ECOSYSTEM APPROACH TO FISHERIES: A BRIEF OVERVIEW AND SOME CONSIDERATIONS FOR ITS APPLICATION IN ICCAT

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SUMMARY

During the last SCRS plenary meeting, the sub-committee on environment suggested to present a document on the 'Ecosystem Approach to Fisheries' (EAF). This document firstly recalls the general scientific and institutional background of EAF, then we propose a synoptic view of EAF, including four main domains: governance, exploitation, resources and impacts on ecosystems. The way that EAF is tackled within the various tuna commissions is then summarised. Finally, we rapidly examine the way the SCRS could cope with EAF issues and we suggest to merge the sub-committee on environment with this on by-catch into a single sub-committee on ecosystem.

RESUME

A la suite de la dernière réunion plénière du SCRS, le sous-comité pour l'environnement avait proposé de présenter un document de synthèse sur l'approche écosystémique des pêches (EAF). Après un rappel des contextes scientifique et institutionnel, nous proposons une vision synoptique de l'EAF basée sur 4 grands domaines : la gouvernance, l'exploitation, les ressources et les impacts sur les écosystèmes. La façon dont l'EAF est abordée par les différentes commissions thonières est ensuite résumée. Le document se termine sur la manière dont le SCRS pourrait aborder ces questions et nous suggérons une fusion des sous-comités pour l'environnement et des prises accessoires en un 'grand' sous-comité écosystémique.

RESUMEN

*Durante la última reunión plenaria del SCRS, el Subcomité de medio ambiente propuso presentar un documento sobre el enfoque ecosistémico de la pesca (*Ecosystem Approach to Fisheries, EAF*). En este documento, tras una revisión de los contextos científico e institucional, proponemos una visión sinóptica del EAF basada en cuatro grandes campos: gobernanza, explotación, recursos e impactos en el ecosistema. A continuación, se resume el modo en que las diferentes comisiones atuneras abordan el EAF. El documento termina examinado el modo en que el SCRS podría abordar estas cuestiones y sugerimos una fusión de los Subcomités de medio ambiente y de capturas fortuitas en un "gran" subcomité ecosistémico.*

KEYWORDS

Ecosystem; resources; exploitation; governance; environment; by-catch

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1 Background and purpose

Despite the lack of universally-agreed definitions, terms such as "ecosystem based management" (EBM) and "ecosystem approach to fisheries" (EAF) are being used with increasing frequency in national and international fisheries fora. A common underpinning of the terms implies an understanding of extremely complex interactions: that ecosystem processes and social and economic forces affect fisheries, and that fisheries impact the ecosystem beyond the target resources.

Because of the complexity and multidisciplinary nature of the issues involved, there have been few cases in which EBM or EAF have been attempted in an operational manner. In spite of this paucity of examples, it may be useful for ICCAT to begin to take steps towards evaluating how an EAF could be embraced. The purpose of this paper is to provide a brief overview of the current thinking regarding EAF, giving consideration to tuna fisheries and tuna ecosystems. In addition, the paper provides a proposal for a change to the current structure of the SCRS which should better enable it to tackle the scientific and monitoring aspects of EAF.

2 General context of the EAF

2.1 The General Background

Since the 1950s, worldwide exploitation of natural marine resources tremendously increased following the rapid development in fisheries techniques (such as storage and positioning and prospecting equipments, gears, etc.) and a sharp expansion in both fishing areas and fishing capacity (Hilborn, et al. 2003, FAO 2004). Global fisheries production reached its maximum in the early 1990s. Since then, there is a stagnation of the yields worldwide. However, the proportion of fully exploited, overfished and depleted stocks of high commercial values also augmented during the last decades. This general observation is widely accepted in the scientific community and has been documented in several FAO reports (e.g. FAO 2002, FAO 2004). Issues regarding the sustainability of the exploitation of marine resources, especially in a general context of increasing demand for marine products and increasing human population along the coasts, have been therefore stressed (Delgado, et al. 2003, Garcia and Grainger 2005). Furthermore, the strong development of (marine) aquaculture, following the increasing gap between the demand and fisheries production, still remains largely dependent on the fisheries products (e.g. for fish meal, Garcia and Grainger 2005).

Despite constant effort made to regulate fisheries by local or central administrations, the fishing capacity remains nowadays largely above what would be necessary to exploit marine resources in a sustainable way, especially in developed countries. Most of the current management regulations, often based on TAC (Total Allowed Catch) and complementary technical measures, have indeed failed to avoid overexploitation and overcapacity in many cases (often because of poor governance, FAO 2004). Furthermore, other human activities, such as exploitation of fossil sources of energy, dumping of industries through rivers, urban development along the coast, tourism, transport, aquaculture, also strongly impact marine ecosystems. Such activities affect directly (e.g. competition for space) and indirectly (e.g. pollutions) marine exploited resources and the functioning of the exploited ecosystems. The sustainability of exploited populations and marine ecosystems, thus, implies substantial changes in incentives and governance, but also in the way that fisheries research and monitoring and expertise are conducted (Bosford, et al. 1997, Pauly, et al. 2002, Garcia and de Leiva Moreno 2003, Hilborn, et al. 2005).

2.2 The Scientific Backgound

Although research in fisheries science has always included some basics of ecology and economics (see e.g. Hjort 1914, Hjort 1926, Ricker 1954, Beverton and Holt 1957, Cushing 1975, Cushing 1982), it has considerably expanded its scope since about 20 years ago, moving from a single stock focus to a view integrating various components of the ecosystems (Larkin 1996). Doing so, fisheries science integrates more and more knowledge from other disciplines, such as molecular biology and genetics (for instance studying the loss of genetic diversity within exploited populations, see Birkeland and Dayton 2005), ecology, oceanography, economics and social sciences. This movement results from the willingness to better understand the dynamics of exploited populations, but also to take into account the fishing effects on: unexploited (or non-targeting) species, diversity of marine ecosystems, biodiversity within each ecosystem, habitat quality and quantity, trophic interactions and other uses of marine ecosystems (Gislason, et al. 2000).

The impact of « *top-down* » or « *bottom-up* » processes on dynamics of exploited populations and ecosystems lead to an increasing number of studies gathering fisheries scientists together with ecologists and oceanographers (Larkin 1996). Uncertainties related to environmental stochasticity, climate change further add another level of complexity to this type of research. Coping with uncertainty in scientific advice (Harwood and Stokes 2003) has also induced a drastic change in the way that stock assessment advice for management is transmitted to stakeholders and finally led to the concept of the precautionary approach to fisheries (FAO 1995). The failure of many governance systems has also led to research for studying the responses of exploitation and management to modifications of ecological, economical and institutional situations (Garcia and de leiva Moreno 2003, Hilborn, et al. 2003, Hilborn, et al. 2005).

However, even if operational tools for assessing single stocks have existed and been applied for several decades, there is no real operational counter-part for assessing ecosystems. Operational tools for the EAF indeed lead to an intensified research activity, but are still in early development stages. Furthermore, there is no full consensus within the scientific community on how operational models should be developed. Roughly, the scientific community could be divided into two lines of thinking: The ones who believe that over-exploitation and over-fishing mostly result from bad governance and inappropriate incentives rather than due to a failure of current assessment paradigms and tools (e.g. Garcia, et al. 2003, Hilborn 2004, Mace 2004), and, the others who believe that both the governance and the scientific approach (including paradigms and models) are unsuitable (Pauly, et al. 2002, Lotze 2004, Zeller and Pauly 2004). While diverging views on the way to proceed operationally exist, there is a general consensus on some key points, such as the absolute necessity to reduce fishing mortality and fishing capacity and the need to reform the governance and incentives, especially the linkage between scientists, stakeholders, fishermen, others users and civil society.

2.3 The Institutional Backgound

The development of EAF is further related to an international institutional context, mostly due to three organisation of the United Nations (Turrell 2004): UNCLOS (United Nations Convention on the Law of the Sea), UNCED (United Nations Conference for the Environment and Development) and FAO (Food and Agriculture Organisation), to which one might add the UN convention on the biodiversity. These organisations have organised international conferences and summits (in Stokholm in 1972, Rio de Janeiro in 1992 and Johannesburg in 2002) which lead to several declarations and agreements, including (for more details, see UN 2002):

- *Oceans, seas, islands and coastal areas form an integrated and essential component of the Earth's ecosystem and are critical for global food security and for sustaining economic prosperity and the well-being of many national economies, particularly in developing countries.*
- *Encourage the application by 2010 of the ecosystem approach, noting the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem and decision V/6 of the Conference of Parties to the Convention on Biological Diversity;*
- *Promote integrated, multidisciplinary and multisectoral coastal and ocean management at the national level and encourage and assist coastal States in developing ocean policies and mechanisms on integrated coastal management;*
- *Regarding more specifically Fisheries, we could retain the following declarations:*
- *Maintain or restore stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015;*
- *Implement the 1995 Code of Conduct for Responsible Fisheries, taking note of the special requirements of developing countries as noted in its article 5, and the relevant international plans of action and technical guidelines of the Food and Agriculture Organization of the United Nations;*
- *Urgently develop and implement national and, where appropriate, regional plans of action, to put into effect the international plans of action of the Food and Agriculture Organization of the United Nations, in particular the International Plan of Action for the Management of Fishing Capacity by 2005 and the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing by 2004. Establish effective monitoring, reporting and enforcement, and control of fishing vessels, including by flag States, to further the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing;*
- *Encourage relevant regional fisheries management organizations and arrangements to give due consideration to the rights, duties and interests of coastal States and the special requirements of developing States when addressing the issue of the allocation of share of fishery resources for straddling stocks and highly migratory fish stocks, mindful of the provisions of the United Nations Convention on the Law of the Sea and the Agreement for the Implementation of the Provisions of the UNCLOS relating to the Conservation and*

Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, on the high seas and within exclusive economic zones;

- *Support the sustainable development of aquaculture, including smallscale aquaculture, given its growing importance for food security and economic development.*

3 Main stakes and Challenges of EAF

In comparison to the classical stock assessment approach, EAF, thus, leads to a double shift in meaning: (1) shifting from the single-stock to the whole ecosystem and (2) from the system resource-fisherman to the scheme resource-society (which includes various users, among which fisherman is only one kind, as well as various civil society's representatives).

From a scientific perspective, this double shift implies a tremendous increase in the number of variables that should be taken into account during the assessment of exploited populations and ecosystems. Figure 1 gives a synoptic view of the main research areas of EAF, which can be divided into four main domains: (1) governance, (2) exploitation, (3) resources, and (4) impacts on ecosystems.

The challenge for EAF is thus considerable and its success will depend on our capability to translate general objectives into operational and effective goals (Jennings 2004). For instance, the main objective of several regional bodies, such as ICCAT, is to maintain exploited populations at levels which will permit the maximum sustainable catch (i.e. MSY), using biological reference points or targets. Translating such objective to incorporate an ecosystem perspective could be: "to maintain exploited ecosystems at levels which permit sustainable exploitation together with other uses at given and desirable levels" (note that in some cases, ecosystems (mostly coastal ones) have been so strongly exploited than ecosystem rebuilding rather than sustainability becomes the default policy goal, see Pitcher 2001, Zeller and Pauly 2004). While such objectives sound simple, they raise several difficult questions, such as: How do we assess the status of an ecosystem? What is (are) the desirable(s) state(s) of an ecosystem? What is the sustainable exploitation for a given species regarding all the other species?

4 EAF within other Tuna Regional Bodies

The EAF has been increasingly a source of concern for various fisheries commissions. For instance, ICES, PICES and GFCM have set up committee or working group to tackle EAF issues. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) further stated in its convention both the precautionary and the ecosystem approaches (see http://www.ccamlr.org/):

CCAMLR's approach to the conservation of Antarctic marine living resources is defined by Article II of the Convention, from which two central concepts have evolved to guide CCAMLR in carrying out its management responsibilities, namely:

(i) Management strives to follow a 'precautionary' approach. This means that CCAMLR collects the data it can, then weighs up the extent and effect of the uncertainties and gaps in such data before making a management decision. The approach aims to minimise the risk of long-term adverse effects rather than delaying decisions until all necessary data are available.

(ii) Management also follows an 'ecosystem' approach. Ideally, this takes into account all the delicate and complex relationships between organisms (of all sizes) and physical processes (such as currents and sea temperature) that constitute the Antarctic marine ecosystem.

It is generally accepted that impact of fishing in open-sea ecosystems mostly affects the biosphere, but not so much the geosphere as it does in coastal ecosystems. Therefore, regional tuna bodies mostly focus on the by-catch issue.

In the **IATTC**, ecosystem issues were raised during the mid-1970s by the considerable by-catch level of dolphins due to purse seine fisheries. Dolphin mortality has nowadays been reduced to low levels and an observer on-board programme (with 100% of coverage) has been implemented on these fisheries. This programme has led to various by-catch studies, regarding dolphins and FAD associated fauna. Thus, present investigations mostly aim at reducing by-catch (especially those of sensitive species such as sharks and turtles). Note, however, that an attempt has been made using ECOPATH and ECOSIM, but the results remain preliminary and cannot be used for assessment and management purposes.

In the Indian Ocean, **IOTC** has given priority to traditional stock assessment. However, trophic interactions have been an important issue within IOTC since the beginning because of the strong predation of marine mammals (mostly killer whales) on tunas caught by longlines. Therefore, a by-catch WG has been set up and firstly and briefly met in 2005.

In the **CCSBT,** the priority has been given *de facto* to the recovery of the heavily overfished Southern bluefin tuna, but there is a strong pressure to reduce levels the mortality of albatross, a by-catch of longliners in the southern seas (this accidental mortality being recently reduced by technological changes in the gear).

In the **WCPFC** (the new western and Central Pacific tuna Commission created in 2004), EAF issues have been tackled more directly. This partially results from the numerous research studies conducted in this field by the SPC Tuna and Billfish Research Programme since the early 1990s. The WCPFC Scientific Committee has, thus, set up an ad-hoc WG, the "Ecosystem and Bycatch" WG (the provisional terms of reference given to this WG are given as annex 1). Objectives of this WG are rather ambitious, including the estimations of by-catch by all tuna fisheries, a realistic modelling of trophic and environmental interactions in its area of competency and the development of ecosystem reference points that would be used for management of tuna fisheries (the report of the 1st WG can be obtained in the SPC WEB site).

5 The ICCAT SCRS: Institutional Structure

The SCRS stock assessment mechanism is composed by single species groups working mostly independently. The exception is for the three tropical species groups, i.e. bigeye, skipjack and yellowfin, which are supervised by a chairman of tropical species (resulting from the fact that tropical tuna fisheries are mostly mixed fisheries). For the most part, the stock assessments follow a single-species paradigm. It may be undesirable, inefficient, and simply impossible at the start, to move all the Species groups towards an EAF for various reasons. Indeed, there is still a debate about the efficiency of single species paradigms and models, which have led to sustainable exploitation in some cases. For Mace (2004), and other authors (e.g. Hilborn, et al. 2004, Sissenwine and Murawski 2004), there is indeed a need "*to develop ecosystem-based approaches to fisheries that build upon and integrate 'traditional' single-species objectives, and not solutions that abandon traditional approaches that have never been fully implemented, in favor of what are often ill-defined concepts that may do little to solve the overall problems and may not be operational*." Furthermore, tuna and tuna-like species are highly migratory fish. They spread over large areas, often covering various and contrasting ecosystems, and their exploitation imply various fleets of many countries. Because of this additional source of complexity, single species approach or model is likely to remain more efficient for tunas for some years to come.

The SCRS also counts with three permanent sub-committees that deal with issues of a more general nature: Statistics, Environment and Bycatch. Considering that the sub-committees of by-catch and environment already tackle issues that are in one way or another related to EAF (see e.g. http://www.iccat.int/SC_ENV.htm), it appears more realistic to initiate an EAF for Atlantic tuna and tuna-like species through these two sub-committees, perhaps merging into a single sub-committee (rather similar to the WG established in the WCPFC). The immediate mandate of this new sub-committee could be to study how the EAF can be incorporated into the overall scientific work of the SCRS and, more pragmatically, to organize and host working groups to answer to specific questions related to the EAF that would arise from the Commission and from the Species groups (e.g. to confront the various management approaches to reduce the by-catch of under-sized fish in mixed fisheries or to study the impact of some tuna fisheries on the biodiversity in some ecosystems). This sub-committee should also promote an active cooperation with other organizations that carry out research on pelagic ecosystems.

The approach proposed here to accommodate the EAF within the SCRS institutional framework is only an initial step. Further steps will need to consider institutional arrangements more widely than just the scientific arm of ICCAT. Indeed governance is probably one (if not THE) key point to achieve sustainability, so that an interface between SCRS and ICCAT commission will be also necessary to tackle this crucial topic.

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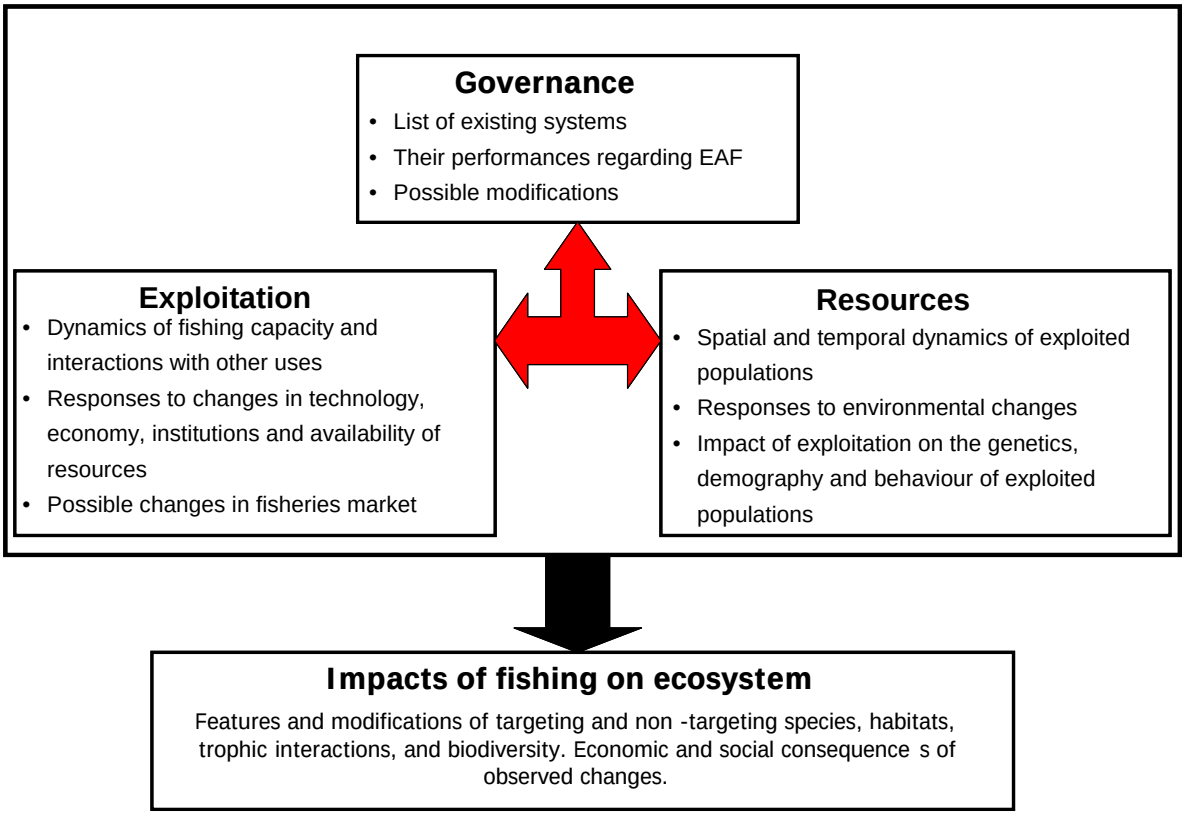

Figure 1. Synoptic view of the EAF, listing within each box main research topics