ANNEX IV PAPERS PRESENTED AT THE WORKSHOP

FISHERIES MANAGEMENT

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WHAT IS FISHERIES MANAGEMENT

Fisheries management can be simply described as the rational exploitation of fisheries resources based on notions of sustainability, efficiency and equity.

A fuller working definition is offered by FAO 1997 (Technical Guidelines for Responsible Fisheries. No 4. Fisheries Management. Rome, FAO. 1997. 82p.) as:

"The integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and accomplishment of other fisheries objectives."

Whichever definition you prefer, the main point to note is that fisheries management covers all aspects of exploiting natural aquatic resources not only the scientific, economic or monitoring control and surveillance (MCS) aspects.

This process of rational exploitation is generally the responsibility of the State or States into whose jurisdiction the resource falls. A fisheries management authority is usually designated to manage the fisheries. This may be a ministry, department, agency or community organisation of national, regional, or international nature.

WHY DO WE MANAGE FISHERIES

When asking why do we manage fish stocks it may be suitable to ask what happens if we don't? A common explanation is that by not controlling a fishery with rules on access rights and controls on fishing we would repeat the 'tragedy of the commons'.

There are three main reasons why free access and unmanaged fishing methods are to be avoided:

1. Over-exploitation or depletion of the stock to biologically harmful levels, which will result in a loss of potential benefits such as food, income and employment, both immediately and in the long term;

2. Ecological damage that may result in negative affects on the fish population itself and also on other species in the habitat. This is because a very low level of any stock is likely to have negative impacts on other dependent stocks and

3. Economic waste due to over investment in the fishing activity causing over capacity and resulting in the loss of future economic income.

Therefore we can answer the question as to why do we manage fisheries by stating that we manage fisheries in order to assure the best long-term use of the fishery either for biological, social or economic reasons.

IMPORTANT CONCEPTS AND ELEMENTS IN FISHERIES MANAGEMENT

OPTIMUM USE OF RESOURCE

Resource Constraints and Stock Assessment

Fish stocks are very variable, that is they fluctuate in abundance and structure from year to year due to natural changes as well as due to human interactions.

Understanding the status of fish stocks at a given time or in order to predict the status is a very complex task known as stock assessment. There are many forms of stock assessment, some simpler, some more complex, but they all require some level of information or data obtained from monitoring the resource. It is not necessary to go into different stock assessment methods in this context. It is enough to know that in assessing a fishery you should always use the best available estimate of the stock or the most reliable estimate and that you should continuously look for means to improve these estimates through improved monitoring programmes.

Scientists usually carry out the actual work of stock assessment. These scientists may be working directly for the fisheries authority such as a Ministry or they may be contracted through an Agency etc. to perform this work. However, this work should not be seen as the private domain of scientists as the work of monitoring is performed by a mixture of different people from various aspects of the fisheries organisation. Data are collected by scientists on dedicated research cruises and fishing trips, by inspectors and data collectors through the collection of logbook and landings information, by at-sea observers and landings monitors through the biological sampling of catches and information on fishing activities and by administration personnel through the collection of licence and vessel information.

It is therefore recommendable to try to develop communication links and feedback between these different groups. In the end the fuller the understanding of all fisheries staff of the different roles in the organisation and the links between them the more successful the organisation is likely to be.

Maximum Sustainable Yield

One very basic concept in fisheries management and one of the simplest stock assessment tools is that of Maximum Sustainable Yield (MSY). Figure 1 depicts this concept and shows how initially when fishing effort increases the yield in weight also increases. At the point where the graph starts to flatten out an increase in effort no longer results in an increase of the catch and if fishing effort continues to increase then the catch will actually decrease. This is because the fish stock has passed its MSY and growth overfishing is occurring. This means that the resource does no longer reach its maximum possible biomass, fish remain smaller on average and more effort is spent on catching less fish. (This does not mean that the parent fish are so heavily fished that they are unable to replenish the stock with young fish. That is so-

called recruitment overfishing and that happens when the Spawning Stock Biomass (SSB), the parent stock, is brought down to a very low level.)

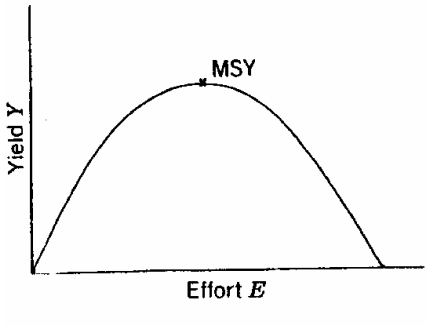
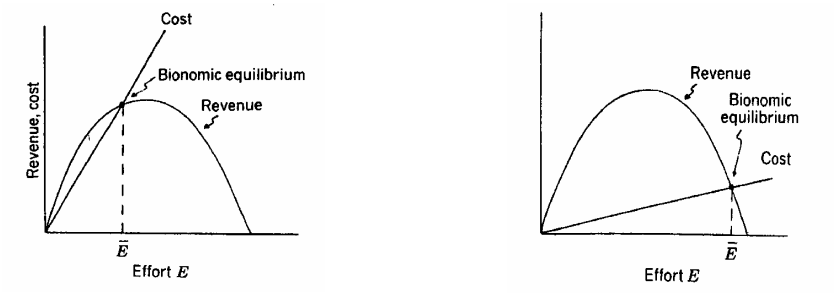


Fig. 1 The sustainable yield-effort curve (from Schaefer, 1954)

The concept of MSY is used when optimum fish production (catch) is an objective and it is based on the theory that annual catch from a fishery should not exceed the annual production of that fishery. The aim is to avoid overfishing of the stock but at the same time to allow the maximum catch to be removed.

It is a very simple concept that has many limitations in the real world but it is still often referred to when discussing the biological maximum yield of the stock. Current thinking suggests that this biological optimum yield should be a limit rather than a target as this allows for some uncertainty in the variability of annual production.

One of the important limitations with the MSY approach is that it is not effective when you have multi-species fisheries as fishing of one species will affect the other and the total MSY for a multi-species assemblage will be less than the sum of all the separate MSYs. In other words you cannot simultaneously harvest each species at MSY level when you have an assemblage of different predators and prey.



(a) *(b)*

Fig. 2 The static Gordon-Schaefer model: economic equilibrium at (a) high cost and (b) low cost.

Economic Considerations

While the MSY is the biological measure of optimal production the economic potential of the fishery is known as the Maximum Economic Yield (MEY). Figure 2 depicts MEY when p = the price of the fish, c = the opportunity cost for a unit of effort, the revenue curve is

R = pY and the cost line C = cE. Cost is directly proportional to the effort and therefore graph **(a)** shows the cost line when costs are high (e.g. deep-sea fishing) and graph **(b)** shows the cost line when costs are low (e.g. low technology inshore fishing).

The open access equilibrium is the point in a fishery when costs are equal to revenue and the point when fishers will start to leave the fishery. Figure 2 indicates how this is sooner if the costs are high **(a)** than if the costs are low **(b)**. It can also be seen how the second situation **(b)** would encourage more entries into the fishery and therefore encourage a higher risk of stock collapse and higher expenses in terms of effort.

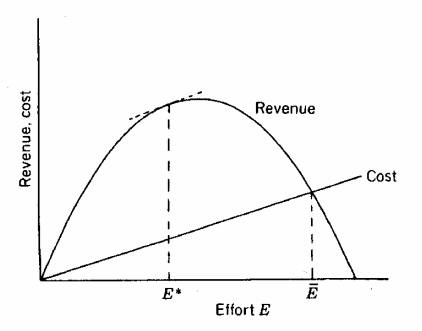


Fig. 3 The static Gordon-Schaefer model
Maximum Economic Yield (MEY) occurs at E = E*

The optimum level for economic exploitation is at the point when the difference between the costs and the revenue is the greatest (MEY). As can be seen in Figure 3 this is to the left of the peak of the curve and therefore at a lower level of fishing effort than the MSY.

The use of economic potential is considered important due to the viewpoint that it is important to consider the benefits of fishing to all resource users, that is recreational, traditional subsistence, semi-commercial and commercial users. It is considered that in most cases fishers fish to make an income not to catch fish *per se* and therefore in a commercial fishery the costs and income need to be considered. MEY is again a very simple model and in reality many limitations occur but it is a useful tool to gain a basic understanding of the different elements that need to be considered when making management plans.

Social Considerations
Often the economic objective of MEY or the biological objective of MSY are seen to be too narrow. The social effects of fisheries management are also considered as important elements of fisheries planning. Therefore the concept of Maximum Social Yield (MScY) has also been introduced.

This is a very difficult measure to deal with, as it is more abstract in nature. The concept behind it is to see the economic yield in view of the distribution of this yield or catch in the community not as merely simple fixed gain or loss. Therefore if you find a scenario such as ‘no alternative employment’ to the users of the resource then this may justify a permissible increase in the level of fishing above that allocated when a purely economic viewpoint is considered.

Environmental Constraints and Considerations
Environmental variability has a direct effect on the health of stocks and thus productivity. It will specifically influence:

- The recruitment of young fish into the fishery, that means the annual addition of new fish to the stock,
- The fish distribution in the water which may influence the ability to catch the fish and
- The 'carrying capacity' of the habitat, this means that it will change the ability of the environment in a more or less favourable way to be able to support the stock to grow and prosper.

This last point is of special interest as human influences on the habitat can also increase or decrease the carrying capacity of the habit. For example, the creation of artificial reefs has been seen as habitat enhancement.

Biodiversity and Ecological Considerations
Fishing activities may have positive or negative effects on other components of the ecosystem through the food chain effect, by-catch or physical damage. It is therefore important to strive for the sustainable use of the entire ecosystem not just the species being targeted in any one management plan.

MANAGEMENT DATA AND INFORMATION REQUIREMENTS

Management data is needed at all the levels of policy and management plan development and implementation. As you move through the levels, the degree of aggregation and synthesis increases, with policy decisions and review requiring the most aggregated data.

Management data required includes scientific, MCS, administrative, social and economic data. The data required for MCS can vary greatly from the more simple collection of catch and effort information at landing points or through logbooks to the dedication of patrol planes and vessels to the task, with the large legal and administration structures required to support these.

MANAGEMENT MEASURES

In order to maintain the fish stocks at a target level, the management used is that of controlling fishing mortality, that is the amount and age of the fish removed. This can be achieved by three methods that are often used in combination:

Technical Measures
These are restrictions or constraints that regulate the efficiency of fishing; they include closed seasons, closed areas, gear restrictions such as type of gear, mesh size and control of attachments to gears.

Input Controls
This is control of the effort put into the fishery, e.g. various forms of limited entry. Effort can be measured in many ways e.g. number of vessels combined with size, horsepower, number

of crew, number of fishing lines or gear; number of fishers combined with the gear they are using; or the number of days fished or other time measure.

It is vital that if this type of control is being used that the increase in the technological ability of gears and fishers is taken into account. As this increases so does the effort and efficiency of the fishery.

Output Controls
This is the direct regulation of the catch taken from the fishery, e.g. forms of quota management. This is a more total control of the primary factor 'the catch', but it can be both expensive and complex to enforce. Additional controls on the catch can also be made such as the size of fish or the sexual state of the fish.

KEY TASKS OF THE FISHERIES MANAGEMENT PROCESS

Fisheries management entails a complex and wide-embracing set of tasks. Sometimes one of these tasks are mistakenly considered separately as representing the whole picture of fisheries management such as MCS or stock assessment. However, in reality each of these separate components has a vital role to play in the overall picture of fisheries management and one cannot be effective without the others.

The modern outlook is to move towards an integrated approach to fisheries management. This includes all fisheries components, in particular the fishermen, governments, NGOs and other interest groups in the whole process. This is of key importance to encourage confidence in the fisheries management regimes and plans and to move towards more appropriate and participatory ways to manage fisheries.

SETTING FISHERIES POLICIES

Fisheries policies give broad directions and priorities on how the resources of a nation or region are to be utilised. These policies consider the biological characteristics of the stock, the nature of existing or potential fisheries and other activities related to or impacting on the stock. They also consider the potential economic and social contribution of the fishery to national or local needs and goals.

This is the level of macro-economic and macro-policy setting. At this level no detailed information is used, as it is more a matter of using aggregated information on the fisheries and linking this to national development planning strategies and broader economic and social strategies. In practise it is common that all the information that is ideally wanted is available, this is especially common if not much fisheries management has taken place to date. Whatever the situation, it is important to aim to collect as much information on costs, benefits and alternative uses for the resources as is possible, before policy setting occurs.

The policy produced may be in the form of a white paper or other documentation, but it is common for this policy to be an important guiding and binding document.

One of the most important elements of the policy will be the criteria by which access to the resource is granted, e.g. the policy could stipulate whether preference in each fishery should be given to small-scale traditional fishers or to large-scale industrial fisheries or to some other

arrangement. The policy may also translate national policy on employment, treatment of small and medium enterprises and other issues into a working policy for the fisheries sector.

Review of fisheries policy is required and will depend on changes in the national or regional scene. It is advisable to review any policy at least every five years. This review will require:

- Scientific information on the state of the stock;
- Economic information on the performance of the fishery;
- Costs and effectiveness of all MCS activities;
- Economic and social assessment of impacts of the policy on the fish stocks and the communities exploiting them.

MANAGEMENT PLANS AND STRATEGY DEVELOPMENT

Management plans and strategy setting is all about determining a detailed plan of what is required to achieve the policy objectives for that fishery resource. It is a task that, although usually performed by the fisheries management authority, is best performed with full participation of all interest groups. This will hopefully assure confidence in the resultant plan and strategy and assure a commitment to the implementation of it. However, far too often this isn't the case, the management plans are designed in an ad hoc manner by government staff behind closed doors. This should be avoided whenever possible as it will create a lack of trust and will result in more work and effort further down the road when implementing the plans is required.

Because of the importance of MCS, the implementation of the plan and the implementation of alternative management plans must be seriously considered by management authorities when selecting the most appropriate plan. Management plans should not be adopted where the implementation cannot be adequately monitored and controlled.

For example, the use of total allowable catches (TACs) for catch control means that all landings must be monitored (even if by sampling) and catch by species recorded in close to real time. Also adequate steps are required to prevent discarding at sea and the unregistered transshipment of catches. It must be asked; can the MCS organisation implement these required checks; or can the organisation be realistically developed to do so?

Another example would be that effort control is generally less expensive but it requires accurate fleet registration, close monitoring of fleet performance and of the technical or operational developments that may affect efficiency. Again the question must be asked can the MCS organisation do this?

Even a simple management measure such as closed seasons or closed areas requires the ability to patrol in the closed times and areas to ensure that the management plan is really implemented.

In all cases the most appropriate combination will depend on the nature of the resource, the fishery, any national policies and the capacity of the management authority to enforce the plan.

An outline for a possible Fisheries Management Plan could be (FAO, 1977):

1. Title
2. Area of operation of the fishery and under which jurisdiction it falls
3. History of fishing and management
4. Particulars of the recognised interest groups
5. Details of consultations leading to the formulation of the management plan
6. Arrangements for on going consultations with interest groups
7. Details of decision-making process or processes, including the recognised participants
8. Objectives for the fishery
    a. *Resource*
    b. *Environmental*
    c. *Biodiversity and ecological*
    d. *Technological*
    e. *Social*
    f. *Economic*
9. Outline of the fishery resources including particulars of life histories as appropriate
10. Outline of fleet or fishing categories participating in the fishery
11. Outline of status of the stocks as indicated by stock assessments
12. Description of aquatic ecosystem
13. Details of non-fishery users or activities which could impact on the fishery and arrangements for liaison and co-ordination
14. Details of access rights and the groups or individuals given them
15. Description of the measures agreed upon for the regulation of fishing in order to meet the objectives within a specified time frame
16. Specific constraints e.g. details of any undesirable by-catch with details
17. Details of any critical environments or sources of concern and actions required to address them
18. **Particulars of arrangements and responsibilities for MCS and enforcement**
19. Details of any planned education and training for interest groups
20. Date and nature of next review and audit of management plan

In general we can say that a rule of thumb is that management plans need to be reviewed and evaluated every three to five years.

IMPLEMENTING MANAGEMENT PLANS AND STRATEGIES

Management implementation involves the action and decision-making necessary to ensure that the management plan is put into operation and functions efficiently. It therefore includes responsibilities such as:

- Collecting and analysing the biological and fishery data necessary for assessment, monitoring, control and surveillance;
- Adoption and promotion of appropriate and effective laws and regulations necessary to achieve objectives;
- Ensuring that fisheries comply with them to achieve the objectives.

In order to do this effectively you need:

- A legal framework;
- An institutional framework;
- An administration structure;
- An MCS organisation;
- A scientific capacity.

MCS IN FISHERIES MANAGEMENT

MCS activities should relate to specific management objectives. Therefore clear management statements are required to develop MCS to the appropriate levels and at an appropriate cost. Even if full management plans are not in place some indication of management objectives and the measures that will be used are required. Priorities in the MCS system relate to the priorities in Fisheries Management objectives.

In setting fisheries policy, the previous records of success or failure in MCS in the region are important in evaluating the likelihood of success of the proposed approaches in the new policy.

CONCLUSION

In most cases fisheries management starts with considering the biological stock and striving for maximum sustainable yield. As the management capacity and availability of information increases the economists usually start to press for acknowledgment of the economic implications of the fishery and in particular the concern of over capacity. Their main cry is to try to take maximum catch at lowest cost rather than the biological approach of maximum sustainable catch. Once the economic aspect has been considered we usually find that close on the heels to the economists are the social scientists. Their common cry is that fishers do not necessarily all act in a manner to maximise there income and that it is therefore important to view what is socially ‘just’ and acceptable as well as the purely economic and biological considerations.

When the objectives for fisheries policy are set we are unlikely to see the goals given as MSY, MEY or MScY they are more likely to be given as:

- Increased food supply or improved food security (more fish at a lower price);
- Increased export earnings;
- Increased income for the fishing population;
- Increased employment possibilities for the fishing population.

However, with a little understanding it is easy to see the underlying concepts that drive these political, social and economic policies. Understanding these basic principles also allows us to see the conflict in applying all of these goals to the same fish stock, that is trying to aim for MSY, MEY and MScY all at the same time. Interestingly enough fisheries policies often ask for this. The result of this is that when the scientists, economists and social scientists are asked for their advice on the appropriate levels of catch for a stock for the coming year, their advice may well be conflicting. The dilemma will then be in the hands of the politicians to decide which advice to take. Often a compromise choice is taken, which leaves no clear target and tangible for the management of the fishery.

It is only through grasping the larger picture of fisheries management even in a simple form that the links between each element of the fisheries organisation can be fully understood. These will vary in every situation and it is not easy to give generic examples, but suffice to say that every role is intricately linked to every other role in the holistic approach.

Cost effective and efficient MCS contributes to effective fisheries management, which at the end of the day is itself, only one part of the larger picture of sustainable ocean and global management.