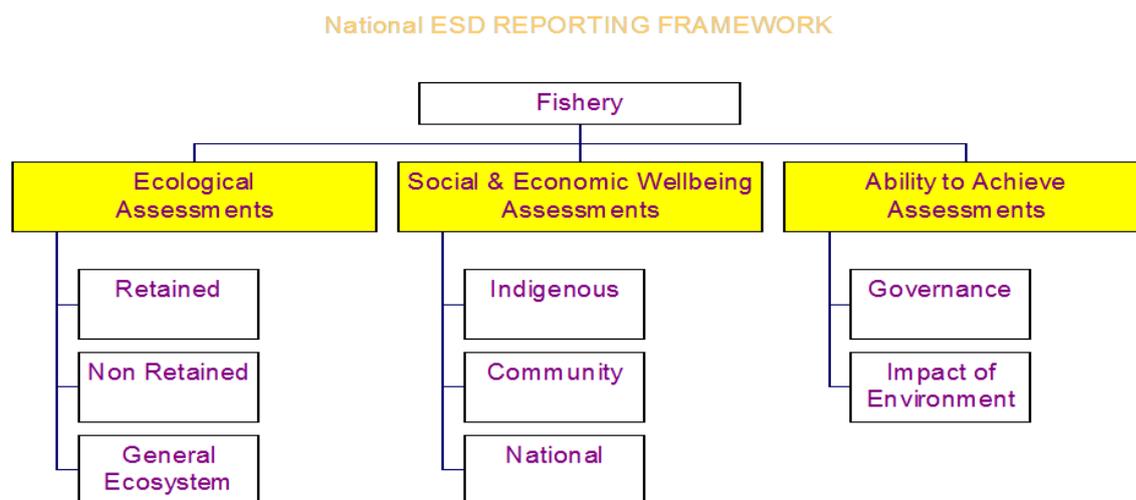


Figure 4 Component framework for a fishery level ‘ecosystem based’ assessment (from Fletcher et al., 2002¹⁹).

¹⁶Fletcher WJ. 2008. Implementing an ecosystem approach to fisheries management: lessons learned from applying a practical EAFM framework in Australia and the Pacific. Chapter 8 pp 112-124. *The Ecosystem Approach to Fisheries*. FAO, Rome.

¹⁷Fletcher WJ. 2010. Planning processes for the management of the tuna fisheries of the Western and Central Pacific Region using an Ecosystem Approach. Forum Fisheries Agency, Honiara, Solomon Islands. Facilitator’s Version 6.1 January 2010

¹⁸Fletcher WJ & Bianchi G. 2014. The FAO-EAF Toolbox: making the Ecosystem Approach accessible to all fisheries. *Ocean and Coastal Management*. 90:20-26.

¹⁹Fletcher WJ. et al. 2002. *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Wild Capture Fisheries*. FRDC Project 2000/145, Canberra, Australia. 120pp.

²⁰Fletcher WJ. et al. 2004. *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Aquaculture*. FRDC Project 2000/145, Canberra, Australia 78pp.

Since that time all Australian jurisdictions have undertaken fishery level assessments of their main fisheries using a variety of risk based tools and systems, reflecting that fisheries management is really just a specific form of risk management (Fletcher, 2005²¹). Within Western Australia, for example, comprehensive risk based assessments are now routinely completed by the Department of Fisheries for each major fishery. These examine the impacts on target species, by-catch species and habitats, plus any potential indirect impacts of these removals on the broader ecosystem, and more recently, risks to social and economic outcomes (Fletcher, 2015²²). Most of the major ecological problems for individual fisheries have now been identified and addressed including most fisheries developing clearer harvest/decision rules (Fletcher et al., 2016²³).

A Hierarchy of Ecosystem Frameworks

Despite this success, it was identified that fishery level assessments do not address the combined effects of all fisheries operating within the same area, cross-fishery allocation issues or fully incorporate social and economic aspects. To address these deficiencies, senior fisheries managers in Australia proposed the use of three levels of ecosystem frameworks (Figure 5). In addition to the fishery level, regional level assessment and management was also needed. This multi-fishery, regional level approach was termed Ecosystem Based Fisheries Management (EBFM) and it deals with the cumulative impacts on the environment (including fish stocks, habitats and ecosystems) from all the fisheries-related activities (commercial, recreational, etc.) operating within a region. Finally, the third level, full Ecosystem Based Management (EBM), covers all activities and sectors (of which fisheries is only one) that operate within a region.

The group also identified that applying any of these levels (EAF/EBFM/EBM) is based on the universal concepts of resource management which can be answered using the following 4 questions:

- What impacts are the activities I control having on the assets that I manage?
- What impacts are these activities having on the assets that someone else manages?
- What economic/social benefits and costs are generated from these activities and the use of my assets?
- What activities managed by others affect me and my assets?

²¹Fletcher, W.J. 2005. Application of Qualitative Risk Assessment Methodology to Prioritise Issues for Fisheries Management. *ICES Journal of Marine Research* 62:1576-1587

²²Fletcher WJ. 2015. Review and refinement of an existing qualitative risk assessment method for application within an ecosystem-based management framework. *ICES Journal of Marine Science* 72: 1043-1056.

²³Fletcher WJ et al. 2016. Refinements to harvest strategies to enable effective implementation of Ecosystem Based Fisheries Management for the multi-sector, multi-species fisheries of Western Australia. *Fisheries Research*. 183:594-608.

National ESD Frameworks

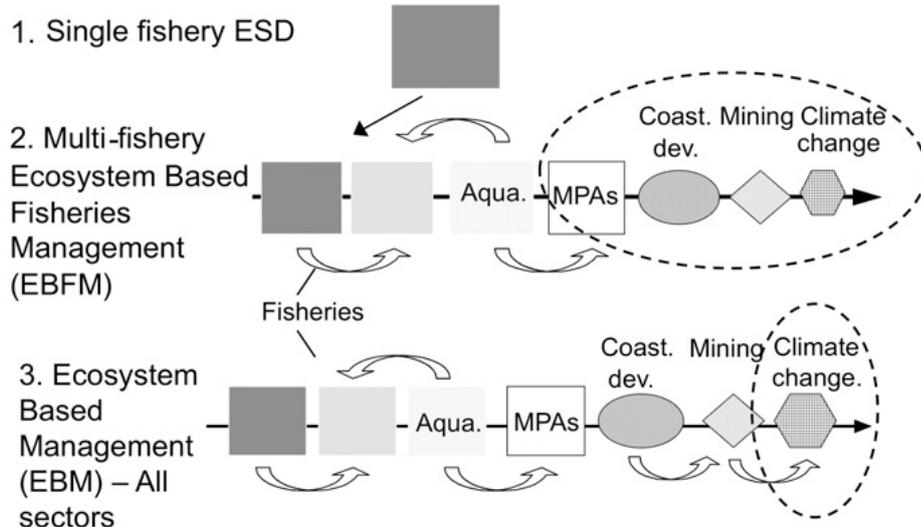


Figure 5 Relationship between the three framework levels. The elements included in the dashed ovals compare external drivers between EBFM and EBM— (modified from Fletcher 2006²⁴).

Developing Methods to apply EBFM

To develop methods to apply EBFM, a number of potential and perceived problems had to be avoided. These included:

- Stakeholders assuming EBFM just involves the collection of more ‘ecosystem’ information
- Generating an impossibly large, complex set of issues, uncertainties and expectations.
- Complementing, not duplicating, activities covered by fishery level management systems.
- Realizing that there was often no option of getting significantly increased resources.

To address these issues, a hierarchical, regional level, risk based framework was generated (Figure 6). This enables each fishery level risk to be used to generate cumulative, regional-level risks.

A key part of the EBFM process was therefore the consolidation of the individual stock-level issues into broader regional-level risks. This process utilizes the branch structure of the component trees whereby each of the branches represented groups of ‘like species’ that can/should be managed collectively with the risk status of the indicator species (the most vulnerable) determining the risk for the entire suite. For the West Coast example, 80 individual fish stock risks were consolidated down to just 9 regional or suite-level risks (Figure 7).

²⁴Fletcher WJ. 2006. Frameworks for managing marine resources in Australia through ecosystem approaches: do they fit together and can they be useful? *Bulletin of Marine Science* 78:691-704

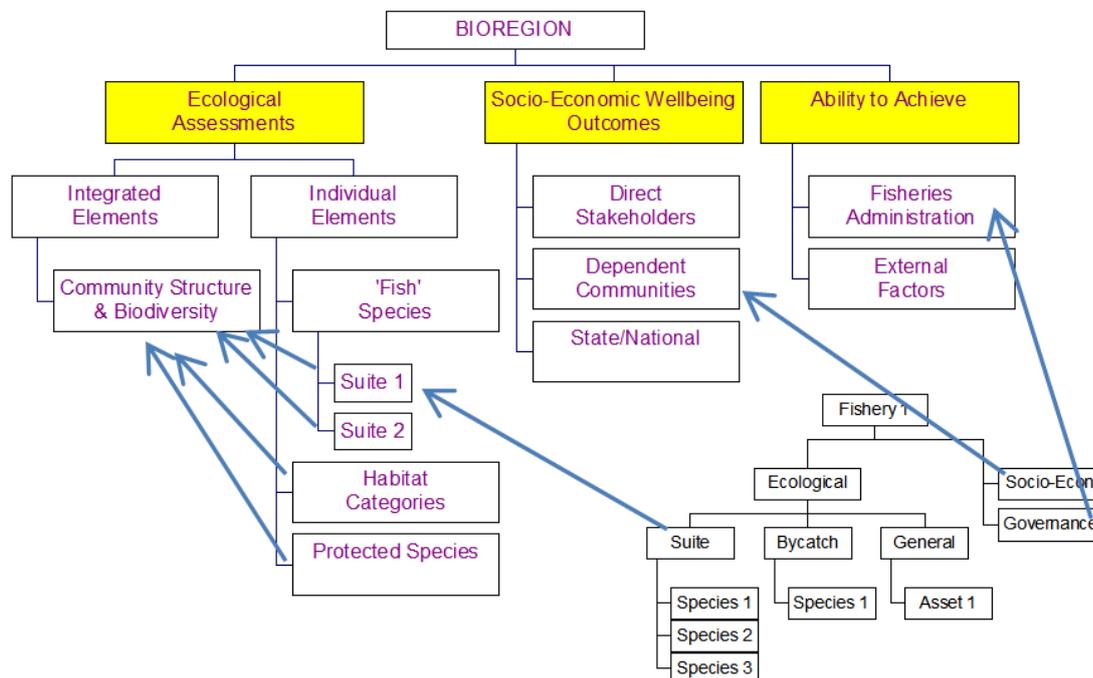


Figure 6. The EBFM component tree framework indicating how each of the fishery level components are mapped into cumulative, regional-level individual assets and outcomes. Furthermore, how the ecosystem elements are the integrated set of individual elements (modified from Fletcher et al. 2010²⁵)

Finally, as many of the regional level risks are interrelated, an integrated set of priorities can be generated by recognizing that they manage ecological assets to generate economic and social benefits for the community. Consequently, each of regional level ecological assets/suites are used as the primary unit to integrate their associated social and economic values and risks to generate an agency level priority score. Using this approach, the >600 West Coast consolidated items was reduced to just 24 agency level priorities (see Table 1). The priority score provides a good indication of the relative level of resources that should be applied to deal with the cumulative risk issues associated with each ‘resource’ (asset).

The EBFM approach also recognizes that if a stock or ecological risk is mostly being generated by human factors external to the fisheries management (legislative) control (e.g. pollution, coastal development), the overall priority for direct Departmental activity is likely to be reduced accordingly. These external risks were taken into account in the Agency level priorities through use of a ‘discounting term’. Consequently, there can be a different priority for action by the Department compared to the whole of government.

²⁵Fletcher, W.J., Shaw, J., Metcalf S.J. & D.J. Gaughan. 2010. An Ecosystem Based Fisheries Management framework: the efficient, regional-level planning tool for management agencies. *Marine Policy* 34:1226–1238

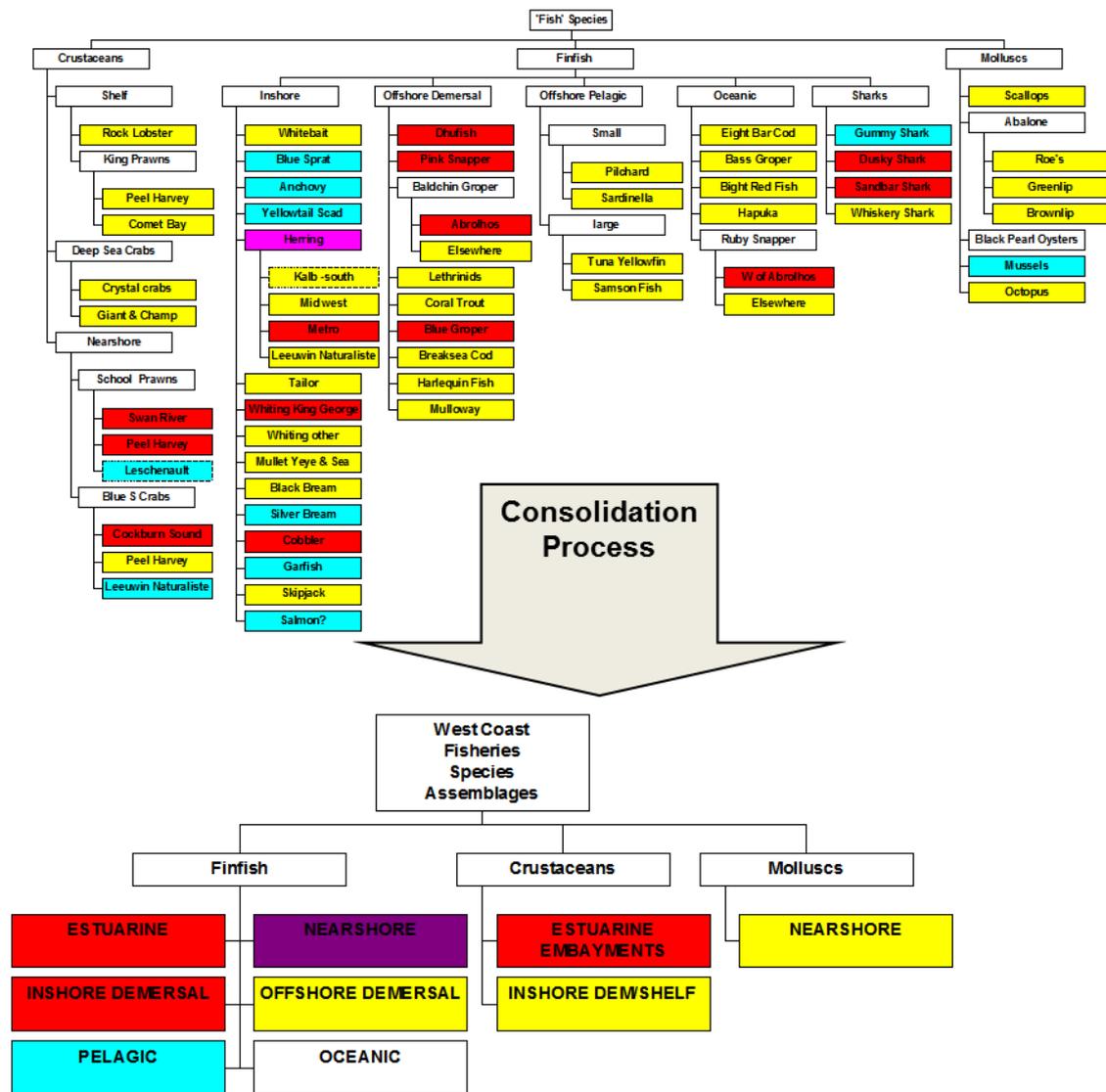


Figure 7: The individual, indicator “fish” stock risks and the consolidated risks of species-suites from the West Coast Bioregion of Western Australia (modified from Fletcher et al, 2012²⁷). Note the highest level risk for any indicator species is used to determine the risk level (red: severe, pink: high, yellow: moderate, blue: negligible) of the entire suite.

Table 1 – Examples of 4 of 24 EBFM level assessments and agency level priority scores (modified from Fletcher et al 2012²⁶). The scores indicate relative risk levels and community values scaling from 0-5, with 5 the highest value of risk for each of the assets. The priority score for each asset is generated based on combining the risk and value scores using a MCDA formula. The column on the right indicates what actions were subsequently taken to reduce high risks.

ASSET	Ecological Risk	GVP level	Economic Risk	Social Amenity	Social Risk	External Impacts (Other Agencies Manage)	Current Dept. Fisheries score and priority (EBFM)	Whole of Govt. score and priority(EBM)	Actions Taken
WC Crustacean (Lobsters)	3	5	5	4	3	0	111 Urgent	111 Urgent	Adopted MEY Introduced quotas
WC Finfish Pelagic	2	1	1	1	1	0	4 Very Low	4 Very low	Nothing
WC Estuarine Ecosystems	5	3	3	4	4	4	25 Low/Mod	125 Urgent	Developed a WoG governance system
WC Demersal Scalefish	4	3	3	4	5	0	116 Urgent	116 Urgent	Reduced catches Sectoral allocations

Benefits of Using EBFM

- EAF and EBFM are just refinements of the ISO 31000²⁷ risk management approach (Figure 8).
- A small number of indicator species can be used to assess risk status of the entire resource/species suite.
- All departmental activities can now be directly linked to managing risks to either an ecological or an organizational asset.
- Risk scores are reviewed and reported annually which generates sensible shifts in resourcing during budget planning process
- Adopting EBFM was the catalyst to draft a new Aquatic Resources Management Act which is resource-based (not activity-based) that requires Government to set explicit objectives and sector allocations at the whole of resource level.

²⁶Fletcher WJ. et al. 2012. Using a regional level, risk based framework to cost effectively implement Ecosystem Based Fisheries Management (EBFM). In: *Global Progress on Ecosystem-Based Fisheries Management*, Pp 129-146 Alaska Sea Grant College Program doi:10.4027/gpebfm.2012.07

²⁷<https://www.iso.org/iso-31000-risk-management.html>

- A new harvest strategy policy has been generated that deals concurrently with multi-species, multi objectives and multi sectoral allocations.
- This approach has helped enable all WA fisheries to be put through MSC assessments.
- The use of indicator species is now being adopted by MSC for assessing multispecies fisheries.

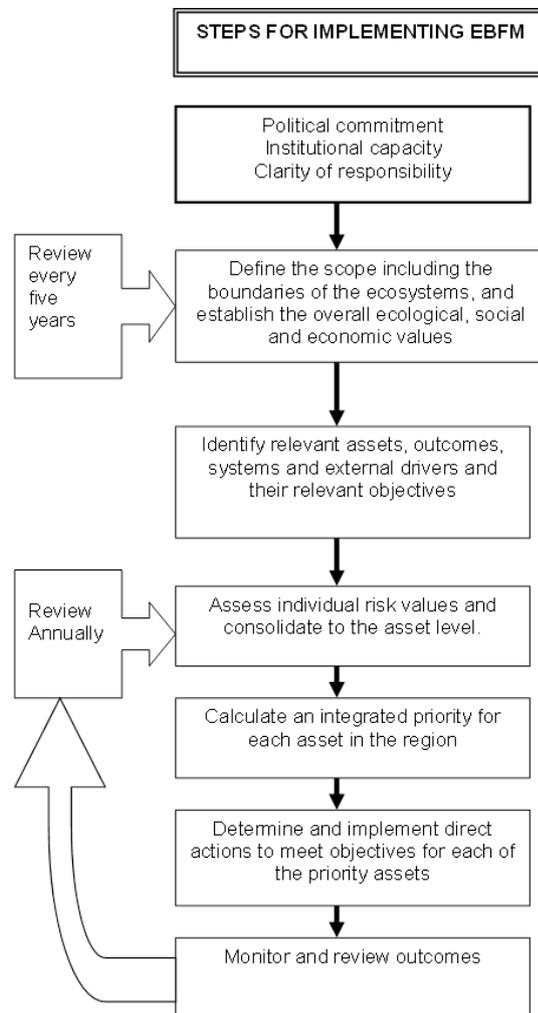


Figure 8. Outline of the entire EBFM process which is based on the ISO 31000 risk management principles²⁷ and guidelines (Fletcher et al. 2012²⁶).

Key Conclusions

- The first and most important step in successfully implementing EBFM (or any management system) is having an appropriate level of political commitment and institutional capacity that will enable suitable management arrangements to be developed and enforced (Figure. 8).
- Implementing EAF and EBFM did not require a detailed understanding of all the ecosystem or models.
- It required efficient, risk-based consideration of all ecosystem assets and their associated community benefits/costs they generate
- It determines what MOST requires direct management to deliver the ‘best’ set of community outcomes.
- Fisheries management failure is usually from a lack of good governance, not the lack of information which is often due to the lack of will to undertake what is already known should be done
- Linking ecological assets to the social and economic outcomes that they generate is the key part to actually undertaking a practical EBFM.
- EBFM could not have been done without already having the individual fishery-level ESD/EAF assessments (see Figure 5) as building blocks

Perceived Challenges of Implementing EAF and EBFM:

- Most jurisdictions will not be given more financial resources to implement EAF and EBFM – therefore it requires adopting a more pragmatic approach not a more complex one.
- Short summary documents for EAF can be generated quickly (i.e. a matter of days) which can cover >80% of the main issues.
- Dealing with actual ‘ecosystem’ issues have not been the main problem - despite them being hard to clarify
- Most of the high risks that have been identified have been generated from poor governance systems, not a lack of information (Fletcher, 2008¹⁶).
- Poor ecological outcomes are often generated because the social and economic issues are not being appropriately dealt with –especially inter-sectoral allocations.

Final points:

- EAF, EBFM etc. are all risk based management planning processes, not research activities – research/science just informs these processes.
- The term ecosystem approach is a misnomer- these approaches would be more appropriately described as ‘comprehensive and holistic’ approaches and they must explicitly include the human and governance elements of sustainable development or they are very likely to fail.
- Scientists can sometimes want to make processes and outputs too complicated and focus on the interesting areas of uncertainty that are not really high risk.
- If managers aren’t listening maybe it’s because they don’t think they need to!

4.2 USA

Heather Sagar presented NOAA Fisheries’ work in relation to EBFM. NOAA Fisheries is responsible for the stewardship of the nation’s living marine resources and their habitats, interactions and ecosystems. NOAA Fisheries recognizes that implementation of EBFM is a process that requires cooperation among diverse groups, including scientists, managers, resource users, and stakeholders. In collaboration with its partners and stakeholders, NOAA Fisheries has already begun the process of implementing EBFM.

In 2016, NOAA Fisheries has developed an agency-wide EBFM Policy, which outlines a set of six Guiding Principles to guide and inform its actions and decisions over the long-term. The Policy clarifies the agency’s commitment to integrating its management programs for living marine resources to reap the benefits from a more systematic approach. It directs continued progress toward development and implementation of EBFM approaches (see Figure 9). It also ensures commitment to incorporate EBFM into the agency’s resource management decisions.

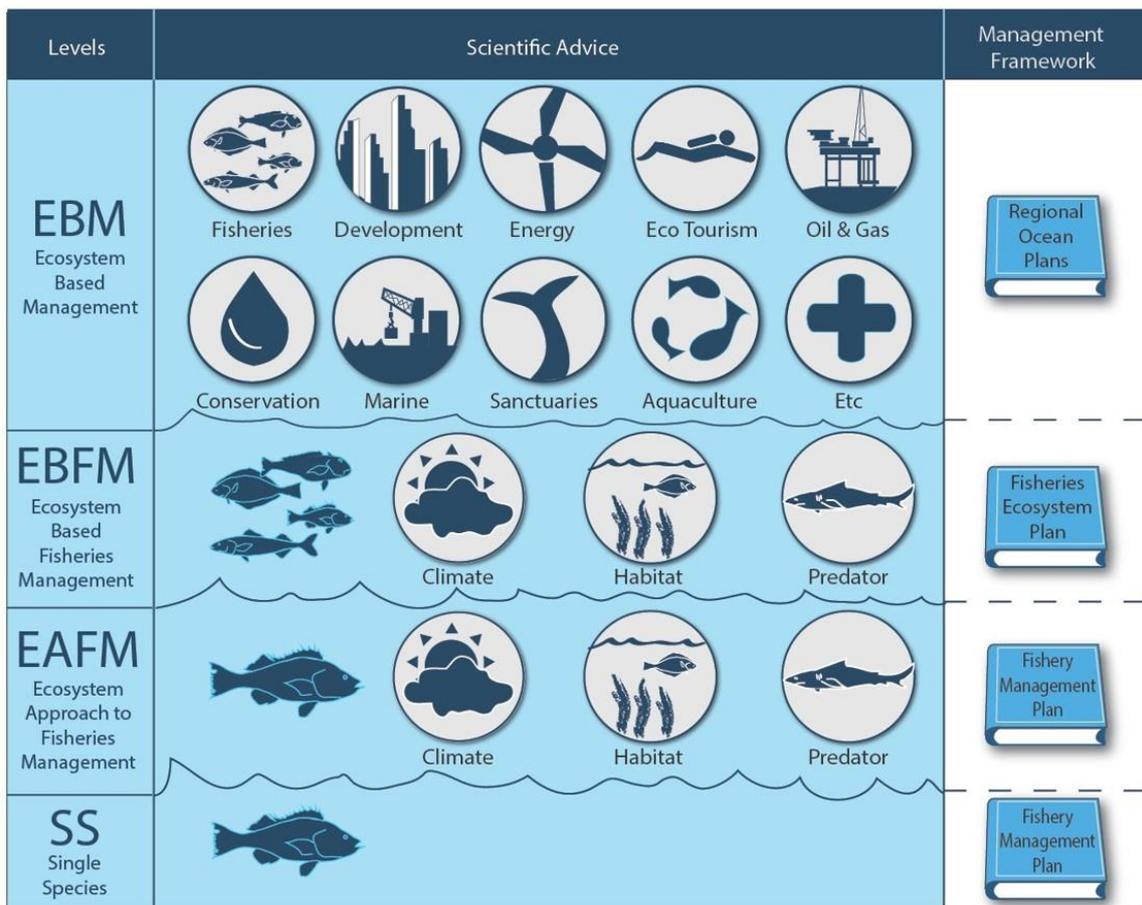


Figure 9: Levels of Ecosystem Based Management (from the NOAA Fisheries Ecosystem-Based Fisheries Management Road Map²⁸)

²⁸http://www.st.nmfs.noaa.gov/Assets/ecosystems/ebfm/EBFM_Road_Map_final.pdf

NOAA Fisheries EBFM Policy defines EBFM as:

“a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals.”

NOAA also recently released in 2016 a NOAA Fisheries new EBFM Road Map to help guide implementation of the EBFM Policy over the next five years. The EBFM Road Map calls for increased coordination across all the living marine resource (LMR) science and management efforts in each U.S. marine region. A major objective of this Road Map is to identify complementary efforts that would benefit from additional coordination.

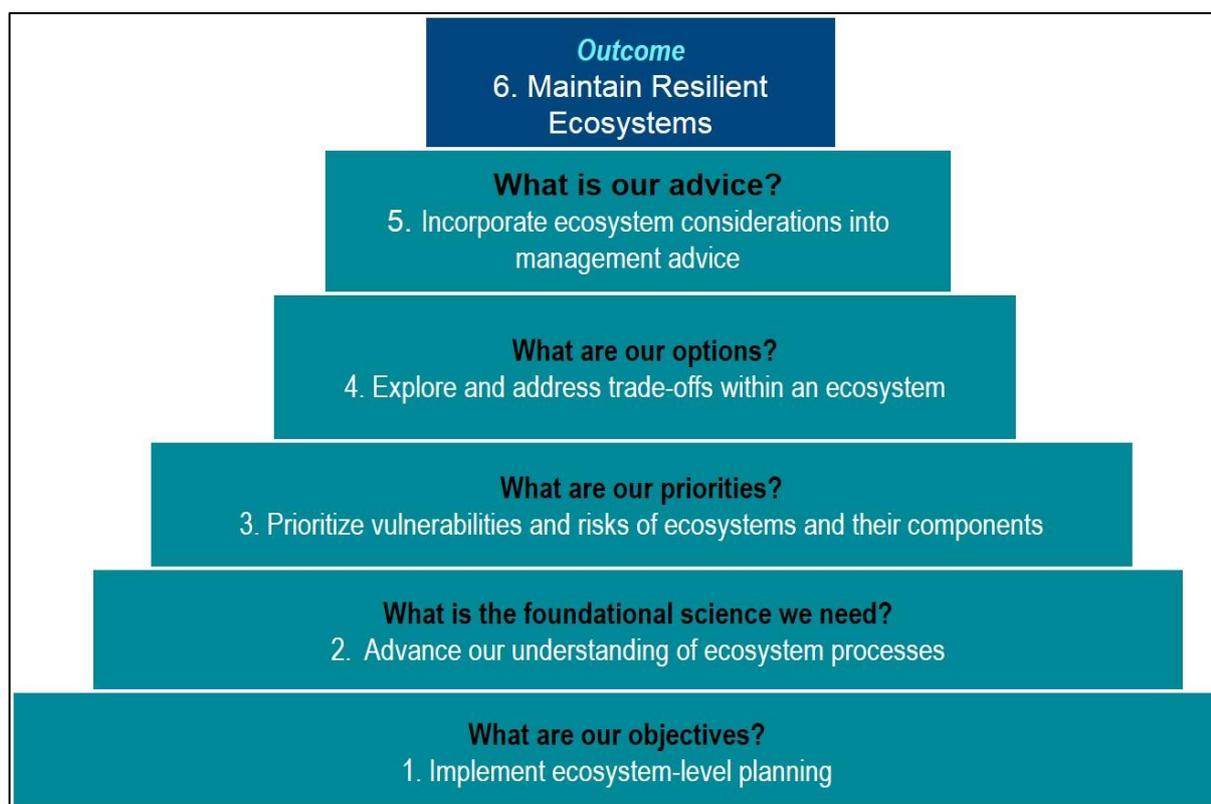


Figure 10: Illustration of the interconnected and interdependent nature of the major EBFM guiding principles (from NOAA’s 2016 Ecosystem-Based Fisheries Management Policy²⁹)

The six Guiding Principles (see Figure 10) from the Policy are expanded in the Road Map, with to include their associated core components, they are:

1. Implement ecosystem-level planning
 - Engagement Strategy
 - Fishery Ecosystem Plans
2. Advance our understanding of ecosystem processes

²⁹<http://www.nmfs.noaa.gov/op/pds/documents/01/01-120.pdf>

- Science to Understand Ecosystems
 - Ecosystem Status Reports
3. Prioritize vulnerabilities and risks to ecosystems and their components
 - Ecosystem-Level Risk Assessment
 - Managed Species, Habitats and Communities Risk Assessment
 4. Explore and address trade-offs within an ecosystem
 - Modeling Capacity for Trade-offs
 - Management Strategy Evaluations
 5. Incorporate ecosystem considerations into management advice
 - Ecosystem-Level Reference Points
 - Ecosystem Considerations for Living Marine Resources
 - Integrated Advice for Other Management Considerations
 6. Maintain resilient ecosystems
 - Resilience
 - Community Well Being

These Guiding Principles, and the core components contained within them, are the actionable steps for the implementation of EBFM within NOAA Fisheries. Ultimately, all factors affecting fisheries resources or affected by them need to be considered in a systematic manner in the science and management pertaining to these resources. These efforts will provide for a more effective approach to meeting mission objectives.

NOAA Fisheries will review and, as appropriate, update the Road Map every 5 years. This will enable NOAA Fisheries to meet further NOAA guidance on EBFM or as the needs of NOAA Fisheries and its partners evolve. Key to the successful implementation of EBFM will be trade-off analyses regarding prioritization of various activities in each region.

5. Barriers to EAF and EBFM implementation in t-RFMOs and potential solutions

Workshop participants discussed the barriers to EAF and EBFM implementation and potential solutions they are perceiving in their respective t-RFMOs

Table 2: Barriers to EAF and EBFM implementation in t-RFMOs and potential solutions

Issue	t-RFMO	Barrier	Solution
Structural: Is the organizational structure of the tRFMO conducive to supporting an EBFM framework and annual/ biennial assessments?			
Reference to ecosystem considerations in mandate	CCSBT	There is no explicit reference to EBFM in the CCSBT Convention, but there is reference to "ecologically related species" (ERS). The Extended Commission has recognised the opportunity to incorporate modern principles and/or standards of fisheries management (e.g. precautionary approach, EBM). The CCSBT Strategic Plan contains items that recognise the need to incorporate the EAF in the Convention text, the Commission's decisions, the Management Procedure, and other aspects of the Scientific Committee's work. Historical lack of consensus among members as to the role of CCSBT in addressing issues beyond those stated in its single objective to "ensure, through appropriate management, the conservation and optimum utilisation of southern bluefin tuna"	
	IATTC	EBFM is not explicitly stated in the Convention, but several components relate to the biological conservation of individual species and dependent species, and ecological sustainability.	Requires amendment of the Convention to explicitly detail EBFM objectives. This will require sign-on by all CPCs.
	ICCAT	Legacy structure: the organizational structure was established before the concept of ecosystem based fisheries management. Consider how best to adapt the existing structure.	Legacy structure: the organizational structure was established before the concept of ecosystem based fisheries management. Consider how best to adapt the existing structure.
	IOTC	The Agreement does not require that the Commission take into account of the impact of fishing on the broader ecosystem, nor the ecosystem itself.	In practice, many ecosystem considerations are already taken into account through a number of resolutions and the WPEB and SC, however, this could be more coordinated through a EBFM framework and dedicated ecosystems working group.
	WCPFC	No explicit description of the EBFM framework in the WCPFC. Article 6 of the Convention requests the impacts of fishing, other human activities and environmental factors on target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks.	Currently, several bycatch mitigation related conservation and management measures are in place but may need the Commission's decision/commitment on EBFM.
Specific group in place tasked with conducting ecosystem assessments	CCSBT	Ecologically Related Species Working Group (ERSWG) in place.	
	IATTC	'Ecosystem Group' tasked with undertaking ecosystem assessments, primarily Ecological Risk Assessment, periodic ecosystem modeling, and reporting of non-target species catches and mortalities (e.g. dolphins). However, the data for some fisheries (e.g. longline) is very poor for most CPCs. Primary problem is reporting catch of non target species, and species identification issues.	Improved data quality required for assessments to be meaningful to support EBFM, especially for longline. Reporting requires improved sign-on by CPCs and training.
	ICCAT	Sub-Committee on Ecosystems and Bycatch in place, but there is no defined plan in place that dictates how each part of the organization is supposed to support the ecosystem assessment.	Structural void: if you are dealing with bycatch and ecosystem issues, adding an annual/biennial ecosystem assessment is likely not possible. As you move through the EBFM design, implementation and maintenance phases the work/time commitment will change (hopefully decrease). Plan on getting help from contractors until the work load reaches a level that the existing ecosystem group can handle.
	IOTC	The IOTC WPEB is dedicated to dealing with all ecosystem and bycatch related issues, however, the group has a very broad mandate and an already large workload, despite dealing primarily with bycatch issues to-date. The meeting agenda is already tightly packed with many scientists straddling tRFMOs so adding additional meetings to the schedule may prove difficult.	WP dedicated to Ecosystem Considerations. If an additional annual ecosystems-focussed WP meeting is not possible, then an ad-hoc (not necessarily annual) or biennial working group might be created, or ecosystems could be rotated as a priority agenda item for the WPEB, as part of the assessment schedule.
	WCPFC	An Ecosystem and Bycatch Scientific Working Group (2005-2009) and an Ecosystem and Bycatch Mitigation Theme (since 2010) have been in place under the Scientific Committee. Independent assessments have been conducted mostly at bycatch species level, but no specific group is in place for ecosystem assessments as a whole.	Currently the Commission focuses on developing a harvest strategy framework for target species. The Commission may consider ecosystem assessments in the future.
Management objectives established	CCSBT	No specific objectives for ERS but mentioned under article 5, 8 & 9 of convention.	
	IATTC	EBFM objectives not established for ecosystem as a whole, but is for some components including target species (e.g. space-time closures for bigeye tuna) and dolphins (e.g. dolphin mortality limit).	Establishing management objectives for ecosystem will require well defined and valid indicators that are sensitive enough to detect major changes to allow managers to react.
	ICCAT		
	IOTC	Lack of clear operational management objectives.	Establish clear management objectives at the Commission Level
	WCPFC	No specific objectives for EBFM considered.	May consider EBFM after the current focus of developing harvest control rules and MSE for target species. The Scientific Committee however is considering approaches for the design and testing of ecosystem indicators.
Ecosystem and risk assessments	CCSBT	There are annual/biennial risk assessments in place.	
	IATTC	No strategic assessment plan in place.	An IATTC 5 year strategic plan, and a biennial plan for the Ecosystems group are currently in development where EBFM could be incorporated with approval from Commissioners.
	ICCAT	There is no group tasked with conducting the ecosystem assessments.	
	IOTC	Ecological Risk Assessment for shark and turtles were conducted in 2012-2013.	
	WCPFC	Several ecological risk assessments were conducted during 2005-2009.	Researches on ecosystem indicators be supported in due course.

Report – 2016 Joint Meeting of t-RFMOs on Implementation of Ecosystem Approach to Fisheries Management

Issue	t-RFMO	Barrier	Solution
Communication: Developing an EBFM framework and supporting an ecosystem assessment is a coordinated group effort.			
Engagement across sectors	CCSBT	ERSWG co-operate and liaise with relevant experts, scientists (from Convention parties and elsewhere) and inter-governmental and non-governmental organisations, in data collection and analysis on ERS	
	IATTC	Governance - who determines the level of investment of t-RFMOs in multiple use ecosystem(s)? T-RFMOs may be reluctant to act if other RFMOs and industries (e.g. shipping, oil & gas) don't act.	Needs to be a firm commitment from Commissions and overseen by the Director that EBFM is taken seriously. Extension of working groups and EBFM workshops beyond t-RFMOs.
	ICCAT	There is a dependence on other organizations for data related to bycatch, prey species and environmental factors, data not collected or maintained by the organization.	Work with NGOs to provide inputs and expertise.
	IOTC	No specific coordinated effort has been done at Commission level for the development of EBFM framework.	Work with other organisations to share knowledge and collate what information is available, eg., NGOs collecting information on ghost fishing nets. Use of available information such as lengths to develop size spectra indicators across multiple species
	WCPFC	No specific coordinated effort has been done at Commission level for the development of EBFM framework.	First of all, needs a firm decision/commitment on EBFM from the Commission
Engagement of managers	CCSBT		
	IATTC	There are significant political and financial considerations for implementing EBFM. 'Buy-in' needed from all members of the tRFMO and non tRFMOs to seriously pursue EBFM. Responsibilities often not clear.	Needs to be buy in from each CPC, but this will require significant additional funding at some stage to appoint social scientists and economists to the Secretariat.
	ICCAT	It is difficult to engage managers in the process of developing the content for the EBFM framework	Meetings with managers
	IOTC	Need for political will from CPCs to develop an EBFM framework	
	WCPFC	Differing views on managers' engagement – some members advocate the development of EBFM; others, while focusing on the current work plan, prefer to observe the progress of EBFM from other organizations.	Manager's awareness building on EBFM
Engagement across different working groups	CCSBT		
	IATTC	Level of engagement across working groups occurs, but success relates to the chair's ability or willingness to engage others. Engagement can also depend on funding available to bring in expertise from other RFMOs.	Recent IATTC review identified that collaboration could be improved both within the IATTC staff and externally. A 5 year strategic plan is in development that will address such issues.
	ICCAT	It is difficult to engage working group chairs in the process of developing the content for the framework. Species working groups operate in silos with no formal mechanism for crosstalk with each other or the group responsible for the ecosystem assessment. There is no Commission level directive on EBFM that obligates the entire organization to produce and populate a framework.	Meetings with WG chairs: usually hard to get all chairs together except at the annual meeting. Crosstalk and feedback loop: at WG meetings it should be possible to review inputs from other groups internal or external. Likewise, the response to these inputs and outputs targeting other groups can be relayed through the report. This would require each chair checking the reports of other WGs for text to be reviewed at the next meeting. Clear directive from Commission on responsibilities and workflows.
	IOTC	Working Parties operate relatively independently with little interaction except through the SC	More collaborative projects across WPs and improved dialogue among WP Chairs
	WCPFC	Not applicable	
Data: Issues related to data sources, availability, quality and access.			
Data quality and availability	CCSBT		
	IATTC	Basic catch and size data available for a few principal target species, but data lacking for many bycatch species. Low observer coverage (5%) and poor data reporting from the longline fishery. Lack of data collection for artisanal fisheries that are increasingly operating as an industrial fishery. No data collection programs for species groups that do not interact with fisheries (e.g. prey of target species, mesopelagics, primary producers).	Improve resources for the observer program to increase monitoring of more species and detailed catch and size information. Increase observer coverage on longline vessels and amend current data reporting requirements by CPCs. If observers program expanded, some species may be monitored, e.g. seabirds. Develop a sampling program of artisanal fisheries to at least begin to understand the fleet size, capacity, gear types and catch.
	ICCAT	Poor reporting for some species from some CPCs. There is no accepted format for the data. There is a dependence on other organizations for data related to bycatch, prey species and environmental factors, data not collected or maintained by the organization	Proceed with what is available and make sure the report card is sensitive to the deficiencies.
	IOTC	Many CPCs have not yet implemented observer programmes, particularly the gillnet fleets which are thought to have some of the greatest ecosystem impacts. Data reported on bycatch species is very limited, particularly for discards, with the exception of some species that are also targeted and retained (eg blue shark). Artisanal fisheries are responsible for the majority of the catch (and bycatch from the gillnet fleets) but have poorest data collection and reporting systems.	Better resourcing for observer programmes. Clearer guidelines developed for the reporting of discarded species recorded in logbooks. Explore possibilities of electronic monitoring and fisher self-sampling for artisanal fleets where vessels are too small for onboard observation.
	WCPFC	Observer data are the best source of information, with catch of non-target species reported and size data for some non-target species also collected. The observer coverage in the purse seine fishery is 100% but only since 2010 and coverage in the longline fishery is only 5%. There are very few non-target data available for the other industrial gear types (e.g. pole-and-line). Data for the artisanal, small-scale fisheries is generally lacking, although some countries collect non-target species catches at points of landing.	Increase coverage for longline observer programmes. Provide better resources for observer programmes. Enhance the monitoring of species of special interest where required. Investigate what might be the most efficient data collection systems to obtain estimates of non-target species in the other fisheries (pole-and-line and small-scale/artisanal fisheries).
Data access	CCSBT		
	IATTC	IATTC secretariat provided with complete logbook and observer data by CPCs in March each year. Purse seine data is generally excellent, but quality of longline data is very poor for most CPCs, despite many collecting high quality observer data. For example, sea bird, turtle, and marine mammal captures/interactions not reported to IATTC.	Improved cooperation with CPCs required ensure complete datasets are made available to the IATTC in order for ecosystem assessments to be made.
	ICCAT	Outputs and inputs of stock and risk assessments are not generally available. There is no central repository for the data. No one is responsible for managing the data.	Establish data sharing agreements and link to the data. Assign a data rapporteur to copy products to repository. Hopefully each organization has sufficient space. Another crucial component that will facilitate scripted report generation. Don't want to overburden the existing DB manager but it is crucial that an employee of the secretariat is tasked with this responsibility
	IOTC		
	WCPFC		

Report – 2016 Joint Meeting of t-RFMOs on Implementation of Ecosystem Approach to Fisheries Management

Issue	t-RFMO	Barrier	Solution
Socio-economic data	CCSBT		
	IATTC	No data collection programs in place by IATTC or CPCs for social or detailed economic data.	Increase dialogue with CPCs to determine what social and economic data is needed and what can feasibly be collected to support EBFM.
	ICCAT		
	IOTC	Very limited reporting of economic data and no social data are reported	Initiate the discussion of what social and economic data would be useful for managers. Incorporate the reporting of basic economic and social information within the Resolutions on data recording and reporting (15/01 & 15/02)
	WCPFC	No formal requirement to provide socio-economic data, although some economic data may be a WCPFC requirement in the future.	Obtain an indication of the requirements for socio-economic data, including the practicalities for obtaining reliable information, and go from there
Capacity: Issues with the ability of staff and associated researchers to perform task.			
Lack of expertise and human resources	CCSBT	Too early to say what impediments might be encountered within the CCSBT in developing and implementing any EBFM framework	
	IATTC	Although IATTC has ecological research staff that can be dedicated to EBFM research and implementation, there is no social or economic expertise.	Appointment of a social scientist and fishery economist, or 'share' such staff between tRFMOs.
	ICCAT	Lack of manpower to populate framework, conduct assessment and produce report. Lack of expertise to develop indicators and interpret them. Time constraints in the dedicated working group.	Expertise: inviting experts to your ecosystem will not have the same impact as creating functional groups which include these experts on a more continuous basis. Manpower: do not attempt to move forward without proper support or a strategy for transitioning to the operational state. Time on task: to speed development and implementation, involve the secretariat or hire someone. More meetings or a single longer meeting take time from other commitments.
	IOTC	Even within the WPEB there is a current lack of expertise on EBFM and critical mass to drive the process and maintain momentum. Lack of staff at IOTC and researchers from Member states dedicated to working on EBFM. The Secretariat is very small so a new position dedicated entirely to EBFM is unlikely to prove popular unless there is strong commitment by the Commission.	Selection of invited experts with experience in EBFM. Data collection and capacity building – Commission/CPCs level; EBFM needs to be considered a priority by the Commission in order to recruit new staff with relevant expertise at the Secretariat or to set agenda items at WP meetings to ensure that Member scientists begin working on the development of indicators
	WCPFC	The Secretariat has no capacity to perform EAFM-related tasks. The Commission's scientific services provider (SPC-OPF) and neighboring agencies such as FFA have some level of capacity to develop EBFM but associated key resource issues are funding, time, and access to data.	Premature to consider solutions.
Complexity of the issue	CCSBT		
	IATTC	Ecosystem issues may be viewed by commissions as too complex, expensive and time consuming to tackle on top of target species issues and other political and economic drivers (e.g. MSC certification of FAD/dolphin sets)	Priorities of the Commission may change if other t-RMFOs make EBFM a priority.
	ICCAT		
	IOTC	Difficulties to develop and run models.	
	WCPFC	EBFM itself is very broad and complex to cover all relevant species and environmental factors.	Prioritize and limit the boundary
Financial: Issues with resources to makes organizational changes, update infrastructure, hire expertise.			
Funding	CCSBT		
	IATTC	Available t-RMFO funding barely covers basic tuna research and management activities, so it may be difficult to appoint additional staff at this point to address management issues that are not an explicit part of the Convention.	If expert staff (e.g. social scientist and fishery economist) are deemed to be critical for the success implementation of EBFM it may be possible for tRFMOs to jointly appoint or 'share' such staff if similar tasks are being undertaken in each RMFO. Increase levies on CPCs to be part of the Commission. May be possible to appoint 1-2 staff, but unlikely to be able to support EBFM teams and the variety of research and management activities required to implement EBFM.
	ICCAT	No funds available for EBFM work.	No funds: ask FAO for help
	IOTC		EBFM may be incorporated into another broader science role at the IOTC Secretariat or as part of a 'shared' role across tRFMOs
	WCPFC	No funds available for EBFM work.	Financial issues, including organizational changes, update infrastructure, hire expertise can be considered subject to the Commission's decision on EBFM

Issue	t-RFMO	Barrier	Solution
Indicators: Issues related to providing appropriate indicators of element (habitat, trophic level, species) status.			
Development of indicators and reference points at the appropriate level	CCSBT	No indicators or reference points have been agreed for any ecosystem components	
	IATTC	Require robust and ecologically meaningful indicators and/or reference points that describe ecosystem structure and function and incorporate diversity and connectedness measures.	There are many examples from the terrestrial world where indicators have been developed for data-poor rare or endangered species. A serious attempt at looking "outside the box" of fisheries science may be needed now to look for synergies. Reliable indicators may be developed experimentally using desktop models to be consistent across all RFMOs.
	ICCAT	Indicators for target species just reflect what is conveyed in the single species assessment. Relevant indicator for bycatch species is not known. No clear way to reflect status of habitat. No clear way to reflect trends in trophic relationships.	Having an element in the framework for a target species ensures it can be involved in integrated analyses and also clearly demonstrates the objectives with respect to it. Deficiencies in any part of the statement of objectives become obvious should elicit action. Work with NGOs to provide inputs and expertise. No habitat and trophic relationship indicators: http://www.indiseas.org/
	IOTC	Indicators must be accurate and rapid enough to allow for repeat application consistent with the frequency required by managers. Timeliness of data will impact the usefulness of indicators for management. Difficulties in producing synthesised social and economic indicators at the ocean level when these will be highly variable across Member nations. Indicators that are time relative should also incorporate baseline levels to avoid shifting baselines syndrome	Balance may need to be struck between precision and development time for indicators
	WCPFC	A range of candidate ecosystem indicators were developed and proposed for use by the WCPFC but specific design and testing of indicators were not yet progressed.	This work requires resources/funding support.
Data poor situations	CCSBT		
	IATTC	Difficulty in developing reliable, quantitative and repeatable indicators or reference points for data poor species. Many species aren't even recorded by observers, or at least numbers caught.	Most ecosystem models produce a range of indicators. Experimental work needed on a single ecosystem but use different models to determine indicators common to all approaches.
	ICCAT	Need an indicator for data poor species. No life history parameters exist on which to base an indicator.	Develop length based indicators if life history parameters exist (Froese_Simple indicators.pdf). Use DLM toolkit package in R to estimate historical biomass trends given guesses at level of depletion, trend in removals and reasonable bounds on life history parameters.
	IOTC	Many species are data-poor with little information collected on habitats or trophic interactions	Work with other organisations to share knowledge and collate what information is available, eg., NGOs collecting information on ghost fishing nets. Use of available information such as lengths to develop size spectra indicators across multiple species
	WCPFC	There will be a range of indicators which can be developed from existing data, but a broad range of data should be collected, quality be improved and range be expanded.	A broad range of data can be obtained from data sharing with other agencies, CCM's cooperation, higher observer coverage, funding resources, etc.
Lack of clear definitions beyond species	CCSBT		
	IATTC	How are "habitats" defined? Do we use the same definitions in each tRFMO for consistency?	Consider use of Longhurst regions? Or consider developing pelagic-specific habitats/bioregions that align with Longhurst?
	ICCAT	Need a reference level for indicators with no accepted definition. Difficult determining which environmental factors have a causal relationship with the status indicator	Consider using the approach described in the Benchmarking ecological indicators.pdf which is "A benchmarking and assessment framework to operationalise ecological indicators based on time series analysis" Empirical dynamic modeling (R package rEDM) provides a tool for separating correlation from causation (http://www.pnas.org/content/112/13/E1569.full.pdf).
	IOTC	Difficulties in producing synthesised social and economic indicators at the ocean level when these will be highly variable across Member nations.	
	WCPFC	Not considered at Commission level	

Report – 2016 Joint Meeting of t-RFMOs on Implementation of Ecosystem Approach to Fisheries Management

Issue	t-RFMO	Barrier	Solution
Framework and Report card: Issues related to defining the structure of the framework and content of the Report card			
Framing the issue	CCSBT	There is no overall framework for EBFM implementation other than the measures contained in the Strategic Plan. There are specific reporting requirements for members but no elements of these that specifically concern ecosystem components	
	IATTC	Robust indicators are required before a report card can be developed for ongoing assessments. Fishery performance can be difficult to determine with changes in management strategies through time.	A report card may be developed with simple indicators already used such as trophic level of the catch, diversity of the catch etc. This may at least draw some attention to the need for more specific indicators to support EBFM assessment.
	ICCAT	Issues related to defining the structure of the framework and content of the Report card. Difficulty translating the content of the framework into a report card because it's not clear what the reporting objectives are and who the audience is. Not clear what ecosystem/s should be reported on.	Spatial extent of framework and reporting: Start with a large spatial extent and make adjustments when necessary and if the data can support it.
	IOTC	Report card may focus on where information is available rather than what is most important.	Report card should encompass all aspects seen as potentially high-risk, even if there is limited information, to highlight the need for data collection and research on the topic and the need for careful management consideration
	WCPFC	Framework and Report Card: Not considered yet	
Clear messaging and readability	CCSBT		
	IATTC	Managers may find ecological indicators/reference points difficult to interpret (e.g. Kempton's Q, or Fishing in Balance index).	Attempt to present established indicator in an easily interpretable form, similar to a Kobe plot used for stock assessment. Report card should show a timeline of indicator values to aid interpretation of performance. Showing changes in management strategies on the timeline may further assist understanding indicator values.
	ICCAT	Confusion over the relationship to MSE, single and multispecies stock assessments and effect on TAC	MSE may help to set target and limit reference points, SSA may incorporate environmental effects, dependencies identified by report
	IOTC	Indicators need to clearly convey the level of uncertainty and associated risk	Methods familiar to managers, such as those used for stock assessments, could be used to improve understanding
	WCPFC	Framework and Report Card: Not considered yet	
Boundaries	CCSBT		
	IATTC	Although boundaries of the Convention Area easy to determine, the extent of ecosystems is not as they vary through time and 'spill' into other RMFOs.	Adjacent t-RMFOs should ideally develop the same (or similar) indicators and report card framework to take into account the full extent of fished ecosystems, and not be restricted to Convention Area boundaries.
	ICCAT	Stock boundaries are species specific and constrain how the data are reported. How to deal with highly migratory pelagic species that frequent multiple ecosystems.	Start with an area too big for the species to migrate out of. Use length based indicators based on removals from 5x5 squares. Borrow an existing format and modify (Gulf of Mexico Ecosystem Status Report.pdf, Koeller_traffic light.pdf or http://access.afsc.noaa.gov/reem/ecoweb/Index.php?ID=0). Ensure that relevant features of the ecosystem assessment are incorporated in the single species stock assessments.
	IOTC		Explore appropriate levels and methods of aggregation to flag issues as they arise without creating undue complexity in the report card
	WCPFC	Framework and Report Card: Not considered yet	

6. Draft conceptual guidance for EAF and EBFM

6.1 Themes and components to be considered for inclusion

During the workshop participants started to collect some ideas on proposed main themes and components for inclusion into t-RFMO EAF and EBFM frameworks as shown in Table 3.

Table 3: Proposed themes and components to be considered for inclusion t-RFMO EAF and EBFM frameworks

Component	Sub-component	Examples of conceptual objectives	Elements
Ecological theme			
Retained species	Target species	Maintain target stock biomass at or above levels that provide stock sustainability throughout their range.	e.g. Bluefin tuna
	Non-target species	Maintain non-target stock biomass at or above levels that provide stock sustainability throughout their range.	e.g. other finfish species
Non-retained species	Protected species	Reduce catch and minimize interactions with protected species to the extent possible	e.g. seabirds
	other discards	Reduce catch and minimize interactions with discard species to the extent possible	
Ecosystem structure and function (excluding habitat)		Maintain ecosystem functions	
Habitat		Maintain essential fish habitat	
		Reduce pollution caused by authorized fishing vessels	
Economic theme			
Profitability		Maximize economic yield and economic health from the fishery	
		Increase fisheries-based development within developing states (SIDS) economies, especially on-shore processing capacity.	
		Maintain acceptable CPUE	
		Optimize fishing effort	
		Maximize SIDS revenues from resource rents	
Stability		Catch stability	
		Stability and continuity of market supply	
Capacity		Optimize capacity	
		Minimize adverse economic impacts on fishing communities	
		Maintain/develop domestic fishery	

Social theme			
Stability		Stability and continuity of market supply	
		Food security in developing states (import replacement)	
		Affordable protein for coastal communities	
		Avoid adverse impacts on subsistence and small scale fishers	
Employment		Provide employment opportunities	
		Human resource development	
		Maximize social happiness	
Consultation		Use of traditional and local knowledge	
Crew welfare			
Governance theme			
Efficiency			
Effectiveness			
Inclusiveness			
Cooperation			
Equity			
Compliance			
Capacity/HR			
Monitoring and reporting			
Management Plan			
Legislation			
Treaties			
Consultation			

6.2 Operational objectives for consideration

Workshop participants proposed a draft set of operational objectives for consideration by the t-RFMOs as shown in Table 4. Participants recognized that EAF and EBFM are management tools and managers will need to be the drivers of the process. This is particularly important for determining operational objectives.

Table 4: Draft set of operational objectives discussed during the meeting for consideration by the respective tuna Commissions

Ecological theme
Minimize stock falling below B_{lim}
Minimize stock falling below B_{MSY}
Minimize fishery impacts on ecosystem
Maintain SKJ (and YFT & BET) biomass at or above levels that provide fishery sustainability throughout their range
Minimize bycatch
Maintain albacore (and SWO, YFT & BET) biomass at or above levels that provide stock sustainability throughout their range.
Maintain trophic relationships
Economic theme
Maximize yield
Maximize profit
Maximize economic health
Maximize economic yield from the fishery
Increase fisheries-based development within developing states (SIDS) economies, especially on-shore processing capacity.
Maintain acceptable CPUE
Optimize fishing effort
Maximize SIDS revenues from resource rents
Catch stability
Stability and continuity of market supply
Optimize capacity

Social theme
Stability and continuity of market supply
Food security in developing states (import replacement)
Avoid adverse impacts on small scale fishers
Employment opportunities
Affordable protein for coastal communities
Maintain/develop domestic fishery
Human resource development
Avoid adverse impacts on subsistence and small scale fishers
Maximize employment
Maximise social 'happiness', well being or quality of life
Food security
Equity
Governance theme
Efficiency
Effectiveness
Inclusiveness
Promote cooperation amongst members
Equity
Compliance
Capacity to conduct its work

7. Conclusions and next steps

7.1 Main conclusions from the workshop

- a. A common definition and understanding of how to operationalize EAF and EBFM in the context of tuna fisheries management and conservation will be key before developing further steps. Current discussions focus mostly on the ecological component of EAF and EBFM, and the socio-economic considerations are often left out.
- b. Several international instruments such as the 1995 Code of Conduct for Responsible Fisheries (CCRF), inherited from the 1982 Convention on the Law of the Sea (UNCLOS), the 1992 United Nations Conference on Environment and Development (UNCED), and the 1992 Convention on Biological Diversity (CBD) require to increasingly bring ecosystem considerations into fisheries management decision-making.
- c. EAF and EBFM are mostly management tools and can only be initiated at a Commission level. The process cannot be delegated for completion by the Scientific Committee or dedicated technical sub-committees or working groups. It requires identification of explicit objectives. The process will, however, be informed by science and will be an iterative process among the different groups.

EAF and EBFM in the context of t-RFMOs

- d. Most examples for EAF and EBFM implementation are currently at the national level, implementation, in particular stakeholder consultations and prioritization exercises, are expected to become more complex in a multilateral framework with limited time for meetings. However, cases of EAF and EBFM implementation in a multilateral framework exist as is the case of the Convention for the Conservation of Antarctic Marine Living Resources.
- e. The lack or ambiguity of mandates for non-target species might be an issue in some t-RFMOs.
- f. Unlike in a domestic situation, the areas over which the t-RFMOs have jurisdiction are large and span multiple national jurisdictions (EEZs) as well as areas beyond national jurisdiction leading to complex stakeholder relationships which can constrain the nature and effectiveness of management actions.
- g. Decision making within a t-RFMO is subject to the approval of multiple contracting parties (in ICCAT there are 51) which affects the speed of plan implementation and actions defined within it.
- h. While in most cases, the mandate of the Commissions don't explicitly exclude looking at other ecosystem components (i.e., socio-economic and governance issues), they typically translate into an ecological bias with a focus on conserving target and bycatch species.

- i. Whereas socio-economic considerations are behind all fishing activities and decision-making processes, they are often neglected in terms of data collection. The focus is currently on target species and to some extent, on bycatch.
- j. Participants recognized the particular structure of CCSBT being mandated with the management of a single species present in the areas of different RFMOs.
- k. In a multilateral context, many discussions and consultations will still need to take place at the national level. At the RFMO level, the process might prioritize issues, which can support decision-making at the national level.
- l. A review of progress EBFM implementation in the five t-RFMOs showed that many elements required for EBFM implementation, are already in place, but rather working in isolation instead of in a holistic and integrative manner.
- m. For the paper presented by Juan-Jordá, participants welcomed the visual way of presenting the progress already achieved. Some participants questioned the rating scheme highlighting that negative ratings for certain taxonomic groups of bycatch species do not necessarily imply that there is a high risk or that no action is being taken (this was raised in particular for CCSBT where some non-target groups that are impacted by other tuna fisheries are unaffected by the southern Bluefin tuna fishery).

The role of data, science and communications

- n. Scientists will need to find a tangible and effective way of communicating and visualizing EAF and EBFM concepts to commissioners and to support the process subject to the needs of the managers.
- o. EAF and EBFM implementation will be a stepwise requiring improved communications between the groups tasked with technical matters in the different RFMOs.
- p. Working parties are often facing time constraints due to large numbers of thematic issues they have to deal with. Thematic splits and re-arrangements might be required in some cases. EAF and EBFM implementation will likely require additional expertise and increased cross-sectoral collaboration. Initially, some extra work and funding will be required to establish the process, but this is expected to be a one-time investment which should not be required once a routine has been developed.
- q. Ecosystem report cards could be considered as a tool to facilitate communication of the status of the components contained within the themes of the EAF and EBFM frameworks. It can reflect the interdependencies between species (e.g. those species caught in association should be managed as such) or simply report the impacts of fleets and/or gear groups on species within regions. For example, if one species in a multi-species fishery (Figure 7 illustrates the concept) has a problem, the resulting management action will need to act upon all the associated species.

- r. Selection of appropriate boundaries for a bioregion can be based on abiotic factors, stock boundaries, or other ecological factors, as appropriate, and can be adjusted at later stages.
- s. There was some discussion regarding unpacking issues vs. looking at higher levels. There was a general recommendation to keep the level as high as possible (e.g. looking at species groups which are affected simultaneously by certain management actions), and separate when needed.
- t. Information and data collection efforts need to be aligned with their relevance for management. Focus on high risk and high value issues. Data needs will not necessarily increase under EAF and EBFM implementation, but become more focused on priority issues and facilitation of management decisions.
- u. Indicators for ecosystem properties do not necessarily have to be complicated or require huge amounts of additional data collection. But for most t-RMFOs there will be a need for dedicated validation work to ensure the indicators measure the intended constructs, and are sensitive enough to detect moderate changes in desirable constructs.

7.2 Areas for collaboration between t-RFMOs

Meeting participants identified several topics would benefit from collaboration among t-RMFOs, in particular:

- a. Definition and understanding of how to operationalize EAF and EBFM in the context of tuna fisheries management and conservation;
- b. Tools for communicating and visualizing EAF and EBFM concepts;
- c. Selection of appropriate boundaries for bioregions;
- d. Information and data collection efforts;
- e. Indicators for ecosystem properties.

Finally, joint discussions during the design and implementation of EAF and EBFM plans would facilitate cooperation across t-RFMOs.

EAF and EBFM could be part of the agenda of a future Kobe meeting (tentatively planned for 2018). A joint working group to deal with EAF and EBFM issues (similar to the ones on MSE, FADs, bycatch) could be a way to formalize collaboration between t-RFMOs to work on common elements.

7.3 Draft work plan for EAF and EBFM implementation including elements of communication with the Commission

The way forward

- a. Bringing EAF and EBFM to the attention of decision makers in the respective Commissions and getting their commitment was considered crucial in moving forward towards EAF and EBFM implementation. Managers will need to be the drivers of the process. EAF and EBFM are first and foremost management processes. Furthermore, being risk-based it has the potential to generate cost efficiencies by identifying which activities are needed or if some could be done more efficiently such as by using an “indicator species” approach and also adjusting monitoring scope, scale and intensity based on risk.
- b. Action will need to focus on high risk issues in line with established operational objectives.
- c. Similarities of the EAF and EBFM frameworks with the management procedures/harvest strategies emerged during the discussions. It was recognized that it might be a good point in time to start these discussions as commissioners are becoming more familiar with these types of iterative processes and flexible decision-making frameworks.
- d. Science-management dialogues, which are already established in t-RFMOs to convey scientific findings to managers could be used as a forum to discuss EAF and EBFM matters as is already happening in ICCAT and IATTC.
- e. Participants worked on a table to show opportunities to progress EAF and EBFM at the level of each t-RFMO (Table 5). Identifying champions in each Commission was considered a key factor for future progress.
- f. The Common Oceans ABNJ Tuna Project pledged its support for an additional meeting, tentatively in Mid December 2017 or beginning of 2018. This meeting might need to be different in terms of participants engaging commissioners. Participants proposed a three day meeting (including one or two days with commissioners and one additional day for scientist to process and elaborate).

Table 5: Schedule of 2017 meetings/activities and that may offer the opportunity to advance the process of implementing EAF and EBFM during 2017 focusing on the ecosystem element

RFMO	Meeting/Activity	Date	Input related to EBFM	Notes
ICCAT	Meeting of Standing Working Group on Dialogue between Managers and Scientists	June 2017	Two agenda items: 7. Outcomes of the 2016 Joint Meeting of t-RFMOs on the Implementation of EAFM; 8. Development of a draft road map to implement EBFM, including roles and responsibilities	Roadmap may include how the Common Oceans ABNJ Tuna Project may help in implementing the roadmap activities, (capacity building, further dialog meetings)
ICCAT	Meeting of convention Amendment	June 2017	Possible adoption of new Convention text which expands scope of convention to ecosystem impacts: "....protect biodiversity in the marine environment; (d) [consider the impacts of fishing, other relevant human activities, and environmental factors on target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks within the Convention area];"	Text has been, in principle agreed, however adoption of amendment is blocked by the lack of consensus on a few other sections of the amended text
ICCAT	Meeting of subcommittee of Ecosystems	July 2017	1) Advance work on Ecosystem Report Card; 2) Implement new mechanisms or improve current mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the SCRS Working Groups	-
ICCAT	Meeting of SCRS Plenary	October 2017	1) Midterm review of advancements towards reaching objectives of ICCAT Strategic Research Plan (there are a few objectives related to EBFM) 2) SCRS review of 2nd ICCAT performance review	-
ICCAT	Annual meeting of the Commission	November 2017	Consider input from SCRS and Commission Intersessional meetings related to EBFM	-
IOTC	Technical Committee on Management Procedures	May 2017	2 items: SC 2016 Report including Ecosystem Report Card Outcomes of the 2016 Joint Meeting of t-RFMOs on the Implementation of EAFM	-
IOTC	IOTC Commission	May 2017	2 items: SC 2016 Report including Ecosystem Report Card Outcomes of the 2016 Joint Meeting of t-RFMOs on the Implementation of EAFM	-

RFMO	Meeting/Activity	Date	Input related to EBFM	Notes
IOTC	WP Ecosystem and Bycatch	September-2017	1) Advance work on Ecosystem Report Card; 2) roadmap for the practical implementation of the EBFM in IOTC, 3) implement new mechanisms or improve current mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the SC Working Groups	-
IOTC	IOT Scientific Committee	November-2017	1) Present an Ecosystem Report Card for IOTC; 2) roadmap for the practical implementation of the EBFM in IOTC, 3) inclusion of EBFM in the Science Strategic Plan	-
CCSBT	Meeting of the Ecologically Related Species Workong Group	21-23 March 2017	Presentation by Chair on outcomes of 2016 Joint Meeting of t-RFMOs on the Implementation of EAFM	
CCSBT	Meeting of Extended Commission	9-12 October 2017	Presentation by Chair of ERSWG report to the EC; Discussion of EBFM related items on Strategic Plan	-
IATTC	8th Meeting of the Scientific Advisory Committee	8-12 May 2017	One agenda item with several papers presented: Ecosystem considerations; Ecological Risk Assessment methodology comparison, preliminary ERA for longline fishery in the eastern Pacific Ocean, outcomes of the 2016 Joint Meeting of t-RFMOs on the Implementation of EAFM	-
IATTC	92nd Meeting of the IATTC	17-28 July 2017	Two agenda items: Report and recommendations of the 8th meeting of the Scientific Advisory Committee Conservation recommendations by the Commission staff	-
WCPFC	13th Scientific Committee	9-17 August	Post Joint Meeting of t-RFMOs on the Implementation of EAFM report if available on the SC website as an information paper	-

Annex 1: List of participants

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