P A R T IV
REPORT OF THE WORKING GROUP ON SOCIETAL IMPLICATIONS OF VARYING FISHERY RESOURCES

by

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ABSTRACT

This report identifies the different effects the variability of fisheries resources has on society, the different groups (at individual, national and international level) which play a role in the decision-making process, and those sectors that are more seriously affected by resource fluctuations. The report also discusses the development of some fisheries in the past, sources of problems related to fisheries management, the participation of fisheries scientists in the decision-making process, the problems that confront fisheries scientists in this process, and suggests some remedies for dealing with such problems.

1. INTRODUCTION

Neritic fish populations are of great importance to the many countries that exploit them. They serve as a source of food or as a source of feed supplement in the form of fishmeal. Used as exports, these fish products may earn substantial foreign exchange. Pelagic fish populations, in particular, exhibit wide fluctuations in abundance over time (e.g. Tanaka, 1983; Parrish et al., 1983; MacCall, 1983). Such unpredictable sharp changes in the biomass make it difficult to development management plans that seek to maintain high and sustained yield or benefits while at the same time ensuring the preservation of the resource. Scientists in many regions of the world have been concerned with these fluctuations, how to predict their occurrence, and how decision-makers should respond once a catastrophic event in fisheries is imminent. Geophysical and biological fluctuations also lead to fluctuations in the societal benefits that may be derived from the exploitation of fisheries resources. This, in turn, makes it difficult for policy-makers to put in practice national development plans based on potential long-term contributions from the fishing sector. These are some of the reasons why this particular Expert Consultation was convened and why this Working Group was requested to look into the societal implications of the variability of fishery resources.

This report presents the contributions of a working group that was set up to review the societal implications of varying fishery resources. Major contributions to the discussions and to the drafting of this report were made by R.J.H. Beverton and A. Gumy, who acted as rapporteurs, and by B. Brown, D. Butterworth, J. Cañon, E. Kwei and others. The report is divided into five parts: possible causes of fluctuations of neritic pelagic fish; a general description of the implications for society of fluctuations in fish catches; a general discussion about how some fisheries developed in the past; the participation of fisheries scientists in the decision-making process at national and international levels, including problems that confront fisheries scientists in the decision-making process and some of the sources of, and suggested remedies to, these problems. The report concludes with a set of recommendations.

The report is presented in general terms and not all examples apply to each and every fishery. It is also important to note that different characteristics of political, economic and cultural systems often foster different approaches to fisheries management, and that similar approaches can have different implications in these varied political, economic and cultural systems.

2. FLUCTUATIONS IN FISH CATCHES

An important characteristic of fish populations that affects society is that they exhibit large fluctuations in overall abundance, which affect catches obtained by man (and other predators). These fluctuations seem to be larger in pelagic neritic fish populations. In the past, when pelagic fish populations have declined sharply, a debate ensued as to whether the decline resulted primarily from fluctuations of the environmental factors or from overfishing. Those who believed that fishing pressures were responsible contended that the fish population would probably have been able to cope with fluctuation in its physical environment in the absence of heavy fishing activity. Others contend with equal conviction, and often with equally convincing pieces of scientific information, that the sharp decline in landings resulted primarily from changes in environment. Usually, both heavy fishing and environmental changes are involved in the collapse of fisheries. It is not surprising, however, that these debates tend to remain unresolved, as participants in the debates tend to adhere to one view or the other. In the recent past there have been several declines in pelagic fish catches in such fisheries as the Californian Pacific sardine, the Peruvian anchoveta, and the South African and Namibian pilchard. Murphy (1977) has identified other clupeoid populations that have shown drastic declines in catches: Hokkaido-Sakhalin herring, Atlanto-Scandian herring, Downs herring and the Japanese sardine. At this stage of our scientific knowledge, and as long as perceptions of the issues remain polarised, it is not at all certain that this debate will ever be resolved to the satisfaction of either of these groups. A third group has emerged that considers both factors to be about equally important in the demise of such fisheries. The arguments presented in these contending views notwithstanding, there is no instance as yet of the collapse of a fishery under conditions described as light exploitation. In addition, each of the fisheries that has witnessed sharp declines in landings (Californian Pacific sardine, Atlanto-Scandian herring, South African and Nambian pilchard, and Peruvian anchoveta, among others) has been advised to reduce fishing effort before its respective collapse.

Other sources of variability in fish landings relate to the fluctuations that occur in international and national political and economic systems. Even if members of the international community are not directly involved in the exploitation of a national fishery, the fishery will be affected by factors that originate in other nations. Such factors can affect the supply of fish and might include, for example, transfer of technology (including technical advisers), changes in policies related to free access to coastal resources, need for foreign exchange, and loans from international development agencies. They can also affect demand for fish products, and might include such factors as international market demands, competition from other fisheries, and international commodity prices for fish products. A third set of factors might not appear to relate directly to fishery management, but in fact can have a major impact on the fishery, for example, the expropriation of foreign investment in sectors other than fishing, and international conflicts in general.

National factors affecting the fishery can centre around changes in government and/or changes in governmental personnel in a variety of ministries. Other national factors can include conflicting objectives pursued by various groups in society, many of which are not directly involved in the fishing sector. It is important to remember that the fishing sector is but one subsystem embedded in a larger political and economic system. In addition the fishing sector, too, is a complex system, the competing members of which may have different objectives.

In the two sections that follow, discussions are presented about how a typical fishery develops and declines. These are developed in reverse order, with the typical decline presented first, as it is the societal implications for that phase which are less well understood.

3. SHARP DECLINES IN FISH CATCHES

This section briefly describes in general terms how a typical society might be affected if fish catches became sharply reduced, in a relatively short period of time, regardless of cause. While the brief description that follows may appear to be a simplistic representation of a relatively complex process, it serves to suggest to decision-makers (not just those involved in the fisheries) that sharp declines in fish catches can have widespread societal implications. The impacts mentioned in the following paragraphs have been taken from the history of one or more of the pelagic fisheries that have recently undergone either a sharp decline in productivity or a collapse.

First, it is important to note that there can be minor fluctuations in fish catches as well as major sustained declines. Temporary declines in fish catches can, for example, lead to bankruptcies of marginal producers and of those in the fishery who are heavily in debt (boat-owners, processing plant owners, etc.). Some observers view this adjustment as an economic rationalisation of the fishing sector while others view it as an increasing concentration of capital amongst a declining number of industrial firms. Temporary unemployment often follows, foreign exchange earnings may decline (or may increase with short-term jumps in prices due to shortages of that product), and some foreign investment may enter the fishery. Minor declines in landings have in general minor adverse aggregate effects for society, even though they may have major effects for individuals within the society.

Relatively major sustained declines in fish catches, however, cause more profound social, economic, and political dislocations. These dislocations will not be confined to the fishing sector but will spread like ripples throughout various sectors of society. For example, bankruptcies of the seemingly stable larger fishing firms lead to financial difficulties, including an inability to repay either bank or government loans, in industries that support fishing activities, such as boat construction, gear and net manufacture, etc. Crewmen are released by boat-owners, while factory workers are released by owners of processing plants and other industries as well. Some of the unemployed workers will emigrate (with or without their families) to other larger cities where they believe chances for employment will be higher. In some instances, layoffs of crewmen and factory workers lead to labour unrest and possibly to worker or union demands for government support in these crises, including financial assistance until the end of the crisis. (An extreme but not atypical example of pressure that decision-makers might have to face, is when workers occupy their factories until their demands for government assistance are met.)

In response to increasing layoffs of workers and fishing crews and to related unemployment problems, governments may find employment for some of the unemployed in other sectors of the economy or on public works projects. Often this will be at the government's expense and in time may prove to have provided either no more than a delay in confronting labour unrest or a shifting of labour unrest from one sector to another. Changing jobs also means a loss in human resources (accumulated training and knowledge) and a need for the retraining of these employees either voluntarily or with government assistance.

For the government, a decline in fish landings will be accompanied by a loss of foreign exchange, and perhaps a need to renegotiate foreign loans and a disruption (e.g. a delay or cancellation) of regional or national economic development plans that were dependent on the earnings from the fishing and related sectors. There will also be a need to meet contractual obligations that had been made months earlier and had been based on anticipated landings. The apparent instability in the availability of the resource could lead to loss of markets as buyers search for alternative supplies of the same product or for subsitute products. This was the case with the sharp decline of the Peruvian anchoveta catches in the early 1970's which stimulated the production of soybeans and amino acid supplements, mainly in Brazil and the U.S.A., as substitutes for fishmeal in animal feedstuffs.

With a sharp decline in pelagic fish catches, there tends to be an even greater concentration of capital in fewer fishing companies, as even some of the larger producers go out of business. Many of the larger industries that do survive either had diversified their financial investment before the collapse or, if not, tend to diversify after the collapse by investing in other sectors of the economy in order to hedge against the financial impact in the future of similar declines in fish catches. In some instances, bankrupt businesses may fall into the hands of the government, which may have guaranteed the loans to industry and fleet-owners during the development phase of the fishery, in order to stimulate investments. In other instances, nationalisation of the fishing sector or massive subsidies to the surviving industries may take place. In still other instances, sharp declines in fish landings can lead in time to government denationalisation of the fishing sector, if the fish populations remain at relatively low levels (e.g. “reprivatisation”, as in the Peruvian situation in the mid-1970's, when the fleet, but not the fishmeal processing factories, were denationalised).

In a developing country the impacts of a sharp decline in fish catches can have catatrophic long-lasting societal effects, whereas in developed countries the societal impacts of stock declines may be more easily absorbed by other sectors of the economy. This is especially valid when the developing country is dependent for the financing of many of its development programmes on the foreign exchange derived from its fishery or when its fishery is dependent on the exploitation of one major fish population as opposed to a truly multispecies fishery.

Finally, as witnessed in most recent pelagic fishery collapses, sharp declines in fish catches are usually followed by calls from many quarters for improved and costly scientific assessments of fish populations as well as of the environmental factors that might affect them, as there seems to be no clear consensus about what the primary cause for the sharp decline had been. In addition, each sharp decline or collapse has been followed by a plea, always too late, for an economic rationalisation of the industry, as well as for increased regulations on fishing activity.

4. DEVELOPMENT OF A TYPICAL NERITIC FISHERY

This section presents a brief, general description of how a typical fishery develops, with some emphasis on pelagic fisheries. Again, it is important to note that this description will not match exactly the historical development of any single pelagic fishery but instead represents a composite of factors taken from the histories of several of them.

Preceding the development of a large fishing industry, there usually exists an artisanal fishery which in most countries supplies fish to local markets, usually for local consumption. As large industrial fishing firms develop, many artisanal fishermen may join the industry and, as a result, less fish is available locally and the costs of what is available begin to increase. In addition, catches of fish by the industrial fleet may reduce the availability of the resource for artisanal fishing activities, or the by-catches of the large fishing concerns may compete with the artisanal catches in the market-place. These problems, among others, cause conflicts between the emerging industrial and the existing artisanal or traditional fisheries.

The growth phase in the development of a large commercial fishery can be divided into two stages. An “early growth” stage begins with awareness of an abundant resource, at a time when there is a growing national or international demand for fish products, and at a time when the national economic or political setting is conducive to tapping that resource (as was the case in Peru in the early 1950's and in Chile in the latter part of that decade). The primary products of interest are usually canned and frozen fish and fishmeal. While it may be true that the canning or freezing industries are very important economically in terms of catch utilisation, fishmeal has exhibited a more dynamic demand in the international market-place. In addition, it is often favoured as a source of foreign exchange.

An accelerating process of expansion in the fishery develops once the basic components of continually increasing demand for fish products (e.g. canned fish or fishmeal) and of perceived abundance of the resource (bordering on limitless) are present. The early growth stage of the fishery development exhibits, in general, the following features:

- There is a rapid increase in investment in vessels and plants, as well as in the necessary supporting infrastructure. Such investment can be national or international in origin. Because the fishery is still in the early stages of development and there is a relatively high level of implied financial risk, financing will not have achieved (as yet) the same dimensions as in the later stage of the expansion process (to be discussed).
- Many unskilled labourers are attracted to the fishing sector, usually drawn away from economically marginal sectors including rural agricultural areas. This process of attraction is exerted region-wide and produces a migration to the areas in which the fishing activities are developing. The urban infrastructure in such areas is often ill-equipped to handle the immigration.
- Supporting (ancillary) industries such as shipyards, net manufacturers, warehouses, food suppliers, etc. appear gradually.
- Modern technologies are brought into the fishery and, because of the inexperience of labourers in using these technologies, their effectiveness at first is relatively low. Sometimes this lack of effectiveness raises questions about the appropriateness of the new technologies for that particular stage of development of the fishing sector.
- The investment process is not an across-the-board proposition that covers all elements in the fishing sector. As a result, conspicuous gaps in investment and time lags between investments in the different elements in the fishing sector appear along the chain of catching, processing, marketing, and supporting activities. These gaps and lags lead to increased costs of operations.
- The fishing industry at this stage is usually a profitable business venture, despite its unstructured, virtually anarchical growth. The cost burdens produced by the lack of experience of the workers and infrastructural gaps within this stage can still be absorbed by the profits derived within the sector.
- Direct government involvement in the fishery at this stage of development is often not evident. The lack of government participation usually reflects the relative lack of importance given to this economic activity by the public sector and the interest of the entrepreneurs in maintaining this as a private activity.
- Air and water pollution increases mainly in the coastal areas. This may adversely affect other potential economic and social activities such as tourism.
- At the end of this stage (the duration of which depends on a number of international and national factors including demands in the market-place and national economic policies and development strategies, respectively) the fishing sector appears to some observers to be the picture of stability. Many of the investment gaps generated during the initial growth process have become filled. At this point, the exact potential of the resource may still be unknown and the fact that it could suffer from the effects of fluctuations in the environment, from the biology of the fish population, or from the socio-economic environment may continue to be ignored; in some cases intentionally.

The “late growth” stage is often dominated by political factors. The sector achieves importance as a major source of foreign exchange and employment, though this varies from country to country. Representatives of various governmental agencies have finally taken cognizance of the new economic and social importance of the fishery. The sector begins to acquire relatively more influence in the decision-making process and the already established (but small) industrial sector begins to recognise the potential role of the government in limiting to some degree the access of newcomers to the resource, thereby ensuring, at least temporarily, a more favourable situation for themselves.

During this stage of the fishery's growth process, the government can exert considerable influence on the fishery's rate of expansion. In general the salient aspects of this phase might be as follows:

- There is an increase in investment in the fishery, facilitated by low interest, long-term loans, “drawbacks”, favourable import licenses, favourable export policies, guaranteed foreign loans, and so forth.
- Public investments in port and service infrastructure also increase.
- Existing industries reinvest in the fishing sector.
- New capital from other national and international sectors is infused into the fishery.
- The sector becomes a “magnet” for an ever-increasing number of unskilled labourers.
- There are massive, accelerated inputs of efficient, modern technologies.
- Scientific activities related to stock assessments increase in connection with those resources that are exploited by the fishery.
- The activities in the fishing sector continue to be highly profitable, even though the high debt burden of one part of the industry orients its activity more in terms of meeting its financial obligations than its rational production planning.
- Industry acquires an overwhelming influence in decision-making processes that directly and indirectly relate to the fisheries. The labour sector, too, becomes increasingly organised and begins to assert influence on policy matters related to its interests.

Once the growth phase has reached its peak, the industrial component of the fishing sector, which has now become very influential in the decision-making process, finds itself at a crossroads. Fluctuations in the market-place (i.e. demand and price) as well as fluctuations in various aspects of the national economy (e.g. inflation, exchange rates, balance of payments, etc.) have eliminated many of the economically marginal units (i.e. smaller and/or less efficient) from the sector. This leads to an increasing concentration of industrial capital which tends, among other positive and negative effects, to increase production efficiency through the large-scale coordination of the factors of production. Over-capacity in fleet and processing facilities is acknowledged but not reduced. Because the industry expects state support to neutralise the adverse effects of fluctuations of the national economy, earning expectations of the industry usually remain very high.

At this stage, a politically significant element of the population has become directly or indirectly dependent on the fishing sector. The contribution of the fishing sector to the economy is important for social aspects of economic development. At this point the government begins to solicit (but not necessarily to accept) advice from the scientific community about the fish resource. Also at this time, the conflicting objectives of the various sectors, conflicts that had remained latent during the early growth stage, begin to manifest themselves.

5. FISHERIES SCIENTISTS IN THE DECISION-MAKING PROCESS

The involvement and influence of scientists in the decision-making process clearly varies from one country to another and it can vary from one government administration to the next, especially where the scientific input has not yet become institutionalised. A set of case studies would be extremely useful on how scientists derive their recommendations for decision-makers and how those decision-makers use them in developing fisheries-related policies. Similar studies are needed of how other interested parties, such as the fishing industry or conservation groups, derive their recommendations and how they insert them into the decision-making process. It appears that many of these situations are often discussed anecdotally and are in need of systematic, objective assessment.

There are many international organizations with varying degrees of responsibility for providing advice on the management of fish stocks in different parts of the globe's oceans. The procedural characteristics of many of these organizations are well-documented. What is needed are assessments of whether decisions in these bodies are in fact based on the best scientific information available or are the result of compromise between participants (e.g. science by consensus). Some observers strongly believe that much of the maneuvering in such organizations is in manipulating the information to suit the needs of particular interest groups or nations. Do the institutional arrangements match the needs of the fishing communities and the national decision-making bodies?

Among developing countries, there also exist regional forums (Fisheries Committee for the Eastern Central Atlantic (CECAF), Permanent Commission for the Southeast Pacific (CPPS), General Fisheries Council for the Mediterranean (GFCM), Indian Ocean Fishery Commission (IOFC), Latin American Economic System (SELA), Western Central Atlantic Fishery Commission (WECAFC), etc.) where scientists from member nations meet periodically through seminars, workshops and working parties. Information is exchanged and joint activities are proposed, often undertaken, and subsequently evaluated. The intensity of these activities varies from region to region. By the nature of their charters and operations, some of these bodies have not as yet been able to reach the appropriate decision-makers with their scientific findings and recommendations related to the exploitation and management of fishery resources.

5.1 Some problems fisheries scientists face in the national decision-making process

In this section some problems that fisheries scientists often face with the decision-makers are presented, with some suggested remedies. These problems do not necessarily represent those found in any one fishery but are a composite drawn from the experience of scientists involved in many pelagic fisheries.

- Scientists are expected to draw conclusions to meet requests for advice within a fixed time schedule. In many instances, information is not available or cannot be processed in time.
- The resource system itself varies with time so that the basic scientific conclusions available today may have to be modified, perhaps radically, at some time in the future. Assessments are usually out-of-date by one to five years, as a result of data and analysis delays.
- These and other factors mean that scientific assessments can never be precise or permanent. So the scientist is always faced with the problem of convincing the reluctant politician or the sceptical fisherman that he really can make assessments which provide a sound basis for action.
- In order to provide quantitative assessments, the scientist must try to give confidence limits to his central figure. These, although scientifically sound, may be quite wide, and therefore may leave the scientist open to the criticism that “he does not know what he is talking about”.
- The decision-maker, faced with an unpalatable figure from the scientist, will almost always choose to adopt a figure within those confidence limits that best suits himself. The scientist may anticipate this response by the decision-maker, causing him to modify his presentation.
- Scientists are often placed in a position of confrontation with industrial, political or other objectives. This makes the implementation of a rational scientific advisory function extremely difficult, and scientists must be prepared to defend their conclusions against often irrationally opposing views. The problem is that the scientists can only rely on the amount and quality of the data and knowledge they have available (which depends, in part, on the budget and support provided by other sectors), while others in the sector have more powerful (often more emotional and less scientific) political, economical, and social arguments. As a way of pressing the decision-maker, others in the sector can argue that they want to maintain high yields, profits, employment and so forth, while scientists usually argue that they want to avoid overexploitation and to heighten the probability of preserving the resource.
- Normal processes of scientific debate in a lay forum give the impression of incompetence and/or ignorance. Scientific debate should therefore be conducted in a scientific forum and the question of what can, and what cannot, be concluded should be made clear in presentations to the public.
- Predictive fisheries assessments, like all such ventures, will sometimes be wrong. Inevitably, such errors will be used to undermine confidence in the scientists.
- A particular case of such predictive assessments is that of “risk of collapse” calculations. The scientist will be asked to justify why preventive medicine is necessary on probabilistic evidence only.

- Finally, the scientist finds that the decision-makers to whom he is providing information are often likely to be replaced, usually by someone less familiar with his or his organization's research and assessment activities and all his work (including attempts to gain the confidence of the decision-maker) has to begin again.

5.2 Suggested remedies for dealing with such problems

The fishery assessor must accept, as a fact of life, that he will usually be working in an atmosphere that is either indifferent or hostile to his assessments. It has been aptly said that there is no good time to tell the fishermen to stop; if they are doing well they will not listen and if they are doing badly they cannot.

Nevertheless, the process of "educating" the decision-makers about the scientific basis of management must be pursued continuously in a variety of ways. Only then will it be reasonable to expect the scientist to be listened to and understood when there are sharp declines in fish catches.

Confidence must be established between decision-makers and scientists, so that decision-makers can rely on the scientists to: (1) know what they are talking about; (2) admit honestly what they do not know; (3) be impartial in the sense that they have no particular prejudice for one policy over another; (4) be prepared to put their scientific status and integrity on the line to defend their advice as being the best and most effective that is possible, given the circumstances; and (5) not be afraid to admit when they are wrong.

It is important to stress that no less should be expected by decision-makers from other interest groups (such as industry or conservationists) providing advice and recommendations. Specifically, the decision-maker should be aware of their biases and relative credibility. Scientists and their findings are constantly under peer review while other interested parties and their findings are often able to avoid similar scrutiny.

However tempting it may be to provide "softened" scientific assessments in order to make them more acceptable, that temptation must be regarded with caution. It may rebound sooner or later and the scientist will have forfeited his credibility. However, this is difficult - all too often the best policy is rejected as too extreme, leaving no policy. "Softening" is sometimes necessary to achieve results, but it should be done by working with decision-makers in a constructive manner.

Fishery assessments are highly sophisticated scientific exercises calling on a variety of skills, a penetrating knowledge of the biology of the system, and a good understanding of the fishing operations and the industry. There is everything to be gained by treating them as such, and exposing the conclusions to the thrust and parry of open-scientific peer review. Both the substance of the assessments and the confidence placed in them by decision-makers should thereby be enhanced.

Because the fisheries science community is essentially international, it would be desirable, when possible, to extend the scope of scientific review and criticism to the international level as a regular procedure. This would avoid the need for national decision-makers to feel that they must seek another opinion in the hope of finding another, politically more palatable, option. Related to this point is the increasing role of marine scientists as consultants hired by industry to present their view of, and to emphasise the uncertainty aspect of, resource exploitation.

Scientists need to understand what the needs of the policy-maker are, including what he is doing and why (this is essential for the scientist to know in order to give good advice). The decision-maker also needs to understand the scientific and other advice that he receives about the fishery. International reviewers have a higher probability of objectivity, but may suffer from lack of intimate knowledge of the fishery and its particularities; however, these obstacles should not be difficult to overcome.

5.3 Some sources of problems related to fisheries management

Problems faced by fisheries scientists in the decision-making process result in large part from factors over which they have little control. Some representative factors for comment are: conflicting time-scales, perceptions about the resource (and its abundance), uncertainties in the physical and societal setting, fishing as a subsector of society, and discounting the past.

5.3.1 Time-scale

The importance of time-scales cannot be underestimated. Pelagic stocks are often eruptive in nature, and accordingly have high potential increase rates over periods of several years. Harvests in excess of the surplus production cannot be sustained for long as the biomass “reserve” is rapidly depleted. Stocks can be reduced to undesirably low levels by overfishing for a period as short as one to two years.

Over the long-term, many pelagic fishes have low production/biomass ratios, but because of their eruptive nature (serial correlation, etc.) and their high variability, they may be highly productive over intermediate time-spans. Time scale is important, but it is the eruptive time-scale that is important to pelagic fisheries. Depletion sets in very rapidly once the eruption is over, and the spawning base should be maintained at a minimal level for eruptions to achieve a useful level. Flexible management procedures are therefore required that can react on a time-scale shorter than one year, should evidence of stock depletion become manifest.

As biologists, climatologists and oceanographers constantly consider the relevance of different time-scales for their research, so, too, must those who seek to understand the societal implications of variable fish catches. For example, different groups discount the value of the future according to their needs and their objectives. Fishermen may find time-scales of days and weeks most important to the attainment of their objectives, while industrialists may think in terms of seasons and years. Policy-makers may respond to long-range development horizons of decades, or to short-term political horizons of years, or to the extremely short-term crises that they may face not only in the fishing sector but in other sectors of society as well (e.g. elections or government changes). Superimposed on all of this are the time-scales of nature which can range from hours to centuries. Often short-term objectives or benefits prevail over longer-term considerations which often become burdensome costs that will have to be borne by future generations of society (as well as by future generations of decision-makers). The actors involved in the fisheries who hold these conflicting objectives and time horizons (e.g. earn enough support from this decision to stay in their position; earn enough money to feed their family this week; earn enough money this season to amortise loans for their equipment; pay for their bills for the boat, nets, etc.; earn enough in the next few years to buy a house; earn enough from the fishery to subsidize economic development goals) must take into account nature's varied time-scales while they deliberate on how to exploit these fish stocks which, for whatever reason, are highly fluctuating.

Members of society, including decision-makers at all levels of social organisation, have tended to perceive pelagic fish resources as abundant and in some cases virtually unlimited. Yet the fact of the matter is that the ability of a fish population to regenerate itself is directly tied to, and dependent upon, the balance that is established between its rate of regeneration, which depends primarily on environmental processes, and its rate of exploitation. Not only are other marine species predators to these fish populations, so too are fishermen and their purse seines. Even the environment (e.g. fluctuations around the mean values of physical variables in the marine environment) may play a role and, in fact, plays a major role in magnifying the effects of predators and other causes that may alter the ability of the fish population to regenerate itself. This suggests that pelagic fish populations must be perceived as only conditionally renewable and, hence, managed more rationally.

5.3.2 Perceptions of abundance

Fishermen and the fishing industry base their appraisals of the abundance of a resource on the index to which they are sensitive, i.e. catch rate (or CPUE). This means, however, that they may fail to appreciate the fact that (a) in a situation where catchability (proportional vulnerability) is inversely related to total biomass, catch rates may be maintained despite a decrease in abundance; and (b) where selectivity changes with age, CPUE trends may lag behind those of total biomass, so that catch rates fall only some time after a general decrease in total biomass. Furthermore, even if the fishing industry should become aware of a drop in catch rate, it may be disinclined to acknowledge it, knowing that this will cause disruptions in fishing activities. Price may increase as catch rate drops, helping to offset the economic perception of a declining resource by the fishermen.

In cases where a fishery starts exploiting a resource when at a biomass level which is a reasonably high proportion of an average “carrying capacity”, the initial catches will comprise not only the production capabilities of the resource, but also a component (possibly the major component) arising from cropping down the initial biomass. This is a once-only benefit, but contributes to misguided perceptions among entrepreneurs of long-term yield potential, leading to “over-shoot” of expectation, hence overinvestment and overfishing.

5.3.3 Managing under uncertainty

One of the major problems that policy-makers have to address is uncertainty; uncertainty in the physical environment, uncertainty surrounding the fish resources, and uncertainty in the scientific information as well as uncertainty in the economic, social and political systems. In the biological sciences the uncertainties in the physical environment are exposed and discussed by scientists, yet such uncertainties create great pressures for decision-makers. As there are competing interests in society, uncertainty in the scientific information allows enough doubts about what the “real” situation is, that the policy-maker is often at liberty to discount this input (especially if opposing scientific arguments cancel each other) and to make decisions to reduce some of the uncertainty in his broader political and economic environments.

Crises in society require immediate attention of decision-makers. Uncertainty in the biological and environmental information he is given allows him to “take a chance” to achieve a more immediate goal at the risk of some catastrophe that might (or might not) occur at some unknown time in the future. By the time his decision has proved to be erroneous he will probably no longer be accountable as most likely he will have moved to another decision-making position or, perhaps, even to a similar position in another sector of society. Thus, policy-makers can use uncertainty to their political advantage when they perceive that there is a need to do so, because they will not be held accountable: “success has many fathers but failure is an orphan”.

5.3.4 Fishing as a sub-sector of larger systems

In developing countries fishing is considered either for food production, or as an item in the natural resource extraction sector. What premium is placed on either of these categories determines the relevance of predominance of the fishing sector. If the fishery is mainly considered as a food item, the state of food supply and the need for protein for national health becomes important. The availability of protein from other sources also determines what importance should be given to fish as a prime or cheap source that should demand attention.

If the fishery is viewed as an important factor in the extraction sector, its role as a revenue earner in foreign currency or in raising the per capita income becomes relevant. If it happens to be a prime earner of foreign exchange, such as anchoveta and now sardine in Peru and Chile, then its importance in the larger system is raised higher; however, fishing is not only an economic activity but also a political, cultural and social one. Therefore, to understand how a particular fishery is, and should be, managed requires investigations by social as well as physical scientists (Glantz, 1983).

5.3.5 Discounting the past

There now exists an expanding set of case histories of sharp declines in neritic pelagic catches in different regions of the world, at different times, the causes of which have not been agreed upon (generally speaking): South African and Namibian pilchard Peruvian and Chilean anchoveta, Hokkaido-Sakhalin herring, California Pacific sardine, and so on. The societal dislocations that have resulted from such declines have been recorded, although not in forms conducive to comparative analysis. As socio-politico-economic systems differ so, too, do the implications for society of the decline in fish landings. If a country's fishing sector has been heavily dependent on one main fish population (e.g. Peru in the 1960's), the social dislocations would be greater than in a country that exploits a multispecies fishery. It is time to assemble these case histories and to move such experiences from the realm of anecdotes into the realm of comparative analysis of the impact of declines in fish landings. One of the most important ways of preparing for the future is to understand the past. Scientists and policy-makers must ask themselves when will they have had enough information about the implications for society of sharp declines in fish catches.

6. RECOMMENDATIONS

a. Because of the significant social and economic consequences that can result from the highly fluctuating catches of many pelagic neritic resources, decision-makers must be made aware of the growing number of examples of severe dislocations that have resulted from the heedless exploitation of such fisheries.
b. An assessment should be undertaken to compare the effects of a stoppage of fishing activity resulting from a management decision taken at the first indication of a decline in biological productivity with the effects of a stoppage of such activity at some time in the future because of a sharp reduction of the fish population.
c. In managing neritic resources, decision-makers must give more consideration to the long-term interests of society than to the short-term political and economic interests that tend to dominate a policy-making process.
d. The formal decision-making process should incorporate an advisory group that should encompass a wide spectrum of interest groups (of which scientists would be one), ranging across a continuum from conservation to exploitation. This advisory group should not be a replacement for a scientific advisory group, whose role should be strengthened relative to what it has been in the past.
e. Economic measures should be used to discourage additional growth in the fishery before the declining state of the resource dictates such discouragement. Banking institutions and development financing programmes must be informed and coordinated with management. Consideration should also be given to implementing economic measures in order to, for example, sustain the sector through periods of poor catches, buy-back vessels for effort-reduction, and encourage diversification. (This should be done during the early growth stage.)
f. Scientific appraisals must be discussed as widely as possible, especially among the competent scientific community, both national and international. The results of such appraisals should be published in a timely manner. Independence (impartiality) of the scientific appraisal is essential. The scientist must not be pressured by his national political decision-maker to provide “rosy” projections when available scientific information suggests otherwise.
g. Scientists should be given opportunities to present their findings in person, to respond to questions and criticism and to stand by or modify their conclusions. To do otherwise would be a potential source of misunderstanding and lack of confidence.
h. An effective, reliable communication channel should be established among scientists, fisheries managers, and policy-makers so that a proper understanding and atmosphere of mutual trust can be developed, one that will become institutionalised and not dependent on the temperament of the individuals involved at a given time.
i. Stock-dynamic models provide estimates of the most appropriate current yield, taking into account only biological factors. However, it is clear that other social, political, and economic considerations play an important part in the final management decisions that are taken. It should be required that each of these considerations and their alternatives be investigated

and addressed as thoroughly as are the biological considerations. These factors must be identified and assessed in order to understand how fisheries are managed.

j. A management scheme should be established in which fisheries scientists would work on an interactive basis with social scientists, including economists, in order to more effectively assist decision-makers in their role as societal guardians of living marine resources, especially given the large degree of uncertainty that surrounds the existence and exploitation of these resources.

7. REFERENCES

Glantz, M.H., 1983 Man, state, and fisheries: an inquiry into some societal constraints that affect fisheries management. FAO Fish.Rep./FAO Inf.Pesca, (291)Vol.3:871–918

MacCall, A.D., 1983 Variability of pelagic fish stocks off California. FAO Fish.Rep./FAO Inf. Pesca, (291)Vol.2:101-12

Murphy, G.I., 1977 Clupeoids. In Fish population dynamics, edited by J.A. Gulland. New York, Wiley-Interscience, pp.283–308

Parrish, R.H. et al., 1983 Comparative climatology of selected environmental processes in relation to eastern boundary current pelagic fish reproduction. FAO Fish.Rep./FAO Inf.Pesca, (291)Vol.3:731-76

Tanaka, S., 1983 Variation of pelagic fish stocks in waters around Japan. FAO Fish.Rep./FAO Inf.Pesca, (291)Vol.2:17–36