Putting into practice the ecosystem approach to fisheries

Cover picture by Emanuela D'Antoni

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Preparation of this document

This document is an abridged version of the FAO Fisheries Technical Guidelines No. 4, Suppl. 2, entitled *Fisheries management. 2. The ecosystem approach to fisheries*. It is intended to provide a more concise and less technical outline of the purpose and meaning of the ecosystem approach to fisheries (EAF) and guidance as to how to implement the approach.

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Abstract

Although the principles of an ecosystem approach to fisheries (EAF) are not new, there is very little practical experience in their implementation. Translating high-level policy goals on EAF into operational objectives and actions is now the key challenge to sustainable fisheries.

This booklet will:

- provide an overview of EAF, for marine capture fisheries, and its benefits;
- consider what is required to implement EAF;
- consider the range of management measures available;
- provide an overview of the management process;
- outline any outstanding research requirements;
- list the main threats to the implementation of EAF.

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Contents

Preparation of this document iii
Abstract iv

Background 1

What is EAF and what are the benefits? 3

What are the data and information requirements for EAF? 9

How to make EAF operational 11

EAF management measures 13

The need to create incentives for EAF 31

Assessing the costs and benefits of EAF 33

EAF management processes 37

What are the legal and institutional aspects of EAF? 43

Effective monitoring, control and surveillance 49

What are the key research requirements for EAF? 51

What are the threats to EAF implementation? 53

Glossary 55

Appendix 63

Background

Today, about 90 million people depend on fish for their main daily source of protein and as a source of income. Overexploitation, ecosystem modification and international conflicts on management and fish trade are all key threats to the long-term sustainability of fisheries. The global approach to fisheries management began shifting in the mid-1970s, with the introduction of exclusive economic zones (EEZs) and the adoption of the United Nations Convention on the Law of the Sea in 1982. These were necessary, yet insufficient steps towards the effective management and sustainable development of fisheries. By the late 1980s it became clear that fisheries resources could no longer sustain rapid and often uncontrolled development. A new approach, which embraced conservation and environmental considerations more thoroughly was urgently needed.

In October 1995, the Code of Conduct for Responsible Fisheries was adopted, providing a necessary framework for national and international efforts to ensure the sustainable exploitation of aquatic living resources. The Code has established principles and standards applicable to the conservation, management and development of all fisheries. Along with many other international agreements and conferences, it has served to highlight the benefits of an ecosystem approach to fisheries (EAF). EAF is also relevant to inland fisheries and aquaculture but this document focuses on marine capture fisheries

What is EAF and what are the benefits?

Considerable progress was made in the 1980s and 1990s as efforts were made to regulate fisheries to ensure sustainable use. At the time, the focus was almost exclusively on a single-species approach. Fishery studies tended to assume that the fishery and the target species existed in isolation from the rest of the ecosystem. As pressure on resources and ecosystems increased, the shortcomings of this single-species approach became more obvious. We now know that fishing activity not only impacts on the target stock, but on other parts of the ecosystem as well. For example, fishing methods are never selective and in addition to the target species, other species are inevitably caught. Some of this so called bycatch may be valuable and be retained, while some bycatch may simply be discarded. The bycatch of fisheries can include endangered or threatened species such as sharks, seabirds and turtles.

Another major weakness of the single-species approach is that the target stocks are not only affected by fishing;

EAF's main purpose is to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems.

An* ecosystem *is a functional unit consisting of a collection of plants, animals (including humans), micro-organisms and non-living components of the environment, and the interactions between them.

they are also affected by other factors such as loss of critical habitat (e.g. through coastal zone development or pollution). They will also be affected by changes in abundance of predators and prey which could be caused by other fisheries, and they can be heavily affected by climatic changes.

These realizations have led to global calls for the implementation of EAF. The key objective of EAF is the sustainable use of the *whole system* and not just targeted species. The need to sustain or improve the condition of ecosystems and their productivity is essential for maintaining or increasing the quality and value of fisheries production. EAF also recognizes that humans are an integral component of the ecosystem and that the many (sometimes competing) interests of people in fisheries and marine ecosystems have to be addressed.

EAF represents the marriage of two different perspectives, namely *ecosystem management* and *fisheries management*. As a result, while EAF is the responsibility of fishery agencies, its full implementation will require collaboration with and cooperation from those agencies responsible for managing other activities that impact on the aquatic ecosystem (e.g. coastal zone development, offshore mining and oil and gas extraction). For EAF to be fully realized, it is important that these agencies and

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The purpose of an ecosystem approach to fisheries is to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems.

stakeholders interact and work together. This handbook focuses mainly on those actions that are within the mandate of fisheries agencies.

The key principles addressed by EAF are as follows:

- fisheries should be managed to limit their impact on the ecosystem to an acceptable level;
- ecological relationships between species should be maintained;
- management measures should be compatible across the entire distribution of the resource;
- precaution in decision-making and action is needed because the knowledge on ecosystems is incomplete;
- governance should ensure both human and ecosystem well-being and equity.

The wider principles identified by the Convention on Biological Diversity (CBD) for an ecosystem approach in any environment, terrestrial or aquatic, are also useful and are shown in Box 1. All the CBD principles are relevant and important in EAF as well, and are consistent with the FAO list of principles in the previous paragraph.

BOX 1

Convention on Biological Diversity

Principles of the Ecosystem Approach

Principle 1: The objectives of management of land, water and living resources are a matter of societal choice.

Principle 2: Management should be decentralized to the lowest appropriate level.

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:

a) reduce those market distortions that adversely affect biological diversity;
b) align incentives to promote biodiversity conservation and sustainable use;
c) internalize costs and benefits in the given ecosystem to the extent feasible.

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Principle 6: Ecosystems must be managed within the limits of their functioning.

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Principle 8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Principle 9: Management must recognize that change is inevitable.

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

More detail can be obtained from Decision V/6 of the fifth Conference of the Parties to the Convention on Biological Diversity at www.biodiv.org/decisions/default.aspx?m=COP-05&id=7147&lg=0

What are the data and information requirements for EAF?

Information is critical to EAF. It underpins the formulation of national policies, the development of management plans and the evaluation of management progress. Given that EAF involves a broadening of current fisheries management practices, it requires a broadening of the information necessary for good management. In some countries, most of the required information will be readily available, but in others EAF will have to be based on incomplete information. Where this is the case, the best available information must be used. Information is required to formulate the following components of EAF.

- *Policy* is informed by knowledge of the role that fisheries play in the regional, national and local economies and the social setting. Information is needed on the nature of stakeholders; economic factors related to the fishery; details on costs and benefits; the role of fisheries in providing employment; the status of access to, or ownership of, the resource; the institutions involved in planning and decision-making; and the complex interactions that occur within the system.
- *Management plans* must be based on a broad range of knowledge, such as the area of operation of the

fishery and its jurisdiction; the stakeholders involved; gear and vessel types; the socio-economic importance of the fishery; the distribution of the most important commercial species; available monitoring data and the management procedures already in place.

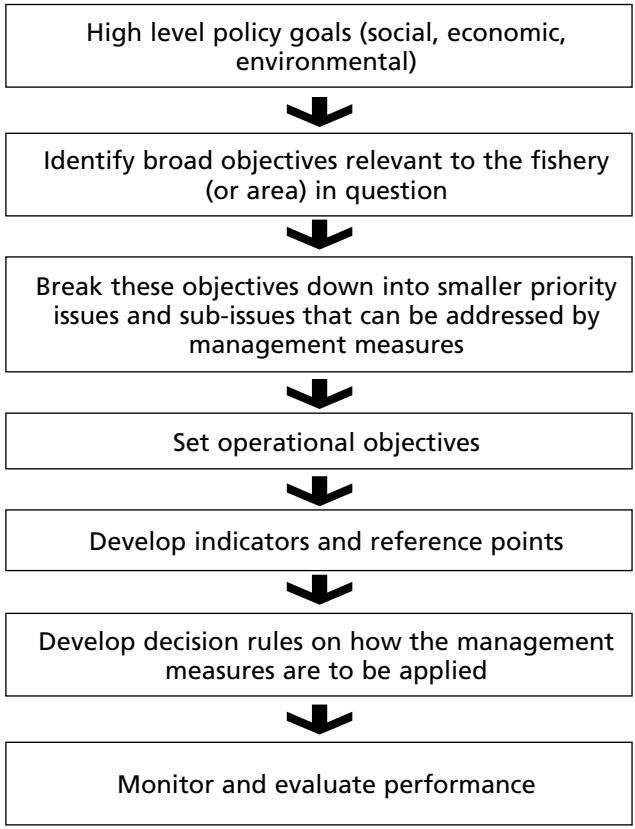
In addition, all the potential *direct* and *indirect* effects of the fishery on species and habitats need to be described. These should include information on aspects such as the habitats that may be affected, the species composition of both retained and non-retained bycatch, the impact of nutrient and contaminant releases, the impact of fishing on life history traits, the legal framework and the possible management measures to reduce adverse environmental impacts.

Fisheries management under EAF should be aimed at achieving the agreed objectives. As a result, the information that will need to be routinely collected in order to feed into the decision-making process will be clear once the *operational objectives* and *indicators* have been identified. Additional information may also need to be collected for the short- and long-term reviews and assessments of management performance. Due to the complex and dynamic nature of the ecosystems in which fisheries operate, there will always be gaps in the knowledge and information required but managers and stakeholders will need to make the best decisions they can using the information that is available.

Potential research gaps and requirements are presented on pages 51 and 52.

How to make EAF operational

In order to implement EAF successfully, it is necessary to translate the relevant policy goals into operational objectives and actions. The main steps in the process of implementation are as follows:



Where serious or irreversible damage is likely, the lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

These steps will vary from fishery to fishery, and may differ between developed and developing countries. What is important, however, is that no significant economic, social or environmental aspect is overlooked, otherwise management plans that are good in all other respects are still likely to fail.

Moving from high level policy goals to operational objectives is a huge challenge in areas where the goals deal with broad and sometime vague concepts such as ecosystem integrity, health and biodiversity. Steps 3 and 4 in the Appendix are intended to help address that challenge. The above process needs to apply to fisheries which have excellent data and capacity, as well as to data-poor fisheries with little to no management and scientific capacity. Given that uncertainty is likely to be much greater than under the target resource orientated or single-species approach (TROM), the precautionary approach will be of significance.

EAF management measures

Once the operational objectives have been agreed on, it will be necessary to determine the required management measures. These should, as far as possible, build on and strengthen existing measures, adapting them as necessary in order to keep the costs and any negative social impacts of the changes as low as possible while still achieving the agreed objectives. Nevertheless, adaptations or extensions to existing measures will almost always be required for the implementation of EAF.

With EAF, the range of input and output controls and the type of measures used to regulate fishing mortality need to be considered in a far broader context. The measures should not only address a series of target species concerns, but should also be aimed at maintaining or restoring the structure and functioning of the ecosystem. Managers should take the functioning of the ecosystem into account when drawing up their approach. They need to be aware of the potential problems related to measures such as restocking and culling. Habitats may also need to be adapted to enhance the populations of target species or to restore degraded areas.

Important note:
Many of the problems facing fisheries management fall outside the direct control of fisheries managers. Examples of such problems include:

- the degradation of coastal waters as a result of agricultural or industrial runoff;
- introduction of exotic species through ballast water and the hulls of container ships;
- destruction of fish habitats through foreshore development, offshore mining, oil and gas exploration and extraction and other human activities;
- the contamination of fishery products by agriculture and industry;
- coastal erosion and the degrading of coastal habitat;
- the use of freshwater for power stations, irrigation and human settlements which changes river flow;
- climate change which affects the distribution and productivity of stocks;

Fisheries managers need to ensure that they are recognized as important stakeholders in the broader process of integrated coastal management.

WHAT ARE THE KEY EAF MANAGEMENT OPTIONS?

The following section describes how *current* management processes would change under EAF. One of the most important consequences of EAF is that it will often require the involvement of more stakeholder groups. This will increase the time and costs required for effective consultation and could also make agreement and compromise more difficult to reach. Where stocks are shared by more than one country, the management measures should be coordinated between the different countries sharing the resource.

Technical measures

Fishing gear regulations

Almost all fishing gear impacts on marine life, sometimes in unexpected ways. Usually, fishing methods are developed to catch only a target species or group of species in a particular habitat but they may also catch non-target organisms (bycatch) or be used in the wrong habitat and cause environmental damage. Fishing may also remove only the larger fish from a population which changes the size composition of the species. The consequences of impacts such as these for the ecosystem may be severe and need to be considered under EAF. Some of the gear- and size-selectivity options are as follows.

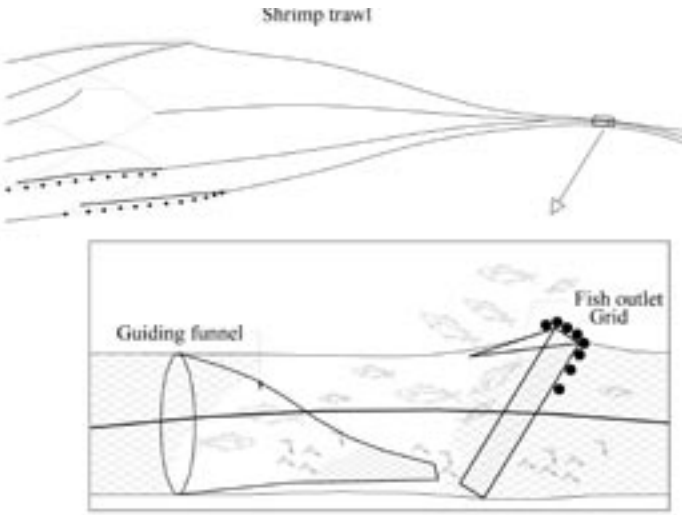
- *Mesh size restrictions* are a useful way of avoiding the capture of immature individuals of the target species and small individuals of bycatch species. Selectivity can be improved through the use of square mesh, sorting grids and other devices which enable the unwanted portion of the catch to escape.
- *Bycatch reduction devices* (BRDs) are tools that reduce the capture of non-

G. BIZZARRI, FAO/21972

An inspector at Agadir port, Morocco using a gauge to measure stretch mesh in the codend of a trawlnet.

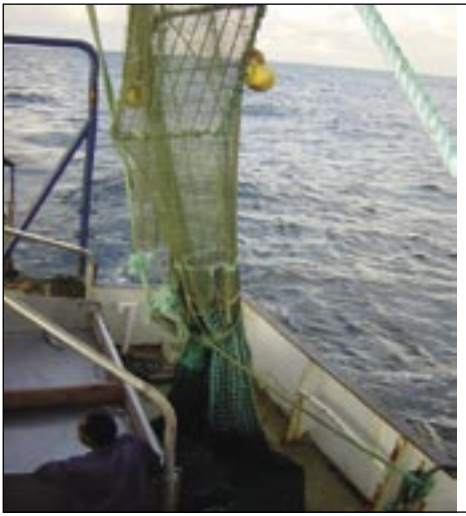
target species. They include turtle excluder devices (TEDs), sorting grids that allow the unwanted bycatch to escape and acoustic "pingers" that distract marine mammals and prevent them from becoming entangled in nets.

- *Lost gear measures* can limit the impact that gillnets or traps and pots have on the ecosystem when they are lost. By introducing biodegradable material or some disabling measure, lost fishing gear can be prevented from continuing to capture fish. The quick recovery of lost nets and periodical "sweeping" for lost gear is another way of preventing so-called "ghost fishing".
- *Precautionary approach in the use of high impact fishing methods.* Fishing gear that touches or scrapes the sea floor during fishing operations is likely to have a negative impact on both living and non-living habitats. Given that knowledge about the long-term effects of such impacts is limited, a precautionary approach is recommended in critical habitats essential to ecosystem productivity. Use of towed gear with reduced bottom contact is an option in such areas. Prohibition of certain gear (such as trawling in coral reef and seagrass habitats) is another option. A further option is to replace high-impact fishing methods with those that have less impact on the seabed, e.g. trapping, longlining or gillnetting.
- *Adjustments to fishing operations and methods.* Ecosystem impacts can frequently be reduced by relatively simple adjustments to standard fishing



ÅSMUND BJORDAHL, INSTITUTE OF MARINE RESEARCH

Shrimp trawl with sorting grid (expanded view). Shrimp and fish that pass backwards in the trawl are guided by a funnel to the bottom of the backwards slanting metal grid. Shrimp and fish of comparable size will pass through the slots of the grid and go to the codend, while larger fish and other organisms (e.g. jellyfish) will slide upwards over the grid and are released through the outlet.



Bycatch reduction devices in action. Two devices (an aluminum grid for releasing large animals such as turtles and sharks, and a square-mesh escape panel for releasing small fish) installed in a commercial prawn trawl in Mozambique.

SEAN FENNESSY, OCEANOGRAPHIC RESEARCH INSTITUTE

practices. For example, damage or death of seabirds by longline fishing operations can be reduced by a range of measures including increasing the sinking rate of baited hooks by adding extra weight to the gear, placing bird-scaring lines above the area where the baited hooks enter the water, and setting the bait at night and with less illumination so that it is less visible to birds. Bycatch of sharks could be reduced in some cases by prohibiting the use of wire traces for attaching the hooks to the snoods on a longline along with reducing the breaking strain of the snoods. There is also some evidence that TEDs can reduce the bycatch of sharks in trawlnets.

SAMANTHA PETERSEN, BIRDLIFE SOUTH AFRICA

Weighted branchlines on tuna fishing gear, designed to increase the sinking rate of the baited lines and so reduce mortality of seabirds.

Spatial and temporal controls

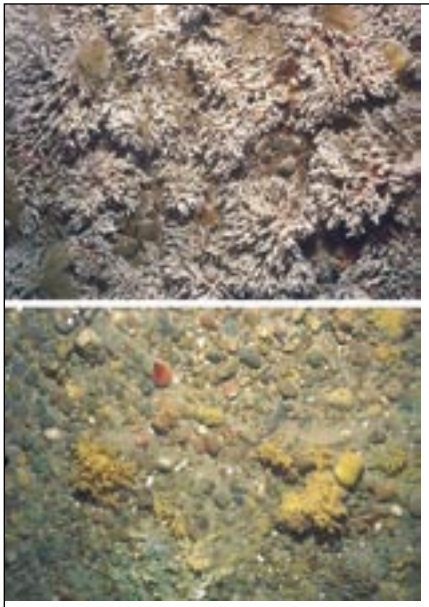
The impact of fishing on target and bycatch species can be modified by restricting fishing activity to certain times or seasons, or by restricting fishing in particular areas. Such measures may help to reduce the mortality rate of individuals of either target or non-target species in vulnerable life stages. Closures may be used to protect critical habitats where fishing activity would otherwise cause damage to the physical structures supporting the ecosystem.

Marine protected areas (MPAs) have been widely used to protect biodiversity and specific habitats, with mixed results. MPAs range from zones in which no fishing is allowed (reserves) to areas in which fishing is strictly controlled. Effective MPAs are known to benefit the conservation of some species and the maintenance of biodiversity. If they are properly designed and enforced they may also be useful to fisheries. However, badly designed MPAs or MPAs that are not properly monitored and controlled will have little or no benefits and may even have negative impacts on fisheries.

Effective MPAs can protect sedentary species and allow a proportion of the stock to remain free of the genetic selective effects of fishing. They may allow for the accumulation of spawning biomass so that surrounding areas may be replenished, either through the migration of fish or the dispersal of juveniles.

Area closures that allow some fishing may require a large enforcement effort and can be costly. Allowing

certain categories of fishing activity can also create loopholes which undermine the intentions of the closure. Management authorities need to consider the cost of enforcing closed areas, bearing in mind that vessel monitoring systems (VMS) may make it easier to enforce area-based management in some regions of the world.



DANN BLACKWOOD AND COURTESY PAGE VALENTINE, US GEOLOGICAL SURVEY

Photographs of bottom habitat on the Georges Bank in the Atlantic coast of northern United States before (top) and after (bottom) being fished with a dredge to catch scallops. Closed areas and MPAs are frequently important to protect critical habitats from such damage. A system of seasonal and year-round closures is used in north east United States also to contribute to management of 20 groundfish stocks. It includes an area of more than 22 000 km² closed year-round to any fishing gear capable of catching groundfish. The closed areas led to big increases in abundance of some commercial and non-commercial stocks, although not for all, with the more sedentary species benefiting the most. There was also spillover of fish from the MPAs into the fishing grounds for some commercial species (including scallops, haddock and some flounders) but not all. This example demonstrates the potential value of MPAs but also the need to be clear on the objectives for their use. The benefits will depend, amongst other factors, on the species being protected, the placement and size of the reserves and the integration of MPAs with other management measures. More information can be found at www.whoi.edu/oceanus/viewArticle.oid=3782&archives=true&sortBy=printed

Energy efficiency and pollution

Many modern fishing vessels use fossil fuels for propulsion, to operate the fishing gear and to preserve and process the catch. Technological innovations to reduce the emission of CO_2 and other gases are encouraged. Increasing the efficiency of fishing gear and improving management approaches all result in a reduction in the fishing effort required.

Input (effort) and output (catch) control measures

Controlling overall fishing mortality

Management methods that are used to control fishing mortality are often referred to as input and output controls. Input controls can be used to regulate fishing *capacity* (the total effort achieved if the entire fleet were to fish full time), and to control fishing *effort* (the actual fishing pressure that is exerted). Output controls are intended to regulate the catch of a species or group of species directly.

Capacity limitation seeks to limit the *total size* of the fishing fleet. This has the advantage of reducing the pressure that frequently arises from an overgrown industry to allow higher fishing effort than would otherwise be permitted. Appropriate capacity controls can lead to reductions in fishing mortality on the target species, as well as a wide range of associated species.

Effort limitation seeks to restrict the *fishing activity* of fleets and thereby limit or reduce fishing mortality. This will usually be an effective measure in multispecies fisheries as the reduction in fishing effort will lead to reductions

in fishing mortality for all species caught. There is a danger that effort and capacity excluded from one fishery or area may simply be transferred to other ecosystems and resources that are already fully fished. Where effort reduction is being implemented, steps must be taken to prevent this happening. Controlling effort in a context of excessive capacity (e.g. fleet size) is often difficult.

From an EAF viewpoint, input controls are beneficial because they restrict the overall pressure on the ecosystem. Without effective monitoring and control, however, there is always the possibility that fishing mortality will continue to increase steadily. Another problem with input controls is that new technologies and experience tend to lead to gradual increases in fishing efficiency. This leads to an increase in the actual fishing effort and a consequent increase in fishing mortality. Suitable monitoring and controls need to be implemented to compensate for increases in efficiency. However, some technological advances, such as the use of echo sounders, may enable fishermen to direct more of their effort towards the target species and decrease the impact of fishing on non-target species.

Catch controls are aimed at directly reducing fishing mortality on target species. If complemented with bycatch controls (such as bycatch quotas) they have the potential to protect associated species. However, catch controls can lead to undesirable outcomes such as discarding of lower value species or smaller size classes. When implementing EAF in a mixed-species fishery, consideration needs to be given to the different characteristics of the various species

GARRY DAY, AUSTRALIAN MARITIME COLLEGE

A mixed-catch from the Northern Prawn Fishery in Australia. The fishery targets nine species of prawn (shrimp) and takes a substantial and very diverse bycatch of teleost fish, elasmobranchs, turtles, sea snakes and many invertebrate species. These include some endangered and protected species, The fishery is controlled primarily by regulating fishing effort, leading to significant reductions in impacts on bycatch species. There are also a number of other important management measures intended to reduce bycatch directly, in particular the compulsory use of TEDs and BRDs and, recognizing the importance of coastal habitat to fishery production, seagrass beds and inshore waters are closed to trawling.

when catch controls are set. Otherwise, more vulnerable and less productive species may be overexploited as vessels attempt to fill their quotas of the more valuable and productive species. Catch limits for target species may therefore need to be modified to control catches of more vulnerable species. The catch limits should also address the ecosystem related objectives, such as maintaining food webs.

Ecosystem manipulation

In some situations, technology and understanding of marine ecosystems have advanced to the point where ecosystems may be manipulated to achieve the desired use, conservation and restoration objectives. Ecosystem manipulation may help to mitigate overfishing or habitat destruction. Mitigation is rarely completely effective and it is usually very expensive.

Habitat modifications

- *Preventing habitat degradation*. Habitat preservation in marine fisheries is critical to EAF. Managers need to adopt measures to prevent habitat damage and correct damage where it has occurred. Measures needed to reduce habitat degradation include:
  - prohibition of destructive fishing methods in ecologically sensitive habitats;
  - prohibition of intentional cleaning of the seafloor to facilitate fishing;
  - reduction of the intensity of fishing on some fishing grounds to ensure that stocks of non-target, habitat-forming species are not depleted to unacceptable levels.
- *Rehabilitating or creating additional (artificial) habitat.* Where habitat has been damaged or lost, rehabilitation programmes should be implemented, but only when the problems causing the damage in the first place have been adequately addressed.

INTERNATIONAL COLLECTIVE IN SUPPORT OF FISHWORKERS (ICSF)

Preventing loss of or damage to critical habitats is an essential component of an ecosystem approach to fisheries. Figure 7a) Fishing for shellfish and crab in a mangrove area in Brazil. Figure 7b) Cleared mangroves for shrimp farming and salt production in Brazil, showing the loss of mangrove habitat. Mangroves provide habitat for many species and important nursery areas for a number of commercially important fish species.

Artificial habitats (if well located and designed) have the potential to improve production by increasing the settlement success of juveniles in years of abundant seed supply. Artificial habitats may also play an integral part in a restocking or stock enhancement programme by permitting a larger number of animals to be released.

Population manipulation

- *Restocking and stock enhancement*

  Target species that have been heavily overexploited may be restored by releasing cultured juveniles to

rebuild the spawning biomass. As there are often high costs involved in restocking programmes, careful analysis is needed to determine whether the goals of rebuilding stocks can be achieved by other management measures. Restocking should only be considered when other forms of management are incapable of restoring populations to acceptable levels. It should be coupled with effective control of fishing capacity.

Stock enhancement is an activity or programme designed to increase the size or growth of the fishery resource stock. It may include restocking programmes but can also involve activities such as habitat engineering and introducing new species or new strains of existing species. As with restocking programmes, careless hatchery practices could also result in the release of individuals unfit for survival in the wild, modification of genetic diversity and the introduction of diseases.

- *Culling*

  Culling is aimed at reducing the abundance of predators or species that compete for the same trophic resources, in order to increase the yields of target species or to maintain the balance of the trophic structure. Such food-web manipulation needs to be carried out with caution to ensure that it produces only the desired effect and does not result in unwanted changes in abundance of other important components of the ecosystem, or threaten the survival of the species culled.

- *Intentional introductions*
  Although new fisheries can be created by introducing species, there is a high risk of causing detrimental changes in coastal ecosystems. A precautionary approach is needed here, but this does not mean that the measure should never be considered. Some introductions of marine species have resulted in social and economic benefits with no apparent impacts on other components of the ecosystem. A comprehensive risk assessment should be undertaken before considering the creation of new fisheries based on introduced species so as to understand the benefits and consequences of such measures.

RIGHTS-BASED MANAGEMENT APPROACHES

An appropriate system of allocating access rights in a fishery should ensure that fishing capacity and effort correspond to the productivity of the resource. It should also ensure longer-term security for the rights holders and enable them to view the resource as an asset to be used responsibly.

Territorial use rights (TURFs) are rights granted to individuals, groups or communities to fish in certain, clearly defined locations. TURFs are frequently used in combination with decentralization of control, giving the rights holder in a particular TURF control over some or all management functions, for example surveillance and compliance.

Limited-entry systems allow only a certain number of individuals or vessels to take part in a fishery, with

entry being granted by way of a license or other form of permit. Entry may also be regulated through a system of effort rights (input rights) or by setting catch controls (output rights), where the total allowable catch (TAC) is split into quotas and the quotas allocated to authorized users.

Each type of right has its own properties, advantages and disadvantages. Further, the ecological, social, economic and political environment varies from fishery to fishery. As a result, no single system of use rights will work under all circumstances. It is necessary to devise the system that best suits the fishery. An access rights system may well include two or more types of use rights within a single fishery or geographic area.

By way of example:

- TURFs may be particularly suitable for the management of sedentary resources;
- effort rights may be more effective and practical than catch rights where there are no reliable estimates of biomass or where good monitoring of catches may be impractical (or where species diversity is high);
- catch rights may best facilitate the management of highly migratory and transboundary stocks where the allowable catch must be divided among the participating nations;
- effort management may be more effective where a fishery uses primarily the same gear type while in a fishery using many different gear types, catch rights may be preferable.

EAF requires that all the uses and users of a fishery resource be considered and their objectives reconciled, and that interactions between different fisheries within a geographic area be taken into account. Therefore, the systems of access rights across different fisheries within a management area need to be compatible. The total effort applied also needs to correspond with the productivity of the ecosystem and its component parts. While difficult to implement, this will be essential for the sustainable use of ecosystems.

JIM ANDERSON MRAG LTD

TURFs, known locally as community fishing rights areas (CRFAs) or "Qoliqoli" are used in Fiji. The red lines show the CRFA boundaries as defined by the Native Lands Trust Board (NLTB) of Fiji. The area of the largest CRFA is 362 km² encompassing 86 km² of coral reef habitat while the smallest, occurring inshore and including mangrove habitat is only 3 km². The boundaries of the CRFAs were determined largely by cultural politics. The larger CRFAs are probably of a suitable size for management, given the likely movement patterns of finfish, while the smaller ones are almost certainly too small and fish "stocks" are likely to cover more than one CRFA.

The need to create incentives for EAF

EAF will be easier to implement if the rules and regulations applied under a so-called "control and command" form of management are supplemented, or even replaced, with more appropriate incentive measures. Incentives provide signals reflecting public objectives while leaving some room for individual and collective decision-making to respond to them.

Different kinds of incentives can be developed in isolation or in combination, as follows:

- improve the institutional framework (definition of rights and participatory processes);
- develop collective values (education, information, training);
- create non-market economic incentives (taxes and subsidies);
- establish market incentives (ecolabelling and tradable property and access rights).

Incentives work indirectly through affecting those factors that lead to particular individual or collective choices. Examples of those factors are the desire to make a profit or the norms and values that individuals hold. Market or social forces can be very efficient means to force the global outcome of individual actions towards collectively set objectives.

Such instruments rely to some degree on control and command. Creating the conditions for an efficient market for property rights requires that these rights be legally set and effectively enforced. Similarly, creating a market-based incentive for environmentally-friendly production methods through ecolabelling requires that certification standards be established and enforced. Incentives and the control and command approach should be seen as complementary, having relative advantages or disadvantages depending on what they are supposed to achieve. Making better use of incentives, in conjunction with appropriate enforcement systems, could help to improve compliance and regulation.

Assessing the costs and benefits of EAF

WHAT ARE THE EAF MANAGEMENT COSTS AND WHO WILL PAY?

The shift to EAF implies higher management costs - to cover the acquisition of broader information, additional planning and consultative decision-making processes, as well as wider scope in monitoring, control and surveillance. Although these costs may often be out-weighed by the long-term benefits of implementing EAF, the question of "who pays?" will often be important, especially in the shorter-term before the benefits of EAF for the ecosystem and stakeholders have been fully achieved.

The idea of the fishing industry paying some fishery management costs is increasingly accepted. However, the fact that EAF responds to wider societal needs requires an explicit policy on how the incremental management costs of EAF should be divided between the benefits derived by those dependent on fishing for food, livelihood and employment, and benefits to society at large. Where countries are given the task of managing global ecosystem goods and services, consideration may have to be given to whether management costs should be carried by the international community, rather than by the local stakeholders or the government of the State where the activity is taking place.

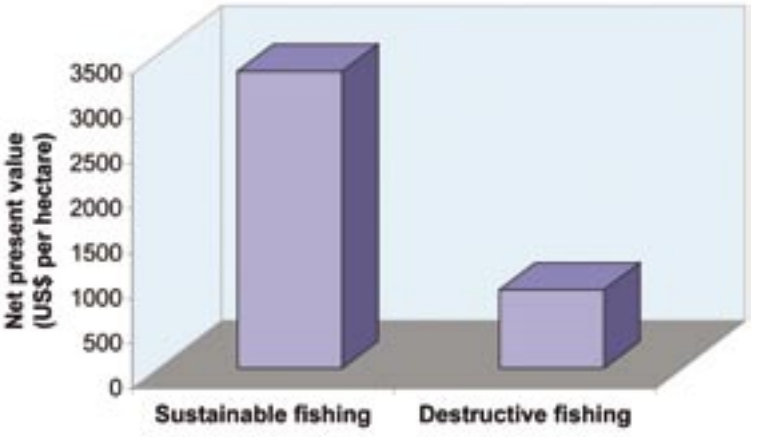
K.L. COCHRANE, FAO

Implementation of EAF requires the involvement of a wider range of stakeholders. This raises important new economic questions such as how the costs of implementing EAF should be divided between those obtaining direct benefits, such as the fishers, and society at large, which is also obtaining benefits. It also raises problems about valuation of benefits and whether valuation should be based on local, national or international preferences.

In considering global ecosystem goods and services, such as biodiversity or conservation of endangered species, the issue arises whether valuation should be based on national or local preferences, or take into account the preferences of the citizens of other countries or the international community. It also needs to take note of goals expressed in international conventions. On the other hand, valuation based on what the most affluent citizens of the globe are willing to pay could result in policy prescriptions that are unfavourable to poor producers and consumers in developing countries. This has given rise to the call for establishing equivalency standards that take into account differences in wealth and the ability to provide alternative employment and income opportunities.

The appropriate tools to estimate the costs and benefits of EAF include bioeconomic and ecological-economic modelling. A useful cross-sectoral tool is integrated environmental and economic accounting. A System of Integrated Environmental and Economic Accounts (SEEA) provides a comprehensive framework to monitor and analyse the interactions between different sectors of the economy and their individual and aggregate impacts on the environment.

The estimated value today (net present value) of the benefits that could be expected from a coral reef in the Philippines over the next 10 years with i) sustainable fishing practices and ii) using destructive fishing methods such as blast fishing (dynamiting). The benefits under sustainable fishing included those from the fishing itself but also included social benefits from coastal protection and tourism that would be lost with blast fishing. The analysis assumes a discount rate of 10% per year. From Balmford *et al*. Science Vol 297, 9 August 2002.



EAF management processes

DEVELOPING AN EAF MANAGEMENT PLAN

This section provides guidelines for producing and revising management plans within EAF. The management plan should be a formal or informal arrangement between a fishery management authority and stakeholders and should have the following components:

- **Title**
- **Background**

  To include:

  - *social and institutional aspects*
  - *description of fishing activity, resources and the ecosystem*
  - *ecological issues and challenges*
- **Objectives**

  To include:

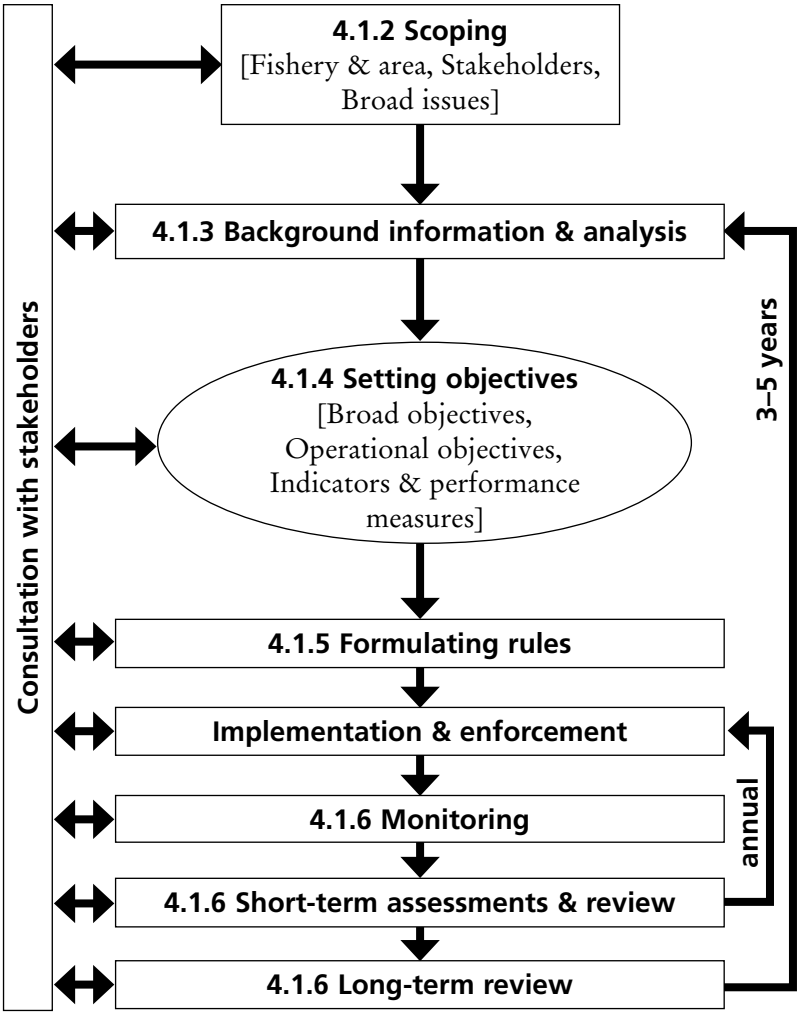
  - *operational objectives*
  - *reference points*
  - *performance measures for the fishery*
- **Management measures**

  Description of the agreed measures to regulate fishing to meet all the objectives within the agreed time frame (e.g. the details of any gear restrictions, closed areas or seasons, days at sea or allowable catches and size limits).

- **Decision rules**
  Rules for deciding on the management measures (e.g. how much effort to allow or the size of a total allowable catch in a particular year).
- **Access rights**
  Description of the system or systems of access rights used in the fishery.
- **Evaluation of management**
  To include a report on the status of stocks including bycatch species, based on risk and stock assessments, state of the ecosystem and social and economic characteristics. Collectively these indicators will demonstrate how effective management has been in the past and will highlight areas where management is failing or greater emphasis is needed.
- **Monitoring, control and surveillance**
  Details of the MCS systems used in the fishery.
- **Communication**
  The communication strategy and activities planned to keep the stakeholders well-informed on developments in the fishery and management activities.
- **Review**
  The details of the next review of the performance of the management of the fishery.

The process of developing and modifying an EAF management plan requires a series of iterative steps, as illustrated in the Figure below. An outline of these steps is provided in the Appendix to this Handbook. While in many cases, sufficient capacity and data will not be

The process that should be followed in developing and implementing a management plan for an ecosystem approach to fisheries. The numbers refer to the sections explaining each step in the FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 2. The ecosystem approach to fisheries. Rome, FAO. 2003. 112p.



available to address all points, the processes outlined are still relevant and will assist in developing effective plans.

It is recommended that there are at least two components to the plan – a higher-level three – to five-year component that states the broad management objectives and measures to achieve them, and another short-term component that specifies the annual cycle of setting and reviewing specific operational objectives, indicators and performance measures.

The importance of consultation

It is imperative that stakeholders are included in all stages of the process through consultation and participation. Stakeholder involvement needs to represent the breadth of views, without the group becoming unmanageably large. Issues related to stakeholder capacity and commitment will also need to be carefully addressed, and formal, transparent and accountable processes set up to allow all parties to work cooperatively. In some cases, logistic constraints may mean that stakeholder inclusion is limited; in these cases, great care will be needed to maintain transparency, credibility and to ensure stakeholder ownership of the outcomes.

KEVERN COCHRANE, FAO.

Effective consultation is always essential to ensure good outcomes and compliance: consulting with stakeholders in the shrimp and groundfish fisheries of Trinidad and Venezuela.

What are the legal and institutional aspects of EAF?

LEGAL

The international instruments which should be considered when implementing EAF need to be reflected in national legislation and all associated fisheries regulations and practices.

At the international level, EAF is reflected mainly in voluntary instruments such as the Rio Declaration[1], Agenda 21[2], the FAO Code of Conduct for Responsible Fisheries, the Reykjavik Declaration[3] and the 2002 Plan of Implementation of the World Summit on Sustainable Development. As a result of the voluntary nature of the instruments, few regional fisheries organizations and arrangements make explicit recognition of EAF in their instruments as yet. Furthermore, EAF is frequently not an integral part of national fisheries policy and legislation. This leads to many deficiencies in current fishery management

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1 The Rio Declaration on Environment and Development, Rio de Janeiro, Brazil, June 1992.

2 Protection of the Oceans, All Kinds of Seas, Including Enclosed and Semi-Enclosed Seas, and Coastal Areas and the Protection, Rational Use and Development of Their Living Resources, United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 1992.

3 The Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem, Reykjavik, Iceland, October 2001.

regimes, such as weak cross sectoral consultation and cooperation and the failure to consider – or a legal inability to act on – external influences such as pollution and habitat deterioration.

In the case of national policies and laws, EAF may require that existing legal instruments and the practices of other sectors that interact with or impact on fisheries need to be considered, and that adjustments be made where necessary. EAF is, therefore, likely to require more complex sets of rules or regulations that recognize the impacts of fisheries on other sectors and the impact of those sectors on fisheries.

It may be desirable to regulate the intersectoral interactions through primary legislation. This could apply, for example, to laws controlling coastline development and coastal habitat protection, the establishment of permanent MPAs, and the creation of cross sectoral institutions.

INSTITUTIONAL

As with conventional management, EAF requires institutions to ensure coordination, consultation, cooperation and joint decision-making – between fisheries operating in the same geographical area and between the fisheries and other sectors that interact with it.

The development and implementation of EAF policy and legislation will most likely be undertaken by the national fisheries department or designated management agencies (at national level) and the regional fisheries management organizations at regional level.

A key challenge in the development of EAF may arise from disparities between the ecosystem and existing jurisdictional boundaries. Any such disparities will need to be addressed. Examples include the following.

- In coastal areas, the sea-use and land-use planning administrations need to cooperate in developing integrated systems of information and governance capable of allocating resources and enforcing use rights.
- In the open ocean, the jurisdictional boundaries of the fishery organizations may not properly match the ecosystem boundaries e.g. the large marine ecosystem (LME) boundaries.
- In the context of conventional management, conflicts frequently arise between different interest groups, which tend to hinder the effective management of fisheries. Conflict will inevitably increase under EAF as the number of stakeholders and objectives increase. It may often be impossible to obtain voluntary compromise between competing stakeholders and higher-level decisions may be required. Institutional arrangements need to be established to reduce potential conflicts and to facilitate their resolution when they do occur.

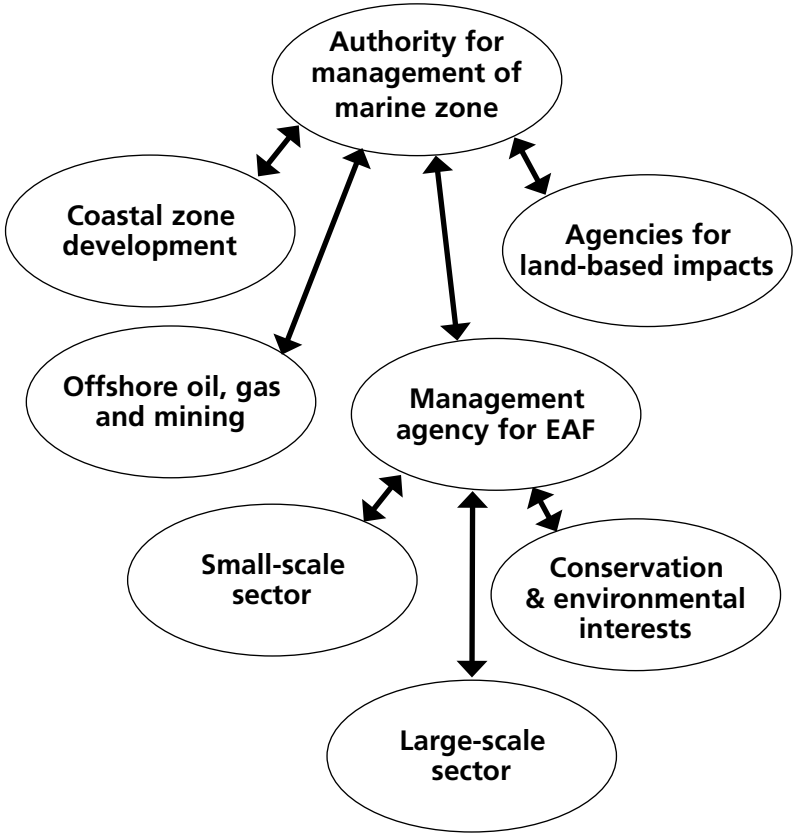
EAF will require adherence to the same principles of transparent and participatory management as conventional management, and as such, relevant authorities will have to:

- ensure the decentralization of decision-making and management responsibility to organizations or

groups (e.g. to make use of traditional management practices);

- build capacity at these new management levels;
- ensure appropriate participation of stakeholders in decision-making;

An ecosystem approach to management requires coordination, consultation, cooperation and joint decision-making not only between different fisheries operating in the same ecosystem or geographical area, but also between the fisheries management agency and the other sectors that have an impact on fisheries or are effected by fisheries.



- improve transparency and dissemination of information;
- establish appropriate systems of user-rights.

If responsibility and authority is devolved to coastal community level, management decisions and actions will need to be highly coordinated. The access rights system will frequently need to encompass other uses, in addition to the use of the target resources. This may complicate the selection and implementation of an effective system of user rights. Examples of additional contenders for access rights under EAF include:

- explicit recognition of predator-prey relationships under EAF, requiring the allocation of some of the potential yield of the prey species to the predator, through leaving a higher biomass of prey in the sea, rather than allocating that portion of the yield to the fishery or fisheries targeting the prey species; and
- different user groups, including multiple fisheries, tourism, conservation and recreational fisheries will require appropriate allocation of resources and access to resources.

Such allocation issues are not new, but have generally been neglected in the past. Under EAF, issues of access and allocation of resources will need to be formally recognized.

EDUCATING AND INFORMING STAKEHOLDERS

In some cases, under conventional management, stakeholder involvement has led to increasing awareness

of, and the capacity to, participate in fisheries management, but in many cases little progress has been made. For the implementation of EAF to be successful, stakeholders will need to understand and accept the need for this more inclusive approach to fisheries management. This will require a proactive effort by management agencies. Scientists and management authorities will need to:

- recognize the value of the knowledge of fishers, their representatives and communities (particularly regarding the ecosystem);
- recognize that with the ever broadening range of stakeholders under EAF, the potential differences in capacity to participate in management will also increase which, if uncorrected, will lead to unbalanced and poor decisions;
- facilitate capacity building and empower all stakeholders to ensure equitable participation;
- ensure effective and appropriate training for all staff having to deal with the changes required for EAF.

Effective monitoring, control and surveillance

The purpose of a monitoring, control and surveillance (MCS) system is to ensure that fishery policy in general, and the conservation and management arrangements for a specific fishery, are implemented fully and expeditiously. As with all other functions of the management agency, EAF may result in additional and broader tasks for the MCS arm of the agency.

The control and surveillance functions of the agency will depend on both the ecosystem components under consideration and the management measures that are implemented, as is the case under conventional management. EAF will address a wider range of ecosystem components and may also have to use a wider range of management measures. Good observer schemes, whereby trained, independent observers are placed on fishing vessels to monitor and record information on, for example, bycatch and discards will be important. EAF may also require more common application of closed areas, including MPAs, and this will require the development and implementation of appropriate technology (e.g. vessel monitoring systems), provision of patrol and enforcement staff, or enforcement by local communities that benefit from the existence of the MPA. In the latter case, training and some logistic support may still be required.

Management agencies will need to anticipate ongoing and possibly increased MCS costs under EAF. Greater efforts are needed to create a social and political environment and management regime that encourages high levels of compliance and strong self-regulation, rather than relying entirely on top-down enforcement. The transition to such systems is likely to be slow in many fisheries.

SANDY DAVIES, SOUTHERN AFRICAN DEVELOPMENT COMMUNITY

Enforcing regulations under an ecosystem approach will often require the implementation of good observer schemes. The photograph shows an observer for the squid bottom-trawling fishery in the Falklands (Malvinas) Islands. His task included measuring length frequency, sex and maturity stage of Patagonian squid to determine whether a new brood had entered the fishery. Such information is used to assist in determining fishery closures. Observers can also be used to provide important information on bycatch, discards and other matters relevant to EAF.

What are the key research requirements for EAF?

If carried out successfully, the EAF management process will highlight areas of uncertainty and show where further research is still required. It will identify the priority research needs for fishery management and assist in guiding research investment.

Examples of relevant areas of research that would lead to improved ability to implement effective EAF include the following.

- **Ecosystems and fishery impact assessments**
  Collection of better information on ecosystem function and assessment of the impact of fishing on non-target species through bycatch and discarding.
- **Socio-economic considerations**
  Investigations into the application of an integrated environmental and economic accounting framework to the assessment and analysis of the interactions between fisheries and other sectors of the economy.
- **Assessment of management measures**
  Further research on gear selectivity to reduce undesirable bycatches.
  Identification of species suitable for restocking and stock enhancement programmes.

- **Assessment and improving management measures**

  Improvements in the compilation of data for management plans.

  Research to further enhance and develop participatory processes.

- **Monitoring and assessments**

  The development of simpler rapid appraisal methods (in the field and at the analytical level).

  Identification of practical and feasible sets of indicators and reference points that could be used in EAF.

What are the threats to EAF implementation?

There are substantial obstacles to the effective implementation of EAF, as has already been seen in the difficulties countries have experienced in implementing the requirements of the Code.

Key impediments to EAF include the following:

- a mismatch between expectations of stakeholders, including the general public, and the resources available for fisheries management;
- difficulties in reconciling the competing objectives of multiple stakeholders utilizing resources from the same ecosystems;
- insufficient or ineffective stakeholder participation in the management process;
- insufficient knowledge of fishing and ecosystem interactions and of the response of different ecosystem components to specific management actions;
- inadequate capacity within management agencies and stakeholder groups to deal with the additional demands of EAF;
- insufficient education and awareness at all levels of EAF and the requirements for its implementation;
- difficulties in resolving issues related to equity;

- the costs and other problems involved in aligning ecosystem boundaries with the existing jurisdictions of the management authorities;
- controlling illegal behaviour by some stakeholders;
- finding means of adequately compensating those living in poverty and dependent on affected fisheries for any short- and medium-term negative impacts on their fishing activities brought about by the implementation of EAF.

Glossary

Access rights	An access right allows a vessel to be used in a managed fishery for the purposes and under the constraints specified in a management plan, e.g. to fish for a particular species up to specified proportion of the total allowable catch.
Biodiversity	The variability from all sources among living organisms including diversity within species (genetic diversity), between species and of ecosystems.
Bycatch	Species (or size classes) taken in a fishery targeting other species (or a different size range of the same species). That part of the bycatch which has no human value is discarded and returned to the sea, usually dead or dying.
Direct effects of fisheries	Direct effects of fisheries are direct impacts on the target and bycatch species or habitat. They include affects on the abundance, size structure and genetic composition of populations and damage to or destruction of sensitive bottom habitats.
Ecolabelling	A voluntary method of certification of environmental quality of a product and/or the environmental performance of a process based on consideration of the full production cycle and agreed sets of criteria.
Ecosystem	An organizational unit consisting of an aggregation of plants, animals (including humans) and micro-organisms, along with the non-living components of the environment.

Ecosystem health	A measure of ecosystem resilience (ability to maintain its structure and pattern of behaviour in the presence of stress), organization (number and diversity of interactions between ecosystem components) and vigour (a measure of activity, metabolism or primary productivity). A healthy ecosystem is able to maintain its structure (organization) and function (vigour) over time in face of external stress (resilience).
Ecosystem integrity	The ability of an ecosystem to support and maintain a balanced, harmonious and adaptive biological community and that has species composition, diversity and functional organization comparable to that of natural habitat in the region.
Fishing capacity	The total quantity of fish that could be taken by a fishing unit, for example a fleet, assuming that there was no imposed limitation on the fishing activities or yield from the stock.
Fishing effort	The total amount of fishing activity on the fishing grounds over a given period of time. Effort is often expressed for a specific gear type, e.g. number of hours trawled per day, number of hooks set per day or number of hauls of a beach seine per day.
Fishing mortality	A technical term which refers to the proportion of the fish available being removed by fishing in a small unit of time; e.g. a fishing mortality rate of 0.2 implies that approximately 20% of the average population will be removed in a year due to fishing.
Habitat	The environment in which the fish live, including everything that surrounds and affects its life: e.g., water quality; bottom; vegetation; associated species (including food supplies).

Incentive measure	A management measure intended to motivate or encourage stakeholders to conduct their activities in a responsible way that contributes towards achieving the goals and objectives. Incentive measures can include, for example, implementation of suitable systems of access rights, taxes and subsidies and market incentives such as ecolabelling and tradable access or property rights.
Indicator	A variable that can be monitored in a system, e.g. a fishery, to give a measure of the state of the system at any given time. Indicators are used to assist, for example, fishery managers to track how well the objectives (e.g. the state of the stock) are being achieved over time. Indicators should therefore be linked to specific objectives and to the related reference points.
Indirect effects of fisheries	Fisheries can affect a population or ecosystem indirectly by, for example, increasing or reducing the abundance of a predator, prey or competitor, or by damaging habitat that is important in the life cycle of organisms in the ecosystem.
Input control	Management measures used to control the time and place as well as the type and/or amount of fishing in order to limit catches and fishing mortality, e.g. restrictions on type and quantity of gear, effort, and capacity; closed seasons.
Integrated environmental and economic accounting	A system that considers stocks and flows of environmental goods and services. It uses a set of aggregate indicators to monitor environmental and economic performances, usually at the national level but, if data permit, at subnational levels and ecosystem levels, to guide policy-makers.
Interested party	See Stakeholder.

Institution	Using a broad definition, an institution is any form of relations between individuals or groups of interested parties and the State. These may include rules (e.g. defining the management rules and measures), mechanisms (e.g. the processes used in making decisions) and the organizational support structures that develop and implement the rules (e.g. a fishery administration, intergovernmental management body, gathering of village elders or committee of users).
Legal instrument	A broad term that includes any accord or law (for example convention, treaty, agreement, decree, act of parliament, regulation) that creates binding obligations for States, entities or persons to which it applies.
Limited entry	A common management tool in which the government issues a limited number of licenses to fish, thereby limiting the number of participants in the fishery.
Management measure	A specific control applied in a fishery to contribute to achieving the objectives, including some or all of technical measures (gear regulations, closed areas and time closures), input controls, output controls and user rights.
Management plan	A formal or informal arrangement between a fisheries management authority and interested parties or stakeholders which identifies the partners in the fishery and their respective roles, details the agreed objectives for the fishery and specifies the management rules and regulations which apply to it and provides other details about the fishery which are relevant to the task of the management authority

Marine protected area (MPA)	An area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the environment within the MPA.
Monitoring control and surveillance (MCS)	Monitoring gathers information on the fishery that is used to assist in developing and assessing appropriate management measures (controls), while surveillance uses this information to ensure that these controls are complied with.
Operational objective	A target that is actively sought and provides a direction for management action. For example, achieving a specified income for individual fishers is one possible economic objective of fisheries management.
Output control	Management measure aimed at directly limiting the fish catch or landings through e.g. a total allowable catch and quotas
Participatory management	Participatory management in fisheries brings together the different stakeholders for the purposes of sharing one or more of knowledge, authority, and responsibility for planning and implementation. The amount of sharing can range from consultation to full responsibility for making, implementing and reviewing decisions.
Precautionary approach	The precautionary approach involves the application of prudent foresight when action needs to be taken with incomplete knowledge. It requires that where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.

Reference point	An estimated value derived from an agreed scientific procedure and/or an agreed model which corresponds to a desired (target) or undesired (limit) state of the resource, the fishery and stakeholders, or the ecosystem and can be used as a guide for fisheries management.
Restocking	The release of cultured juveniles into the wild to restore the spawning biomass of severely overfished stocks to levels at which they can once again provide sustainable yields. Restocking requires managers to protect the released animals and their progeny until replenishment has occurred.
Stakeholder (also referred to as an interested party)	Any person or group with a legitimate interest in the conservation and management of the resources being managed e.g. participants in a specific fishery, recreational fishers, conservation interest groups, artisanal fishers, fish processors and traders, government. The public and the consumers could also be considered as interested parties in some circumstances.
Stock enhancement	An activity or programme designed to increase the size or growth of the fishery resource stock. It may include restocking programmes but can also involve activities such as habitat engineering and introducing new species or new strains of existing species.
Target resource-oriented management (also referred to as the single-species approach)	A term used to refer to conventional fisheries management in which the stock of the target species is the main concern of management actions.
Territorial use right (TURF)	Fishery management methods that assign rights to individuals and/or groups to fish in certain locations, generally, although not necessarily, based on long-standing tradition.

Technical measure	For the purposes of this publication, technical measures are defined as restrictions or constraints to regulate the output which can be obtained from a specified amount of effort. They can include gear restrictions, closed seasons and closed areas. The term may also be restricted to refer specifically to measures intended to effect the efficiency of fishing gear.
Total allowable catch (TAC)	The TAC is the total catch allowed to be taken from a resource in a specified period (usually a year), as defined in the management plan. The TAC may be allocated to the stakeholders in the form of quotas as specific quantities or proportions.
Vessel monitoring system (VMS)	As part of modern monitoring, control and surveillance (MCS) systems the VMS is a vessel tracking system (usually satellite-based) which provides management authorities with accurate information on fishing vessels position (and speed) at time intervals.

APPENDIX

DEVELOPING AN EAF MANAGEMENT PLAN

As discussed in pages 37 to 41, a management plan is a formal or informal arrangement between a fishery management authority and stakeholders. It provides information for all those with interests in a fishery, or an ecosystem, on key aspects on the resources, the ecosystem, the nature and importance to humans of the fisheries, and all aspects of how the fisheries will be managed. Whether or not there is a management plan in existence for a particular fishery or set of fisheries at present, the formal development of an EAF management plan will be an important guide to developing an ecosystem approach. The plan will be an essential tool in implementing the approach. This Appendix describes a process for development of a management plan that could help managers and stakeholders to ensure that the final plan satisfactorily addresses the goals and needs of all the legitimate stakeholders, that it considers the major interactions between fisheries and species and that it is comprehensive and achievable.

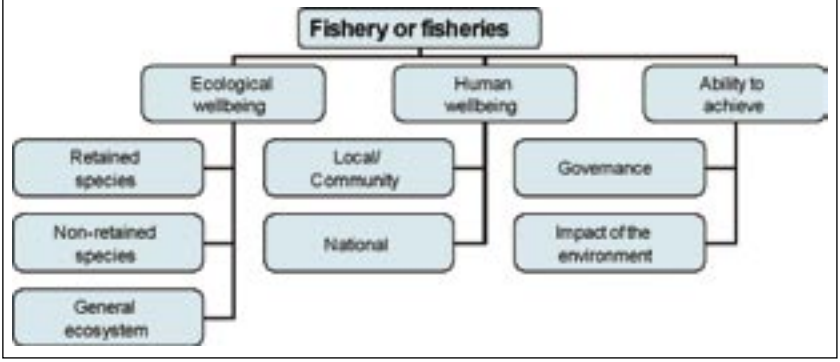
STEP 1: DEFINE THE SCOPE OF THE FISHERY MANAGEMENT PLAN UNDER EAF

Identify the fishery or fisheries, geographic area and stakeholders: The spatial coverage of the management plan must coincide with a well-defined ecosystem. Ecosystems, however, are not clearly defined entities with definite and fixed boundaries, and they may cross or be contained within fishery management areas. A preliminary specification of the area concerned is necessary, if only to allow the identification of stakeholders with common or competing interests. EAF will need to recognize the existing fisheries, management entities and jurisdictions and build on these as necessary to ensure that management recognizes and is consistent with the ecosystem boundaries.

Identify and evaluate the broad issues: This is the first step in developing operational objectives for a fishery or ecosystem and provides a preliminary evaluation of the issues associated with a fishery. The step is intended to identify the potential consequences, positive and negative, that the existing fishery or fisheries and the current or potential management tools may have for the ecosystem and the stakeholders. The evaluation should consider the human (economic and social) and ecological components of sustainable development and it should start from and be guided by the high-level policy goals set at the national or regional level. The high level policy goals are likely to be found in the national or local legislation, such as a national fisheries act and environmental acts.

Under EAF, consideration of the impacts of fisheries will need to be expanded to include not only sustainable use of the target resources and its benefits for humans but also impacts on and benefits from other living and non-living ecosystem components. This would include, for example, the direct effects of fishing on discarded species and on the habitat, as well as the indirect effects of the fishery on ecosystem structure and processes, for example by altering the balance of predator and prey or influencing competition between different species. Any issues related to implementing the current or future management should also be examined.

The first step in developing operational objectives for a fishery or ecosystem is to undertake a preliminary evaluation of the issues associated with a fishery. The evaluation should consider the ecological and human (economic and social) aspects of the fishery or fisheries as well as issues related to implementing the current or future management (ability to achieve). An analysis of broad issues, and the finally agreed operational objectives, should start from and be guided by the high-level policy goals set at the national or regional level.



STEP 2:
COMPILE AND ANALYSE BACKGROUND INFORMATION

When all the potentially important issues have been agreed, relevant information on all aspects of the fisheries and ecosystem, including the people dependent on them for their livelihoods, must be compiled and analysed to allow for the formulation of more detailed objectives. This information will be important for later steps in the process.

The information requirements are outlined on pages 9 and 10 of this document.

STEP 3:
SET OBJECTIVES

Setting the broad objectives: The *broad objectives* for the fishery provide statements of the intended outcomes of the fishery management plan in addressing the set of issues identified in Step 1 above. These broad objectives provide a link between the principles and policy goals and the specific detail on what a particular fishery is trying to achieve. For example, working from the general terms of a fisheries policy, the broad management objectives for a given fishery might be identified as to:

- keep harvested species within ecologically viable stock levels by avoiding overfishing and maintaining and optimizing long-term yields;
- maintain habitats and populations of non-retained (bycatch) species within ecologically viable levels;

- keep impact on the structure, processes and functions of the ecosystem at an acceptable level;
- maximize net revenues;
- support regional employment.

It is important that those responsible for setting the broad objectives consult with those with responsibility for implementing the relevant policies and agreements. In most situations, this will involve several levels of government and several major stakeholder groups.

Developing operational objectives from broad objectives: The broad objectives provide more detail than the issues identified in Step 1 but they are still too broad to be implemented by a manager and they must be translated into even more specific *operational objectives*. Operational objectives should have direct and practical meaning for the fishery being considered. They provide the yardstick against which the performance of the fishery and its management can be evaluated. Operational objectives should be achievable, able to be measured and linked to a specific time period. The process for deriving operational objectives from policy goals should be as transparent and participatory as possible to ensure interested parties feel a sense of ownership and to encourage compliance.

There is a practical limit to how many operational objectives (and linked indicators) are useful for management decision-making. There should be a process of screening the possibilities, and only the most important and feasible ones should be selected. The consultation and decision

process will vary from one fishery to another, but it will involve three tasks:

- identify the detailed issues relevant to the fishery under each of the broad objectives
- prioritize the issues based on the risk level they pose (see Task 2, pages 71 and 72).
- develop operational objectives for priority issues, and as necessary, a process for monitoring lower priority issues.

These tasks should be undertaken in full consultation with representatives of the stakeholders. It will also be important to involve technical experts who can provide relevant technical and scientific information where it is needed. In some cases, it may be found that the information available is inadequate to address some important concern or to resolve differences of opinion, and there will be the need for additional data analysis or collection before further progress can be made. However, even if good information is not available and cannot be produced, the process should still be followed using the best available information, which could be in the form of expert opinions and unbiased qualitative judgements.

Task 1: identify the issues under each of the broad objectives

This task involves a further step in breaking down the goals found in the national fisheries legislation, into the detailed concerns, or issues, at a level at which they could be directly addressed by a manager or management agency.

For example, starting from the following broad objective:

to manage harvested species within ecologically sustainable levels by avoiding overfishing and maintaining and optimizing long-term yields.

the following issues relevant to this objective and referring to the target-species could be identified for the fishery in question:

- the spawning stock declining to a level that could lead to reduced recruitment;
- the older age classes being removed from the stock by fishing leading to a lower long-term yield (growth overfishing);
- the stock is reduced to very low densities in some parts of its range, leading to lower productivity and less efficient fishing operations;
- etc.

The broader EAF issues would also need to be identified. For example, the target-species in this fishery could be important prey for the target-species in another valuable fishery. In that case it may be necessary to ensure that the abundance of the prey species was not reduced by the first fishery to a level at which the productivity and yield of the predator was adversely affected.

By a similar process, other broad objectives might be translated into specific issues against which operational objectives can be set. For example, specific issues related to an ecosystem approach could

include: minimizing the catch of selected vulnerable or endangered species, maintaining the area of identified essential habitats, maintaining selected prey populations at high abundance to allow for predator feeding, and achieving an acceptable net economic return on capital.

In identifying the issues, it is important to ensure that all possible interactions between a fishery and the ecosystem have been considered. As a part of the process that has been followed in Australia to implement "ecologically sustainable development" for their fisheries, useful guides and frameworks have been developed for identifying issues in fisheries and prioritising them. Ecologically sustainable development in fisheries is effectively equivalent to EAF and the Australian guidelines are useful in EAF as well. Two reports of particular relevance are:

- **Fletcher, W.J., Chesson, J., Fisher, M., Sainsbury, K.J., Hundloe, T., Smith, A.D.M. & Whitworth, B.** 2002. National ESD Reporting Framework for Australian Fisheries: The "How To" Guide for Wild Capture Fisheries. FRDC Project 2000/145, Canberra, Australia.
- **Fletcher, W.J., Chesson, J., Sainsbury, K.J., Hundloe, T. & Fisher, M.** 2003. National ESD Reporting Framework for Australian Fisheries: The ESD Assessment Manual for Wild Capture Fisheries. FRDC Project 2002/086, Canberra, Australia.

The full reports can be found at www.fisheries-esd.com

Task 2: rank the issues

This stage involves reviewing the detailed issues which have been identified in Task 1 above, and identifying the most important of them that need to be addressed by management. Operational objectives, indicators and reference points will need to be developed for the high-priority issues so that suitable management measures can be identified and progress in achieving the objectives can be monitored. One way of identifying the high-priority issues is to conduct a risk assessment. A risk assessment can range from a qualitative and opinion-based exercise to a quantitative and data-based assessment. The choice of the approach to follow will usually depend on the amount of information available and the capacity of the group to develop and utilize mathematical models. Where the information or skills to undertake a more quantitative approach are not available, it is still possible to use the best available information to estimate the likelihood of an undesirable event happening and the consequences, in relation to the operational objectives, if that event did occur. For example, scores on a scale of, say, 1 to 5 could be allocated separately to the likelihood and the consequence of an event. The relative priority of that event would then be the risk value, which is calculated as the score for the likelihood multiplied by the score for the consequence. Comparing the risk values for different events provides a means of prioritizing the events, or issues.

The two reports listed under Task 1 also provide useful guidance on this task.

Task 3: develop operational objectives for priority issues

Each issue is then dealt with in the management plan in a manner that depends on its allocated risk value. Issues with high risk values are elaborated into detailed operational objectives and comprehensive plans made for addressing them in the EAF management plan. Some issues with medium risk values might require identification of a mechanism in the plan for ongoing review and some form of back-up plan. Low-risk issues might be noted in the plan, explaining why they are considered low risk.

STEP 4: SELECT INDICATORS AND REFERENCE POINTS FOR EACH OPERATIONAL OBJECTIVE

The next step is to agree on **indicators**, **reference points** and **performance measures** for each of the objectives identified. Under EAF, the standard single species reference points and indicators will usually need to be complemented with others addressing the ecological, social and economic operational objectives.

Each **indicator** should be an ecosystem or population property that is thought to be modified by the impact of the fishery so that its value would change if the fishery impact changes. The final selection of indicators and reference points should also take the technical, management and operational issues of a given fishery into account. The

management agency must have the capacity to measure the indicators and to monitor them regularly.

All stakeholders should feel confident that the indicators are both meaningful and workable.

The overall aim in setting indicators, reference points and performance measures is to provide a framework to evaluate whether the management rules are having the desired effect and to assess the performance of the fishery in achieving its objectives.

STEP 5: FORMULATE RULES

The next step in developing the management plan is to choose a suitable management measure or set of measures for achieving each objective. The management measures are intended to control or moderate the impact of the fishery on the target resources, bycatch species and the ecosystem.

For example:

- *catch controls* might be advocated for a fishery that catches only a few species as a means of ensuring that the most important species retained by the fishery are not overexploited;
- *effort limitation* might be more suitable for a fishery catching a number of different species including discarded species of conservation interest, as a reduction in effort, where required, will benefit sustainable use all of those species, although to varying degrees;

- *closed areas* might be proposed in another case where, for example, vulnerable life stages or species of conservation concern consistently occur in known areas or as a means of protecting important habitats from damage.

In practice, a management regime or management strategy will consist of a mixture of different management measures, each intended to help to achieve one or more operational objectives. Together, this mixture of measures should achieve the full set of objectives for that fishery or ecosystem.

The development of measures and decision rules should ideally be underpinned by good information that, in data-rich situations would include results from rigorous data analyses, including modelling the dynamics of the system or sub-system. In data-poor situations, the best available information should be objectively analysed and considered. In both cases, validated stakeholder information, including traditional ecological knowledge where it is available, should be included. As far as possible, management measures that have minimum undesirable impacts on all operational objectives should be selected.

It is more difficult to formulate effective rules and management measures in a multispecies fisheries than in a single species fishery or one with only a few target species because of differences in the productivity of the species caught. In a multispecies fishery, decisions about adjustments to management rules should be based on indices that reflect the general state of the resources and

take into account the operational objectives for both high productivity and low productivity species.

STEP 6: DEVELOP A MONITORING, ASSESSMENT AND REVIEW PROCESS

The EAF management plan should include arrangements for undertaking regular reviews to assess the success of the management measures in attaining the agreed objectives. The reviews should involve all stakeholders and allow for objective examination of the actual performance of the management measures. The review should examine progress in achieving the objectives and identify and correct any problems that have occurred. To do this, participants in the review will need to be well-informed by comprehensive reports produced by technical experts, based on analyses of data and information collected by an effective and well-directed monitoring programme during the implementation of the management plan. In addition, the review panel should consider information and perceptions from the stakeholders.

It will usually be necessary to conduct both short-term and long-term reviews. Short-term reviews could be undertaken every year to ensure that nothing unexpected is occurring in the ecosystem and allow for minor adjustments to the management measures where necessary. Short-term reviews will be important for regular, often annual, adjustments to more flexible management measures such as total allowable catches or allowable fishing effort.

Long-term reviews, typically every three to five years, will be more comprehensive and may re-evaluate the entire management plan, including checking to see whether the operational objectives are still suitable for all involved.

Although the principles of an ecosystem approach to fisheries (EAF) are not new, there is very little practical experience in their implementation. Translating high-level policy goals on EAF into operational objectives and actions is now the key challenge to sustainable fisheries.

This booklet will provide an overview of EAF, for marine capture fisheries, and its benefits; consider what is required to implement EAF; consider the range of management measures available; provide an overview of the management process; outline any outstanding research requirements; and list the main threats to the implementation of EAF.

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