3. Operational Fisheries Management

3.1 Introduction

Fisheries Management is a term that has come to mean many different things to different people. Characteristically, those undertaking fish stock assessment have used it to describe the process of determining how much fish resources are available and, and what amount of catches should be permitted from the different stocks. Equivalently, it may be considered as the task of determining the amount of fishing effort, or fishing mortality (**F**), that should be allowed on a stock basis. Those responsible for economic and social analyses, and policy formulation and appraisal, also describe their activities as fisheries management while departments undertaking market analysis and product development may also claim that the term describes their activities.

This multiplicity of use of the term *Fisheries Management* becomes more than just a matter of semantics when those in different sectors of fisheries start talking at cross purposes without ensuring that, in fact, the same issues are being discussed. Problems do arise in large departments, or among those who do not have a good understanding of the different functional characteristics of fisheries management, when issues or problems relating to one aspect of fisheries management get assigned to an inappropriate branch of a department to resolve. If the issue is to do with the "nuts and bolts" of the annual process of administering a fishery, asking those responsible for strategic planning will unlikely produce the best result. Or, if the issue is one of the sustainability of the resource in relation to the question of expansion of a fishery, then assigning the problem to the Section responsible for industry development will be unlikely to ensure that the right advice is forthcoming, particularly if they have an added responsibility of finding a use for some surplus fishing vessels.

This section develops a particular perspective, or understanding, as to what *Operational Fisheries Management* is. It many ways it is easier to determine what Operational Fisheries Management (OFM) is not. It does not entail strategic planning - that activity is responsible for determining and articulating the overall objectives that are set for a fisheries department. Neither does it relate to the policies that may be selected to achieve overall planning objectives. For example, a fisheries department might decide that its objectives would be best achieved through introduction of a policy of a rights-based system of fisheries management using individual transferable quotas; another department may believe

that a simple global fleet quota is the best means of achieving its objectives[1]. Nor is it to do analysis of the economics, or social costs and benefits, of a particular policy option. Rather, it is to do with operational issues. These may be as mundane (but still important) as procedures for ensuring the collection of data, a task that may form part of the conditions of a fishing licence - and licensing, or licence renewal, is often part of the annual management process. For example, licences may be issued but be subject to the licence holders providing catch and effort data in a prescribed manner. Likewise, OFP plans are related to the activities of Monitoring, Control and Surveillance (MCS) in that how fishing may be legally undertaken is usually specified in the OFM plan; and it may specify other requirements to ensure compliance with fishing regulations.

But the core of Operational Management Planning consists of (a) the documentation of the manner by which a fishery will be prosecuted in the following management cycle - usually a year; and (b) the process that is used to do this. The contents of an Operational Management Plan provide interpretation of Strategic Planning - the overarching objectives and goals of the minister or his representatives, e.g. usually deputy ministers. As such, the OMP implements management policy - it does not set it. They provide the guiding interface between the managers (usually a department or ministry of fisheries) and those who prosecute the fishery - the fishing industry and the fishermen.

A logical question is whether the issue of Operational Management needs particular attention. It is usual that many staff in fisheries departments have studied fisheries in universities or another relevant discipline, e.g. economics or biology, but these subjects are usually taught by those who have never worked in a fisheries department and thus never had the line authority for making management decisions. Further, the topic does not lend itself to an academic approach - little scope, if any exists for undertaking research or writing scientific papers about the activity, it being primarily a matter of administration.

3.2 Elements of the Operational Fisheries Management Process

Annual management plans provide the operational basis for managing a fishery. Such plans specify how fishermen may exploit the fish stocks on an annual, or seasonal, basis and

[1] Interested readers may wish to refer to the following publications for more information: Barber, W.E. and J.N. Taylor (1990), The Importance of Goals, Objectives, and Values in the Fisheries Management Process and Organization In Am. J. Fish. Mgmt. 10:365-373; Drynan, R.G. and F. Sandiford (1985), Incorporating Economic Objectives in Goal Programs for

communicate other important information to stakeholders - those who have an interest in the fishery. Many aspects of such plans are negotiated between the management authority and the fishermen or their representatives. In fact, OFM plans will be of interest to all stakeholders, but it is important to remain aware that not all stakeholders may be involved in the planning process. In some cases, stakeholders, such as environmental NGOs may contribute their views directly to the department, who in effect become their representatives at the planning process.

The OFM planning process can be difficult for the first year, but once established the process stabilizes and such plans become relatively similar from one year to the next. Table 1 provides an indication of the content of an annual plan that may be used as a guide for those undertaking development of such a plan for the first time.

Table 1

Recommended Elements of an Annual Fisheries Management Plan

I. Overview of the fishery

- Description of the participants – by gear sector, region, etc.
- Location of the fishery
- Time frame of the fishery
- Landings/value, over period of the fishery
- Consultative process used in preparation of the plan
- Management style(s) - Co-operative, centralized decision-making - etc.

II. Stock status

- Prospects for the current year, if possible and relevant, by year class
- Environment and fish habitat issues
- Species interactions - multi-species considerations
- Research, governmental, cooperative with the industry, etc.

Fishery Management, Mar. Res. Econ. 22:175-195; and Patterson, K.R. (1991), An overview of objectives for fisheries management, Fishbyte 9(1):28-30.

III. Management objectives

- Strategic objectives
- Conservation / sustainability, requirements and goods, e.g. biomass reference and limit points
- International considerations, i.e. treaty obligations
- Domestic considerations, e.g. different sectors, gear interactions

IV. Management measures for controlling capacity

- Capacity limiting measures
  - Limited licensing
- - Stock access and gear licensing
  - Area licensing
- Capacity reducing measures
  - Licence buy-outs
  - Regulations controlling stacking, or consolidation, of licences
  - ITQs and other access rights issues

V. Management measures for controlling effort to limit fishing mortality

- Output controls
  - Total allowable catches TACs
  - Quota allocations
- Input controls
  - Fishing seasons/areas
  - Days-at-sea limits
  - Gear restrictions
  - Refuges and marine reserves conservation areas

VI. Monitoring, Control and Surveillance

- Regulations, reporting requirements, operational requirements, e.g. vessel monitoring systems

VII. Conservation, Habitat Protection and Ecosystem Management

- At-sea surveillance, – catch and gear inspections, etc.
- Land surveillance, tagging of gear
- Dockside and marine observer coverage
- Compliance with regulations to provide accurate statistical data on time regulations
- Biodiversity considerations.

3.3 Overview of the fishery

The OFM management plan should make clear to whom it applies and to which fisheries. In some cases the plan may relate to a single species resource that is harvested by several fleet sectors, e.g. a 'mobile' demersal trawl fishery and a 'fixed' gear gill-net or long-line fishery. Or, the plan may pertain to a single gear that may, or may not, receive its own specific TAC allocations and target many species.

The plan should describe the location of the fishery. Getting the relevant area exactly right can be of great importance if there are subsequent legal challenges arising from enforcement activities relating to the area of harvesting operations. Some fisheries have natural boundaries, e.g. that for the Gulf of St. Lawrence harp seal; but if not, then it may be necessary to provide latitude and longitude co-ordinates for the area under consideration.

Many fisheries may be exploited only during a specific 'fishing season'. This may be to protect spawning aggregations or to exploit them, or because it is the most, or only, effective method of controlling fishing effort and thus limiting fishing mortality. In some cases, fishermen themselves may request that the fishery is closed, either for reasons of conservation or because of a perception of fairness - most may prefer not to fish at a particular time, e.g. in winter. Thus, they use the democratic process to ensure that others cannot fish as well. Again, the OFM plan should document the opening and closing time of the fishing season. Annual fisheries management plans sometimes specify the time of day when describing the controlled period, e.g. from 2400 November 20 to 1800 January 30.

If the plan is resource-focused, it should describe which species are the objective of the plan. If several species are taken by the fishery (the usual situation), the plan should note

which of these are under effective management and which not. Often a particular species is targeted and is the subject of a formal management plan while other species are treated as bycatch and may have only a few constraints on how they are harvested and how much can be taken[2]. If these species are retained there may also be constraints on the bycatch, for example, it is not unusual for fisheries for targeted species to be closed once a bycatch limit has been reached even if quota remains to be caught for the targeted species. Nor is it unusual for a targeted species to be landed as something else in these circumstances to avoid authorities closing the fishery! Though this is monitoring, control and enforcement problem.

Management plans should not be provided bereft of context. Thus, it is useful to include a brief summary of the recent history of the fishery, usually in the form of histograms of the landings of relevant species, of the fishing effort, and fleet size or some other measure of fleet capacity. If it is appropriate the catch-per-unit-effort over the period of the fishery may also be given. If information on the value of the landings is available, and is of management importance, such information may also be included. In this case, it is usually the ex-vessel value, i.e. the revenues received by the fishermen, that is relevant and not product prices after post-harvesting processing. However, market prices, especially when the fish is exported and sold in competion with other sources of supplies may be relevant. For example, the market price of lobster on the Rungis Market in Paris may be directly relevant to fishermen in an African country whose catch is mainly destined for these. But, for many fisheries, particularly those whose structures are vertically integrated, i.e. the vessels are owned by the processing or marketing companies, this price information may not be relevant or possible to obtain. Likewise, if a fishery is landing a catch whose price differs depending on the gear used for its capture, fishery revenues are not a particularly useful heuristic, unless the prices can be differentiated by the different gears used in their capture.

Operational Fisheries Management Plans are not produced solely by a single branch in a Ministry of Fisheries, - usually there is at least one level of consultation involved, and often several, both within the department and with those who are affected by it. For example, within government, those responsible for resource advice, based on stock assessments, will provide advice of total allowable catches (TACs). Those concerned with the implications for the fishermen and regional effects will confer with fishermen's groups; and the two groups

[2] Managers should be aware of an increasingly common operational requirement that *all* fish caught must be landed, no matter their market value, if any at all, to facilitate monitoring effects of fishing, and indirectly, to deter harvesting of species

will provide advisory documents for the department that sets the management policy and takes the management decisions. Several series of meetings may be involved with different industry groups and perhaps all of them together; if national policy is to promote co-management, these may be important decision-making bodies in determining the structure of the final plan.

An annual management plan should document what the consultative process is and how it functions. For example, agreement may not have been possible among all stakeholders, e.g. the fixed gear (e.g. gill net and longline) and mobile gear (trawls and purse seine) operators and the department of fisheries many have made a decision in favour of one or other stakeholder (or more commonly neither!). The annual plan should note this with an explanation as to how this was done and why.

These few elements give a broad overview to the annual planning approach. Much of the philosophy and detail in the plan will depend on the framework in which management is undertaken. Many management regimes have operated under a centralized "*command and control*" style. In these circumstances, management decisions were made with minimal effective influence by the fishermen or by other primary stakeholders. This style of management is becoming less popular as the benefits of explicitly involving those most affected - the fishermen - in the planning process are becoming apparent. As decentralization leads to devolution of responsibility, the actual process of operational management planning will become of ever-greater importance as will transparency in the process and basis of decision making.

One issue that may impinge upon the OFM plan is that of *Integrated Coastal Zone Management* (ICZM) planning. It is still not clear whether this is an activity that will be subsequently seen as a fashionable fad or as a management tool that will increase in its application if it becomes more perceived as a useful and productive activity. One of the practical constraints of ICZM is that the number of national oganizations that have a 'mandate' in the marine environment can be large, e.g. natural resource use, transportation, environmental protection, ports and harbours, land use zoning, industrial development, environmental protection and monitoring. These activities are usually the mandate of separate departments and often separate ministries as well. Further, many NGOs, and where

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that are otherwise discarded.

appropriate, donor agencies whose interests include any one of the activities in this list[3], usually wish to be included in deliberations that are seen as relating to the ICZM activity, with the not-surprising consequences for the ineffectiveness of such 'umbrella'-type organizations.

Many inshore areas that are the objective of ICZM plans often have some constraints on the nature of the fishing activities that can be undertaken; e.g. shallow areas have often been closed to fishing, or at least the use of certain gears or vessels above a certain size. There is no doubt that the large amount of funds made available to attempt ICZM by agencies such as the World Bank has given this issue some prominence. But in the applications I am aware of, the complexity and difficulty in achieving the necessary inter-agency co-operation has precluded ICZM from achieving any useful results. However, managers should be aware that inter-agency responsibilities and demands may require that OFM plans explicitly consider the implications of a fishery, or fisheries, to an ICZM plan. Managers should also remain cognizant of possible opportunities to use ICZM plans to further departmental objectives.

3.4 Stock Status

3.4.1 Prospects for the Current Year

This part of the plan should document information on the state of the stocks with emphasis on the prospects and intentions for achieving desired or legal-set levels of exploitation in the planning year. In fisheries where quota management is used this would take the form of setting TACs. In fisheries where input controls are used (i.e. the number of vessels or units of fishing gear that are permitted to engage in the fishery), then this part of the plan should provide sufficient information on the overall state of the stock to justify any restrictions to the length of the season or on fishing effort. This part of the plan can also contain information on species interactions, environmental conditions or other relevant research findings that should be communicated to fishermen.

3.4.2 Limit Reference Points

A number of characteristics of the target stock can be used to convey to the stakeholders the status of the stock as it is perceived by the managers. None are ideal and

[3] In questioning staff at one fisheries research institute responsible for marine research as to why they did not attend a World Bank-funded ICZM meetings it was explained the 34 different agencies participated in the meetings. Despite their

none can be determined without significant potential error. The most basic of the reference measures is that of the stock **biomass**. This is usually expressed in tonnes but in some cases (e.g. whales or seals) it may be given as a number of individuals. Biomass estimates can be derived from trawl surveys (in which case estimates should be accompanied by confidence intervals) or they may be back-calculated using cohort analyses, which provide estimates of the number of individuals in the respective size classes and the mean weights at age. The sources of bias in these estimates are self-evident. In the case of trawl surveys, uncertainty as to the fraction of the stock in the area sampled, and species- and size-specific differences in vulnerability to capture by the trawl remain a major problem. Another source of bias arises from the effective lateral opening of the trawl mouth though acoustic methods can monitor at least the physical distance of separation of the trawl doors. For these reasons, trawl surveys should be primarily used to indicate trends rather than to provide point estimates. In the case of cohort analyss such as VPAs (Virtual Population Analyses) retrospective analyses are showing how bias in estimates of terminal Fs are, in some cases, consistently skewed so as to underestimate fishing mortality in the most recent years. This results in overestimates of the size of the stock's biomass and thus TACs that are too large.

Another useful indicator, when available, is information on the level of recruitment, or future recruitment, to the fishery. This requires that some means of obtaining this information is available, and the work undertaken, e.g. egg and larval surveys, nursery ground surveys, etc. However, this information is rarely available. To be useful, such information must be collected on a regular basis, single point-estimates are of little use.

The status of the age structure of the stock may have direct implications for the management plan. Thus, even if the biomass is large, if the fish are small, significant growth overfishing will occur. Here, the issue may be that of agreeing on appropriate time preferences, that is the utility of catching the fish now and having the revenues immediately, or delaying the catch until the fish are larger and thus deferring income from the fishery. This is a complex topic and in practice usually involves negotiations with the fishermen who are affected. Not surprisingly, little agreement may exist among the fishermen depending on their individual time preferences and attitudes to risk.

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importance their voice was 'lost' in the inter-agency jocking.

If only a few older age classes are abundant, the issue may be one of catching the fish before they die, or conserving them in the hope of future recruitment of a successful (i.e. large number of recruits) age class. Neither choice has self-evident overriding merits.

How does one decide if a management strategy or programme will result in the biomass declining below a pre-set level and what should the desired biomass level be? This part of management approaches the 'management arts' area. Conventionally, the level of 20% of the virgin biomass has become accepted as the level below which stock size should not fall. This measure is at times referred to as the *minimum biologically acceptable level* or **MBAL** other workers have suggested that 35% of virgin biomass is a more appropriate level. To know what the biomass should be, whatever the level set requires that estimates of the unfished biomass are available and measures of the confidence in these estimates - which is rarely the case.

MBAL management approaches are based on Monte Carlo simulation models in which the recruitment and natural mortality of a population can be randomly (i.e. according to specified probability functions) varied and a known level of fishing mortality applied in conjunction with other population parameters. In this way the probability of management failure can be determined for given levels of fishing mortality. Usually, management plans are deemed acceptable if the probability of falling below the MBAL is less than (e.g.) 10% over a 20-year simulation period. This approach to management is common in the CCAMLR[4] area - though illegal and unreported fishing have rendered their exercise rather academic. Such simulation methods have also been used in determining desired levels of harvest from whales by the International Whaling Commission and for other fish species.

Another measure of stock size commonly seen in OFM plans is that of the *spawning stock biomass*. This measure is important in that it determines the possible success of recruitment in the following year. Again, if the resource is in a state such that there are few spawners, particular attention may be needed to ensure that it is conserved to enable the spawing component to increase.

[4] Commission for Conservation of Antarctic Marine Living Ressources.

These measures, i.e. MBAL, MSB, etc., may be considered as *limit* reference points. They proscribe a limit, which, if achieved by the stock, cause a management action to automatically occur - ideally fishing should stop.

3.4.3 Environment and Habitat Issues

The status of the stock may depend on, or be the consequence of, particular environmental conditions - especially changes in the locations of water masses, unseasonably strong mixing of the upper layers that present concentrations of food organisms for fish larvae and warming or cooling of waters. This section of the plan provides an opportunity to describe relevant environmental information and its implications for management of the fishery. Habitat issues could include issues such as toxic phytoplankton blooms, epidemics of disease or other 'strange' pathogens, e.g. Pfiesteria. These may result in the fishery being closed or impose other harvesting or marketing constraints. Other habitat issues may relate to the effects of gear on the benthos, etc.

3.4.4 Species Interactions

This issue may arise in two ways: (a) ecosystem management, which is dealt with in Section 3.9, and (b) multi-species considerations. Characteristically, OFM plans deal with single stocks though this is in no way a binding requirement. However, when there are important predator-prey considerations, harvesting of a species may have to be constrained by considerations over the status of a dependent prey or predator species. For example, capelin form an important prey item for northern cod while at the same time being the target of a fishery themselves, traditionally for the manufacture of fishmeal and oil. Ecological theory indicates that management of the caplin resource without consideration of the cod would affect the status of the cod stocks through reducing the availability of its food. Thus provision should be made to ensure that the demands of cod for food are allowed for in the capelin management plan. In the CCAMLR region particular attention is given to ensuring that krill stocks are not depleted in areas where there are large populations of penguins and other plankton eating seabirds and seals.

3.4.5 Research Activities

It is not unusual to integrate some research activities into the execution of the fishery. For example, fishermen may be asked to record particular observations (e.g. sightings of marine mammals, or to take measurements of unusual species that are caught and discarded

such as turtles) or to retain particular specimens for later invewstigation. There are obvious reasons for encouraging such co-operation, and the OFM plan provides a convenient place to publicize the existence of such programmes, provide detailed information on what is to be done and seek the co-operation of those in a position to provide it. Such activities are also important in building co-operative relations between researchers and fishermen.

3.5 Management Objectives

This section of the plan may document general strategic objectives for all fisheries and the objectives that are specific to the fishery described by the plan; it also may document the objectives for resource conservation and sustainability of harvests and stock biomass. Fisheries may be sustained at low as well as high yield levels and the objective should be to maximize some measure of output of the fishery (e.g. biomass landed, revenues or wealth created from the fishery, i.e. profits) on a sustainable basis. This section can also contain information on other national objectives that apply to the fishery such as those that apply to regional development or employment.

This section may also describe the goals for conservation. These may relate to achieving levels of bycatch reduction, rules on product utilization (e.g. banning of finning of sharks), or the use of a particular gear.

Frequently, exploitation of a fishery is constrained by bilateral or multi-lateral international agreements. These may proscribe the nature of the gear that may be used, the amount of catch that can be taken, the way in which the harvesting is done and the conditions under which a boarding and inspection by international obserers may be undertaken. Thus this section may also describe international conditions and/or constraints that apply to the fishery.

The OFM plan provides an effective way of ensuring that those participating in the fishery become aware of regional, national or international obligations upon those participating in the fishery. Further, the opportunity can be taken through the plan to provide some background material and advise those interested where they may look for further information.

Similarly, there may be regional constraints on how the fishery is managed, particularly in countries that have both federal and state/provincial forms of government (e.g. Canada, the USA and Australia). The OFM plan may provide a means of indicating the bounds of the respective authorities and what the respective mandates and responsibilities are.

At the national level, there are commonly constraints on who can fish where and where particular types of gear may be used. These restrictions are usually intended to achieve some management conservation objective. The OFM plan may be the appropriate place to note these objectives, partially in support of the regulations that may be specified in other parts of the plan.

3.6 Management Measures for Controlling Capacity

An important concern of management plans is that of 'Fleet Capacity'. This is the measure of a fishing fleet's ability to catch fish and is the sum of the fishing power of the individual vessels in the fleet. It depends on factors such as the number and characteristics of the vessels, type and amount of fishing gear used and skills and number of fishermen, etc., which participate in the harvest, though these last factors are generally impossible to quantify. Fleet capacity increases when more vessels enter a fishery or when older vessels or gear are replaced by more modern and powerful versions. For example, in one Australian shrimp fishery, equipping the trawlers with Global Positioning Systems (GPS) was estimated to have increased the fleet fishing capacity by 15%.

A fishery only needs so much fleet capacity to be optimally exploited. When new technology is introduced and productivity increases it should be possible to reduce the fleet size and still exert the same effective fishing effort and thus obtain the same catch. In a perfectly efficient system, the amount of fishing capacity deployed would reach the appropriate level and then the inputs of capital and labour would stabilize, or even decrease with increases in productivity. Determining exactly how much effort to apply to a fishery is difficult, so the participants seldom agree on what the capacity limit should be. Even if this point is known with certainty it is rare in common property fisheries for any participant to withdraw fishing capacity voluntarily (or unilaterally!) as to do so requires that they forgo catch share relative to other participants in the fishery.

The plan should describe any capacity issues that exist in the fishery and note how they are being addressed. Such controls can be grouped into those that limit the growth of capacity and those that reduce capacity. Capacity limiting measures include licensing vessels and fishermen and limiting their numbers. This measure requires that the targeted stocks or fishery on the licence. Licences can also specify, and thereby restrict, the use of particular gears that can be used. This control can prevent the use of destructive gear or those that cause bycatch problems. Finally, since there is a tendency for fishermen to invest in larger more powerful vessels over time, limits on the size of replacement vessels can be introduced through licensing control. These controls can limit fleet capacity but they will not reduce capacity if that is required.

Fleet capacity reduction measures are required in some fisheries. Such measures may include making licences non-transferable, including if desired, between family members. This can be difficult to apply once licences are accepted as a form of property right in a fishery and thus are viewed as a part of family or business assets. Capacity can be reduced through vessel buy-out or retirement programmes and the funding for such programs is often provided by the government. But, industry-funded programmes can be paid for taxing fishermen for this purpose. Buy-back programmes can be designed so that a fixed price is offered to all fishermen within a target group; if there are insufficient buyers, the price is increased depending on the funds that are available.

Other capacity reduction methods can be introduced which use market forces by allowing fishermen to trade the access rights they obtain through licensing programmes. In fisheries where there are no quotas, it may be necessary to allow fishers to combine, or "stack", licences so they can extend their access to other fish stocks. These approaches may require that the licences be restricted or divided. For example, it may be necessary to divide the fishing grounds into sub-areas with the licences being valid for only one sub-area. The fishermen can then gain access to other areas only by purchasing licences from someone else licensed to fish in the other desired area(s). A licence can be restricted to a certain time or portion of the fishing season; here fishermen must purchase licences for the other portions of the season. In both cases the purchaser increases his access to fish resources as the fishing capacity of the seller is removed from the fishery.

Such licensing measures can provide the basis for other capacity reduction schemes that function without the need for government-funded interventions. All such methods require effective administration, which can be costly! For example, if combining, or stacking, of licences is permitted, a relatively accurate measure of the capacity associated with each licence may be required to ensure that fleet capacity decreases.

Another market-based approach to managing capacity is to use catch quotas. If a fishery can be managed by setting total allowable catches, shares (or quotas) of the total allowable catch (TAC) can be assigned to individuals as individual quotas (IQs), or if they are transferable, as individual transferable quotas (ITQs). TACs must be set in advance of the time period to which they apply and must be related to the current fish abundance. IQs are best denominated as percentages of the TAC and converted to weights after the TAC is set. If IQs are transferable they can be effective in maintaining a balance between the resource and fleet capacity levels because fishermen have no incentive to invest in unnecessary fishing power and the open access problem is overcome. However, this system requires accurate (and usually costly) resource assessments and monitoring and control of catches to work. Unless this is assured, such systems will fail! Finally, some fisheries (e.g. beach seines and reef fisheries) lend themselves to area rights or leases. These are usually referred to as territorial user fishery rights, or TURFs. Once an entire fishery is assigned this way trading of access rights through the 'market' can be used to consolidate leases and reduce fishing capacity[5].

IQ systems can encourage discarding and dumping at sea if this provides an advantage to the fishermen. However, discarding may occur if fishermen's landings are restricted and there is a price differential depending on size. The fishermen may then dump small lower-valued individuals and retain only the larger more valuable sizes. Thus, ITQs work best in single species fisheries or in fisheries where all catch can be effectively controlled.

The OFM plan should document what form of capacity control, input, output or both, is to be measured. The plan is not an appropriate place to review the merits of different approaches - rather it should simply state what method is to be used for the period of the plan. If this is to change, or may change, in the future, this too could be noted.

[5] A large and recent literature on property rights in fisheries management now exists. The interested reader will find a wide selection of current works at <www.fishrights99.conf.au>

3.7 Control of Fishing Effort to Limit Fishing Mortality

This section describes the measures for directly controlling fishing effort. The main input controls include limiting the number of participants through vessel, or gear, licensing measures, introducing days-permitted-at-sea restrictions on the operations of individual fishing vessels, restrictions on the length of fishing seasons, introducing area closures to protect spawning or juvenile areas or to create refuges and controlling the number of units of gear that may be used. Regulations can also be applied to fishing gear to make them more selective so they target only that portion of the stock that has been selected for exploitation. For example, regulations controlling many shrimp fisheries now require that bycatch reduction devices (BRDs), such as various designs of grates, are used in the trawls. The reduction of bycatch is often an important consideration here. Gear restrictions can be used to ban the use of efficient gear (e.g. monofilament gill nets) or other technologies (extreme forms may limit a fishery only to sailing craft) but this should be mainly considered if the gear is destructive in some way and imposes additional costs or externalities.

Input controls (i.e. those determining the amount of gear of vessels that can be used) and output controls (i.e. those that determine how much catch the licensee can take) are characterized by their differing effectiveness and enforceability. Input controls are usually easier to enforce. If more than a certain number of traps are being used, they can be tagged and those in excess can be confiscated. But, this still requires resources to enforce the regulation. If the control is on the number of days spent at sea, then an inspection of the harbour will indicate if the vessel is in port. Further, vessels must often receive official clearance to proceed to sea and inform harbour authorities of their return. However, if the amount of fish that can be harvested is a critical management variable, input controls, such as those on fishing effort, will not allow total catch to be explicitly managed. Further, because of 'technology creep', effective gear or vessels controls cannot be imposed and forgotten - rather changes in effective fishing power must be monitored and adjusted for by reducing the number of effort units allowed in the fishery to prevent increases in total fleet capacity.

Output controls, in theory, provide precise control over the fishery, which the management plan may call for, but suffer from being difficult, expensive to enforce and possibly ineffective if fishermen can discard, or land catch that is not recorded. Effective monitoring of landings and some means of allowing for discards in calculating fishing

mortality is required if it is in the fishermen's economic interests to dump fish at sea that are not included in catch or landings reports.

A means of limiting control that is rapidly growing in popularity are marine reserves. These may or may not allow some types of fishing, and where fishing is prohibited they are often referred to as *No Take Zones* (*NTZs*). The effectiveness of marine reserves is still a matter of conjecture though their proponents firmly believe in their benefits; these are much more apparent in the cases of benthic and sedentary species, especially for those with limited egg and, or, larval dispersal, than is the case for migratory species. Here, the purpose of the OFM plan should be to identify relevant marine reserves, or No Take Zones, and what, if any, access or fishing conditions apply to them.

3.8 Monitoring, Control and Surveillance

This section of the plan should describe the approaches which will be used to ensure that the regulations and restrictions placed on fishermen are complied with. It may include a description of the surveillance to be applied at sea and on land, especially at landing sites. It can also specify the need for, and coverage by, dockside monitors as catch is off-loaded[6]. Of course, what is documented concerning surveillance operations should not be so explicit to assist offenders to avoid detection, e.g. dates and times of sea patrols. However, it is appropriate to describe those sections of the law and/or regulations that apply to how the fishery is prosecuted. Whether details of possible fines, or other penalties, should be included should be a decision taken at the local level. There is a danger that this may be perceived as attempted intimidation and thus be counter-productive to obtaining co-operation from the fishermen themselves.

Considerations of fishermen's compliance should be kept in mind during all phases of management planning. Procedures, regulations, and licensing conditions should be design so that compliance by the fishermen is encouraged at all times. Co-operation, not confrontation should be sought.

3.9 Ecosystem Management and Considerations

These issues are progressively increasing in importance in the preparation of OFMplans. Some management agencies require that all plans address this issue, even if it is

[6] In some management regimes, this responsibility is contracted out to industry-funded organizations.

well understood that the fishing creates little or no problem for the environment. A number of different issues may be addressed.

Many fisheries affect the environment through the action of the fishing gear. Gill nets and other stationary gear become lost and may continue to catch fish - *ghost fishing*. Trawls dragged over the seabed change the nature of the benthic fauna, destroying some faunal forms, which may be replaced by other species, and suspending bottom sediments. Vessel anchors if lowered onto corals will break the corals when retrieved quickly destroying fish habitat.

All but a few fisheries take non-targeted species. It is unavoidable that some of these may be rare and their survival as a local population or even perhaps, as a species, may be threatened by continuing depletion through removals as bycatch. If the country in question has ratified any of the various conventions on conservation of bio-diversity, there may be an international obligation to conform to the convention's requirements. Management regimes may have to develop their own protocols on how problems of bio-diversity will be handled. These will establish the requirements of the OFM plan to address this issue.

A distinction may be necessary between ecosystem management, which includes concerns over species of no commercial value and fish habitat, and multi-species management in which a limited number of species are the target of the management activity.

3.10 The Strategic Considerations of the Operations Fisheries Management Process

3.10.1 Starting the Process - the Institutional Implications

Many fisheries managers may be reluctant to start an operational fisheries management planning process because of insufficient information or data. There may even be no certainty that the plan will influence the behaviour of the fishery if there is no high-level commitment to such a process. This can be a difficult administrative issue for when there is no higher-level demand for management planning there will be no incentive to supply it. Conversely, provision of a management plan, even if it initially takes only the form of a stock status report, may provide the demand for such an activity as its benefits become apparent to senior managers and the industry.

Further, formalizing those activities that are undertaken through a plan exposes them to review and criticism and this will lead to improvements in the plan in subsequent versions. As plans are likely to be prepared by a team of staff with different sections assigned to different workers, co-operation will be encouraged and if it is clear that specific sections can be attributed to particular workers, the wise manager will use this to motivate those responsible. Thus, simply starting the process should lead to changes in institutional behaviour that strengthen the process, even if many of the necessary planning elements are initially lacking. Further, their absence, when apparent, will assist in obtaining the resources needed to provide a better product in future management planning cycles.

3.10.2 Operational Aspects

Much of the material in a management plan does not vary significantly from one year to another. Thus, once an initial plan was been prepared, the activities involved in preparing the plan, and the plan layout, in subsequent years will tend to be evolutionary rather revolutionary. Aspects of the plan that relate to past performance of the fishery can be updated by the addition of the new annual point, e.g. for tables of catch and effort and figures showing trends. Most of the descriptive part of the fishery will vary little - particularly that relating to the biology of the resource and the nature of the fishery. Thus, once the process is started, much of the initial effort will not need repeating and resources that are available can be directed to improving the quality of the analyses in subsequent versions.

3.10.3 Stakeholder Participation

Few now doubt the benefits of involving relevant stakeholders in the process of developing management plans by which they must abide and this is a development that is continuing in many different management regimes. However, this process should not be left to develop by its own if most benefits are to be obtained. Care should be taken in deciding who is a 'relevant' stakeholder. Obviously those licensed to fish and those who may have property rights in the fishery will contribute to the process. But in practice, the right to participate is rarely extended beyond that, e.g. to NGOs. This is in part because of the uncertainty as to who NGOs represent, i.e. who are their constituents? Thus, simply being a stakeholder should not necessarily qualify one to be present at the table during important negotiations[7].

[7] Stakeholders who should be eligible to participate in the management process are often described as having standing. This use derives from the right to ‘stand before’ a judge or tribunal to argue one’s case.

It is in the interests of a fisheries department to encourage formal representation by industry groups for several reasons.

i. It facilitates negotiations with the industry - effective negotiations are is impossible if each fisherman wants to individually express his views to the department (and personally lobby the minister) and expects a personal response.

ii. It forces the industry to consider the issues collectively, come to a decision about what represents their interests and approach the department or the negotiations with a single, consensual (one hopes) stand.

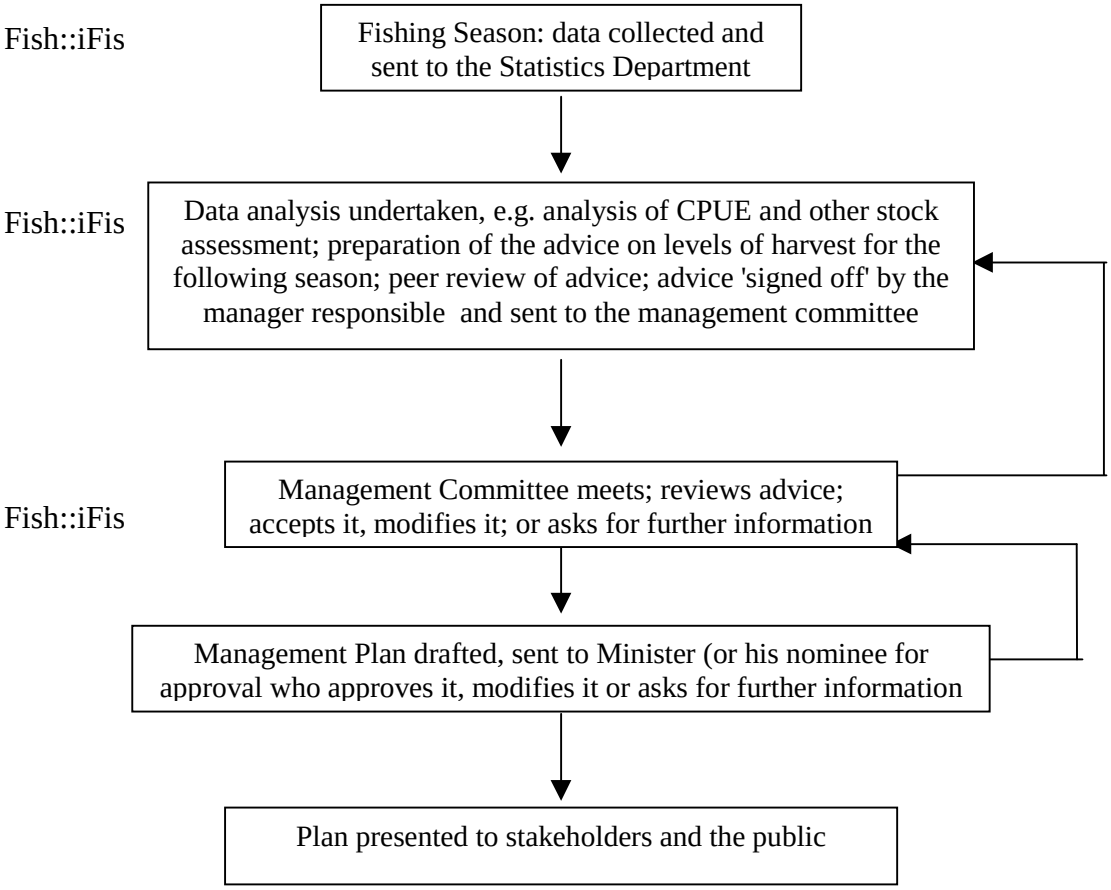
Who should attend planning meetings should be agreed upon, e.g. the industry's group's president and executive secretary, and this should not be a matter for re-negotiation each year.

3.10.4 Developing the Operational Management Process

As mentioned earlier, Operational Fisheries Management Planning should be a regular activity. Meetings should be scheduled to occur close to the same date each year to facilitate planning and encourage participants to schedule their planning and ensure timely preparation of the necessary documentation. Because most fisheries are season, this process usually follows something as below (see organigram).

3.10.5 Who does Operational Fisheries Management Planning?

Different departments approach this task in different ways. If there is a large number of management plans to be prepared each year, either a particular person, or a secretary, may be appointed to manage the entire process. This person may (a) chair the planning and preparatory meetings; (b) be responsible for ensuring that documents are prepared on time; (c) ensure that all members of the committee receive the appropriate preparatory documentation; (d) ensure that reports of the meeting are prepared and disseminated to those who should receive them; and (e) handle relevant correspondence. This person would be the link with the next higher level of administration within the fisheries department and would liaise with those who were members of the committee.



Members of the committee could thus include:

i. those responsible for provision of resource advice resource biologists
ii. a representative from those responsible for MCS
iii. relevant fisheries economist(s)
iv. industry representatives from each of the different gear sectors if it is a multi-gear fishery
v. chairman and, or, executive secretary and
vi. a rapporteur, usually a secretary dedicated to the task.

3.10.6 Postscript

Remember that there is no single way of structuring an operational fisheries management plan, who should be part of the process, or how frequently the planning group should meet. Rather, it should be designed to suit the circumstances of the fishery. The important elements are those of function; they are:

i. it should meet at regular intervals, ideally following the same annual or seasonal cycle
ii. it should have clearly defined terms of reference and reporting structure
iii. its composition should be defined by its terms of reference, notwithstanding the possible chairman's prerogative to invite outside observers (who should follow proscribed rules)
iv. the elements of the management plan should reflect what are the relevant issues of the fishery that are to be managed, and
v. there should be a review and appraisal mechanism of the process's effectiveness, and perhaps its efficiency.