

Governance for a Sustainable Future. II: Fishing for the Future

Report of the Commission on Fisheries Resources

II

Fishing for the Future

The Commission on Fisheries Resources

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Preface

This report is about the governance of the world's marine fisheries. It considers the present condition of the world's fishery resources, the trends in their usage and the possible consequences for the future if current patterns continue, and the opportunities available if governance is improved. The report offers the considered view of the Commission on Fisheries Resources, established by the World Humanity Action Trust (WHAT), on how improvements in the governance of the world fisheries could help provide humankind with a valuable resource for the future. The WHAT has defined governance as 'the systemic framework of social, economic, legal and political structures within which humanity chooses, and/or accepts, to manage its affairs'.

The Commission believes that great advances have been made in recent decades in evolving a system of global governance of fisheries but, equally, that much more needs to be done to institute changes in fisheries management and to resolve shortcomings in the agreed international rules available to humanity to govern these resources. While there are problems that still need to be resolved at a global level relating to the high seas, of greater importance is, ultimately, the implementation of management measures, within the jurisdiction of coastal states, that create the right system of incentives, sensitive to local conditions, that will generate patterns of behaviour consistent with optimal levels of harvesting and that will stop the overinvestment in the industry.

The report is preceded by a summary of the report, setting out the thrust of the Commission's thinking on the governance of

the fisheries sector. In Section 1, the status and governance of world fisheries is reviewed. About one-half of the fish stocks on which the Food and Agricultural Organisation (FAO) holds information are being fished close to their optimum, while a quarter of them are underexploited and the remaining quarter are being overfished. Overexploitation is the unavoidable consequence of open access, still the predominant regime for many fisheries. The central message of the report is the urgent need to put use rights regimes in place to avoid the catastrophe of many more fisheries becoming rapidly overfished and to begin to address the problems of those that are.

The case for a use rights regime is the subject of Section 2. Section 3 deals with the options for implementing use rights regimes and gives attention to the transition process. Many of the obstacles to establishing use rights are associated with the difficulties of making short-term sacrifices for the sake of long-term benefits, and of compensating those who otherwise might lose from the transition.

Fish products are among the most widely traded food products in the world. Trade, and the related issue of the use of subsidies, are discussed in Section 4. Growing public concern about overexploitation of fish stocks has been accompanied by a variety of solutions being proposed, some of which could make a contribution to effective fisheries management, but only in the context of a management approach that goes to the root of the problem. Section 5 assesses the most popular of these proposals. The Commission's recommendations make up the final section.

OVERVIEW: Rights-based governance of fisheries: how do we get there?

Introduction

The Commission concludes that effective governance of fisheries requires the assignment of enforceable rights to shares of fisheries. The importance of rights has been well known for decades, yet rights are either ineffective or nonexistent for most of the world's fisheries. As a result, many fishery resources have been overfished and tens of billions of dollars in economic benefits are wasted annually. Failure to apply rights-based approaches to governance of fisheries is a symptom of not paying enough attention to the transition costs (economic, social and political) that are encountered in assigning rights. Ironically, traditional fishing rights once existed in many fisheries, throughout the world, but have been eroded over time. The Commission is particularly concerned that failure to replace traditional rights in developing countries with effective rights that fit today's reality places millions of people who are critically dependent on small-scale coastal fisheries in jeopardy. In these countries (which account for about two-thirds of global landings), globalisation of trade and advances in fishing technology, which could lead to more prosperity, will continue to exacerbate problems until effective rights that fit local situations are established. The Commission calls for a global conference to highlight the severity of fishery problems and options for solving them.

The Status of Fisheries

During the twentieth century, the yield from fisheries increased from a few million tonnes to nearly 100 million tonnes. People are eating more fish than ever before. In developing countries, fisheries are particularly important for food, income and livelihood. Fish is the most internationally traded of all food commodities, measured as a share of production. Trade in fish products is a major component of export earnings for many developing countries. Can the spectacular growth in production by fisheries continue? Can even today's yield be sustained? The Commission reviewed the condition of fisheries to answer these questions.

The commonest way to describe the condition of a resource is to compare it with its condition when it produces the maximum long-term average yield that is sustainable. This yield is referred to as the maximum sustainable yield (MSY).

Fished resources producing MSY are referred to as 'fully fished'. If more catch than this is being taken, the resource is referred to as 'overfished'. When overfished, the resource becomes too small or unproductive to produce a long-term average yield of MSY. According to the best information available from the FAO, about one-half of the world fisheries resources are fully fished, a quarter are overfished, and a quarter could be fished harder. However, the Commission is concerned that many small-scale fisheries in developing countries are not represented in these assessments. While information on the status of these fisheries is generally lacking, it is the Commission's judgement that small-scale fisheries in developing countries are generally in a worse condition than indicated by reports on the global status of fisheries.

The Commission concludes that the spectacular increases in yield from fisheries will not continue. Indeed, the recent level of yield is at risk. This concern is reinforced by the fact that, unless prevented by adequate management, fisheries almost always evolve toward overfishing, sometimes causing irreparable harm to the resource and hardship for the people who depend on them for a livelihood.

Yet, economic benefits could be greatly increased even from the present yield. While too little is known about the economic performance of most of the world's fisheries, one global study in the early 1990s indicated that the fishing industry loses tens of billions of dollars annually: i.e., costs far exceed revenues. (Fisheries might persist while losing money if governments subsidise their growth, or support a fishing industry that is struggling to survive. Both types of subsidies only make matters worse in the long term. The losses also reflect depreciation of fishing vessels and fishing gear.) However, more recent studies of individual marine fisheries do not confirm the losses or the dependence on subsidies implied by earlier global studies. This may indicate that the situation has changed, i.e. that subsidies are less prevalent. Nevertheless, the opportunity for fisheries to produce tens of billions of dollars of unusually high profits (referred to as rents) is being wasted for most of the world's fisheries.

The poor economic performance of fisheries is basically caused by too many boats, gear and fishing people, referred to as fishing capacity, trying to catch a limited supply of fish. In

most fisheries, the same catch or more could be taken with less capacity. Since the total sustainable catch is limited, individual fishing boats or gears compete to catch shares of the available fishery resource in 'the race for the fish'. Total costs increase as people fish longer hours using more costly gear, thus dissipating rents. As the abundance of the fishery resource declines as a result of fishing, the cost of catching the same amount of fish grows even higher. This behaviour, of spending more in the race, is rational for a while (until marginal costs are no longer met) from the perspective of individuals, but it does not make sense for the entire fishery. Further, the race for the fish may decrease the value of the fish that are caught if it produces lower-quality fish or temporarily floods the market. It may also encourage risky, illegal and environmentally destructive fishing practices, such as using explosives and poisons to fish, which occurs in some parts of the world (e.g., Southeast Asia and, recently, the Mediterranean Sea).

Eventually, fishery resources decline, either from overfishing or natural variability, and the catch can no longer be sustained. However, the empirical evidence is clear that the fishing industry typically resists regulations to decrease catches in the short term, despite the long-term benefits. Fishing people believe they will have no future in the fishery if they cannot pay their immediate bills. Also, if they remain in the fishery, they risk even more competition in the future. Fishery managers often yield to the pressure to give more consideration to short-term economic losses than to sustaining the fishery resource and long-term economic benefits, particularly if the scientific information is uncertain (which is always the case). Making risk-prone decisions on the fishery resource, in the face of scientific uncertainty and pressure from the fishing industry, ultimately makes matters worse for the resource, and all people involved.

The Evolution of Fishery Governance

Governance is a system of formal and/or informal rules that apply to certain types of activities, such as fishing. Governance systems are strongly influenced by dominant paradigms concerning the activities in question.

About 100 years ago, Thomas Huxley, one of the world's leading scientists, proclaimed that most of the great sea fisheries were inexhaustible. This paradigm had profound implications for the governance of fisheries. Fisheries developed without concern for overfishing, and without rules about who could, or could not, fish. Although overfishing was less of a problem in Huxley's time, examples already existed, such as the once great Atlantic halibut fishery that had collapsed by the late 1880s and has never recovered.

By the end of the Second World War, scientists had generally rejected the inexhaustibility paradigm, but existing and new fisheries continued to develop and technology such as mechanised trawling improved rapidly and spread, all with

minimal regulation. In part, fisheries were left unregulated because many of the richest fishing grounds were outside national jurisdiction, which at that time was usually three nautical miles from the coast. After World War Two, there was a tendency to expand national fishing zones and even territorial limits at sea, and by the early 1960s many countries had a 12-mile fishing zone or territorial sea. Some international organisations regulated fisheries on the high seas beyond national jurisdiction. Typically, such regulations came only after stocks had been depleted, and they were inadequate to protect fishery resources. From the 1970s, most countries established national fishing zones (exclusive economic zones) of 200 nautical miles, thus covering the fishing grounds that produce more than 90% of the global catch.

Since 1977, additional international organisations and legal instruments to manage fisheries have been established. The 1982 UN Convention on the Law of the Sea (LOSC) was supplemented in 1995 by the UN Agreement on Highly Migratory and Straddling Stocks to improve the international framework for managing fisheries. Also in 1995, the nonbinding Code of Conduct for Responsible Fisheries and Aquaculture was agreed by FAO member nations. Nevertheless, some fisheries still lack a legal framework for management. More importantly, even where a legal framework exists, fisheries management generally remains inadequate for achieving the full potential of fisheries. In fact, the extension of jurisdiction after 1977 encouraged many countries to promote development of their fisheries, often with subsidies, without necessarily managing them to prevent overfishing.

While governance of fisheries within the legal frameworks provided by extended jurisdiction, the law of the sea and international agreements is a relatively new endeavour, traditional and informal governance systems existed historically for many fisheries. These informal governance systems were local and vested in coastal communities or village institutions. Communities and local leaders controlled who could fish and how. In this way, they moderated the race for the fish. These locally based governance systems were particularly important in many developing countries. However, many lost their effectiveness when they (a) were not legally recognised, (b) could not cope with the introduction of modern technology, (c) could not exercise governance over the full range of fishery resources or gear types (such as industrial-scale trawling), (d) lacked community backing or cohesion and/or (e) were powerless to exclude or control new entrants. Despite these factors, arrangements at the local level are potentially important building blocks for the effective management of fisheries.

The key to an effective governance system is to eliminate the incentives to race for shares of fisheries. To do this effectively, the governance system must control fishing activity over the entire range of the fishery resource and must assign rights to shares of the fishery. These rights should be secured in such a way that the benefits to the rights holders

are linked to the productivity and value of the resource. With a right to a share in the fishery, the incentive is to maximise economic benefits by reducing the cost of using one's right and/or by increasing the value of the right: for example, by producing a higher-quality fish product. Rights that are secure in the long term facilitate the acceptance of short-term sacrifices for long-term gains.

Governance systems that assign rights to shares of a fishery are specified by the nature of the shares in the fishery, the type of entities that hold rights, and rules about transferability and enforceability of rights. Shares can be an amount of catch, units of fishing effort (such as days of fishing) or an exclusive geographical area and time period when fishing is allowed. In order to be effective, the sum of all of the shares must not result in overfishing. Shares that are specified as fishing effort units, or fishing areas and time permits, are not as effective at eliminating the race for the fish as shares specified as catch quantities, but they may be more practical, acceptable to fishing people, easier to enforce, and not so dependent on scientific advice. There may be a need for additional rules, such as fish size limits, that apply to all rights holders in the fishery.

The rights holder can be an individual (a person or corporation), community, collective, or nominated representatives of a group. In many parts of the world it will be appropriate to vest these rights in the local community of which the active fish harvesters and fishworkers are members. This community then takes responsibility for further allocation and monitoring of the use of the resource. In such fisheries, peer monitoring may be important in control of the fishery. This is particularly true of many developing countries where most of the people involved in fisheries live and work.

The type of entities assigned rights is important in determining the rights' effectiveness in ending the race for the fish. When individuals have a secure share of a fishery, they no longer have an incentive to race, since they will not be allowed more than their share. Communities or other groupings may be cohesive enough, or have internal governance mechanisms, to prevent individuals within the community from racing among themselves for the community's share, although this is not necessarily the case.

Allowing rights to be freely transferred is necessary to maximise the economic benefits of a rights-based fishery regime. Unrestricted transferability may, however, have undesirable side effects (e.g., industrial or geographical concentration). One way of dealing with that is to restrict transferability, but other methods less harmful for economic efficiency would be preferable if available.

Individual Transferable Quotas (ITQs) are one form of rights-based fishery management that is increasing in importance. ITQs are now applied in Iceland, New Zealand and parts of the United States, Canada, Australia and Chile, and the number of cases in which they are applied is growing. There

is little doubt that ITQs eliminate the incentives to race for the fish. However, they are not a practical option for most small-scale fisheries in developing countries or many tropical fisheries because of the complexities of multispecies fisheries, the limitations of scientific information needed to set catch quotas, difficulties with enforcement and the large number of people dependent on fisheries. In these situations, other forms of rights-based management need to be applied.

Problems of Transition

Many fisheries lack a governance framework capable of assigning effective rights. This is not surprising for fisheries on the high seas, but it is also the case for many fisheries within national jurisdictions. While countries have sovereignty over fisheries in their waters, many do not have adequate domestic fisheries management legislation or institutions at all levels to implement the legislation. In particular, management authorities are required to manage the fishery resources and their habitats over their entire ranges and yet be small enough to maintain contact with the people in the fisheries. Such a scale is usually larger than the sphere of influence of a community or village but smaller than the national government. These problems are often a subset of broader natural resource governance and infrastructure problems that face many countries.

Even when there is a governance system that is capable of managing fisheries, effective fishing rights are usually lacking. Introducing a rights system is very challenging. The most important transition issue is deciding the initial rights allocation. Generally, historical participation in the fishery is the basis but even this involves some seemingly arbitrary decisions such as which years of historical participation count. In order for the initial allocation of rights to be perceived as equitable, it may be necessary to compensate those who do not receive allocations.

There is usually resistance to the transition to a rights-based system, not least from the fishing industry. This is surprising, as the industry would seem to benefit the most. In part, this is due to resistance to change and fear of the individual consequences. The public may also resist a rights-based fishery management system because a minority of the total population gets the right to exploit the resource and many people feel that a national asset which they share, even if they do not use it, is being given away. In this case, selling rights, or charging for their use, would alleviate this concern, but it would add to the resistance to rights-based fisheries management by the rights holders. Furthermore, when rights-based fishery management is implemented in a situation of overfishing, most of the participants in the fishery cannot afford to pay for rights until the fishery recovers.

Another practical concern in establishing a rights-based system is the effect on the people and capital investments in the fishery. One of the goals of a rights-based fishery

management system is to cope with the ill effects of overcapacity in fisheries. Under the new system, therefore, employment and capital should decrease. Losses in the value of capital, such as fishing gear and vessels that are not needed, may be offset by the value of the share itself, if the rules allow shares to be transferred. The effects of job losses depend on the availability of alternative jobs that fishing people are qualified to fill. Fishing people, however, may find other jobs much less desirable than fishing or may not be qualified for the jobs available. Unless special rules on transfer apply, the decrease in fishing capacity may change the character of a fishery from many small fishing vessels to fewer, larger vessels. Fear that family-owned fishing vessels may go the way of the family farm or the local store is also a cause of resistance to rights-based fishery management.

An effective rights-based fishery management system requires a scientific basis for limiting fishing to a sustainable level and an enforcement capability to protect the rights. Therefore, the adequacy of science and enforcement are concerns. However, the need for scientific information is not generally greater for rights-based fishery management than for other management systems. The need for enforcement may or may not be greater for rights-based management, especially when local level bodies are involved in co-management.

Coping with the Costs of Transition

The economic and social costs of the transition to rights-based management must be recognised and paid for, in ways acceptable to those affected.

Monetary costs, such as those for retiring excess capacity (i.e., vessel buy-backs, retraining people that are displaced from fishing) and for scientific and enforcement needs, can fairly readily be calculated. The social costs are harder to assess because they are intangible, but they are no less real. They are reflected in the stress and social unrest of individuals, families and communities that face unwanted change.

Monetary costs can be paid in one of three ways. One option is that the people in the fishery pay the costs. After all, they chose to invest their money and lives in it. On the other hand, many of the problems have resulted from the failures of governments to manage fisheries so as to provide incentives for their conservation and efficiency.

A second option is for the government to pay the costs. A variation of this approach is for governments to buy initially allocated shares that exceed a sustainable level. The third option is to have those who benefit in the long term pay the transition costs. This usually requires that rights are transferable. For example, those leaving the fishery may sell their shares to those who stay. Fees can also be charged to finance government costs (for example, buy-back and

additional scientific and enforcement costs). If shares are to be transferable or if fees are to be charged, the rules governing these financial transactions need to be carefully specified at the time rights are initially allocated, since the rules affect the value of the rights. Changing the rules later is problematic. However, a plan that allows a phased increase in transferability and fees would not constitute a change of rules.

Realistically, there is no option but for the people involved with fisheries to pay the social costs of change. However, social costs can be reduced and distributed more equitably, especially through careful attention to the initial allocation of rights. One important step is to involve the people most affected by fishery management in the design of a rights-based system that is most acceptable to them, without compromising so much that the system is ineffective in ending the race for the fish. Gradual introduction of change, such as by restricting transferability of rights, is the other primary way to reduce social costs.

While transition costs can be formidable, postponing the transition will make the costs even greater. Delay means forgoing benefits and incurring more costs, including stressful controversy.

Outlook for the Future

The WHAT Commission on Fisheries Resources is convinced that well managed fisheries resources could make a bigger addition to human welfare and prosperity than they do at present. Intense controversies over fisheries of today should be greatly reduced or eliminated once the transition to rights-based management has been achieved. Addressing the costs of the transition is a key to this positive outlook. The move to rights-based fishery management is underway. With leadership from both governments and people involved in a variety of ways in the fisheries sector, progress can be more rapid. Nongovernmental organisations (NGOs) and other support groups concerned with these issues can also contribute significantly to instituting change.

Realistically, the future outlook for fisheries is mixed, with the disparity between well managed and poorly managed situations becoming even greater than today. History has shown that society is reluctant to make major changes until the current situation becomes intolerable. The Commission is particularly concerned about the future outlook for many developing countries that lack the means to implement appropriate governance systems and the infrastructure for fishery management. For complex, small-scale, multi-species fisheries with limited scientific and enforcement capability, rights-based fisheries management with shares specified as catch quotas or ITQs are not a realistic option. Furthermore, where there are few alternative livelihoods for large coastal populations and weak or nonexistent social welfare systems, a rapid reduction in participation in fisheries would be disastrous.

In many developing countries, the Commission believes that legitimising and bolstering traditional rights over small-scale fisheries could be part of the formula for improving the governance of fisheries. While local institutions could be building blocks for rights-based fishery management, they must be accompanied by conservation measures over the entire range of the fishery resources. Thus, it will be necessary to establish some form of regional governance in which communities are nested. Communities must also be able to regulate themselves to avoid an internal race for the fish. All of this will require technical assistance, experimental development and careful analysis to guide the outcomes.

Developing countries that choose to maximise economic benefits from their fisheries by modernising them must not neglect their responsibility for assuring the sustainability of fisheries and fair treatment of large numbers of people that are critically dependent on fisheries.

The Commission recommends a global conference to highlight problems and potential benefits, and, in particular, the key role that rights-based fishery management can contribute toward increasing both the abundance of fish and human prosperity.

1. Global Fisheries

Resources: the Status of Stocks and their Governance

1.1. Introduction

Fisheries resources are producing a record quantity of food and other benefits for humanity. The biomass of many fisheries resources is close to, or greater than, the size needed to produce an optimum yield. It is also true, however, that the yield from the fisheries that depend on wild marine catch appears to have peaked, and available data show a trend towards overfishing. Without an adequate governance framework and careful management, the biomass of many more stocks could plummet, just as many key stocks have already done. The prospects for the world's fisheries are reviewed in this section.

This brief overview of the state of global fisheries resources places in context the urgent need that exists to encourage greater focus on the implementation of the wealth of practical and realistic management measures now available for implementation at a regional, national or local level. It also points to the need to address outstanding problems that require global collective agreement and action.

1.2. Fish as a Source of Food

Fish have traditionally been viewed as a source of high-quality animal protein, supplying approximately 6% of the world's protein requirements and 16% of total animal protein. Estimates of human protein requirements in the 1960s were on the high side. With the important exception of people eating protein-deficient starchy diets based on staples such as cassava, the accepted view now is that if the calorific food intake is adequate then the protein requirements will probably be met.

Nevertheless, fish make a significant, though not essential, contribution to the protein supplies of many fish-consuming communities, in both the developed and developing worlds. In general, lean fish are not an important source of calories, which are mostly obtained from the staple carbohydrates in the diet. Fatty fish, however, are a significant energy source. Today it is recognised that fish are probably more important as a source of micro-nutrients, minerals and essential fatty acids than for their energy or protein value. The essential micro-nutrients and minerals in fish, which are deficient in staples, include vitamins A and D, phosphorus, iron, calcium, magnesium, selenium and iodine in marine fish. Humans have

particular requirements for a number of essential fatty acids, two of which are preferentially available from the aquatic food chain. EPA (eicoso-pentaenoic acid) is necessary for the correct functioning of the vascular system, while DHA (docoso-hexaenoic acid) is essential for the formation of the brain and nervous system, which is laid down during foetal growth and in the first months of infant life.

Determining the quantity of fish that is, or might be, available to the average consumer, or to a particular individual, is not easy. The total food supply available from fisheries would give an apparent annual availability, in live weight terms, of 15 kg for each of the world's inhabitants. This figure has increased from about 7 kg per capita in 1950 as production has more than kept pace with population growth, but is now levelling off. However, such per capita availability figures need to be viewed with some caution as they do not represent individual consumption, which can only accurately be assessed in countries where food consumption surveys have been carried out.

Who actually eats the fish or fish products within a population is heavily skewed—to those who have a cultural preference for fish, those who can afford it or alternatively those who can find it in the market. Even at the first level of disaggregation, between developed and developing countries, there is a discrepancy as availability in developed countries is 29 kg per capita, while it is only 12.5 kg per capita in the low-income food-deficit countries (LIFDCs). In some developing countries fish accounts for a very high proportion of animal protein intake and is particularly important for the lower income groups.

Projections of demand resulting from population and income growth point to an increasing gap between supply and demand. This will impact particularly severely on levels of consumption by vulnerable groups. It will be difficult to close the gap and it is highly speculative to suggest that overall availability could be increased. Significant contributions can come from a number of sources, including better management, aquaculture development, reduction of wastage and better food use of the small pelagic species currently converted to feed. However, the consequences of a failure of management, leading to a reduction of supply, are potentially serious and need to be analysed.

Although in direct nutritional terms the nutrients that fish contributes to the diet could theoretically be supplied from other sources, albeit more expensively, the social and cultural changes implied are impossible to envisage. Even assuming that alternative supplies could be made available at equivalent prices (for instance chicken, the cheapest form of animal protein after fish) it is most unlikely that people would be prepared to change their deeply embedded traditional food habits. The social and economic impacts on employment, investment, etc. are obvious.

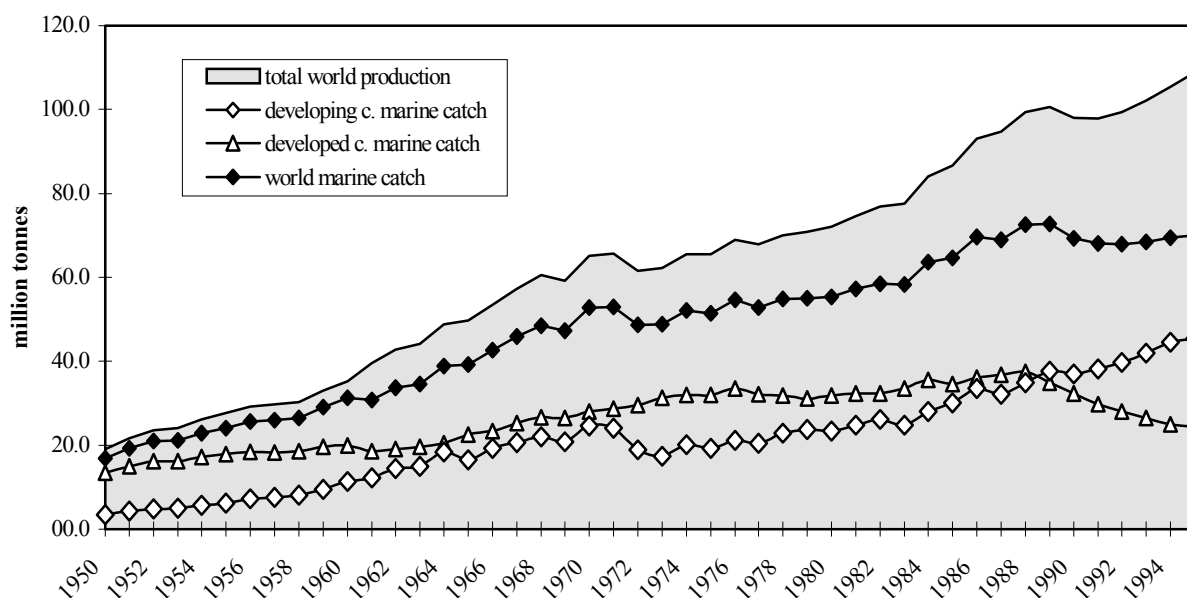


Figure 1-1: Global aggregates, indicating total production (aquaculture and capture), marine capture and the marine catches of developed and developing countries. (Data source: FAO, 1995c; FAO 1996.)

1.3. The Paradox of Abundance and Decline

The first superficial glance at the world's marine and inland fisheries production gives the impression of health associated with almost continuous growth of the harvest experienced since the end of World War Two (see Figure 1-1).

Data for 1996 indicate that the total production through both capture fisheries and aquaculture reached a new peak of 117.3 million tonnes (FAO, 1998a, 1998b): the marine catch reached 87.1 million tonnes and the catch from inland waters accounted for a further 7.6 million tonnes, giving a total figure for capture fisheries of 94.7 million tonnes. Just ten countries accounted for 70% of total catch. These figures hide a more serious and complex tale, which needs to be considered if we are to optimise use of these resources in the future.

The limited usefulness of these global aggregates, and their potential to inadvertently mislead (Garcia and Newton, 1994), becomes apparent in the discussion below. The Commission is concerned that global summaries do not adequately portray the severity of overfishing in the coastal areas of developing countries. Hundreds of millions of people are dependent on these fisheries for food and livelihood. They face a looming crisis if, and when, some of these fisheries collapse (see Recommendation 7).

Production now credited to developing countries has surpassed production by developed countries in the course of the last decade. Developed countries caught 57% of total global landings in the early 1970s but by 1992 this had dropped to 40% (Garcia and Newton, 1994). This is in part explained by the diminishing opportunities for distant-water

fleets, which caught 8.9 million tonnes in 1989 but only 5.7 million tonnes in 1992, as developing countries have taken greater control of their own fisheries (Garcia and Newton, 1994). Some of the change may be explained by the transfer of fleets to the flags of developing countries, in order to secure or maintain access, rather than a real change in operations. Part of the increase in production may also be explained by increased reporting to the FAO.

LIFDCs have had an average rate of growth in production of 6.9% between 1988 and 1994. These countries accounted for 26% of total production in 1988 but for 35% in 1994 (FAO, 1997). The phenomenal growth of Chinese production accounts for one-half the LIFDCs increase in capture fisheries and four-fifths of the increase in aquaculture production (FAO, 1998a; FAO, 1998b). The growth of production for LIFDCs does not necessarily mean increased per capita consumption in poorer countries. There have been declines in per capita consumption of fish in the sub-Saharan Africa region, and in the Middle East and North Africa, with a slight decline in Latin America and a dramatic decline in Russia (FAO, 1997).

Worldwide, 28.5 million people were estimated to be working in fishing and aquaculture in 1990, more than double the number who were employed in the sector in 1970 (<http://www.fao.org/fi/highlight/fisher/>). About 12 million people were engaged full-time in the sector (i.e., fisheries accounted for 90% or more of livelihood), 10 million were regarded as part-time (30–89% of livelihood) and 6.5 million were regarded as occasional fishers (30% or less of livelihood). More than 120 million people throughout the world are estimated to depend on fish, the largest wild food harvest, for all or a part of their incomes (see <http://www.fao.org/gender/en/fishb3-e.htm>).

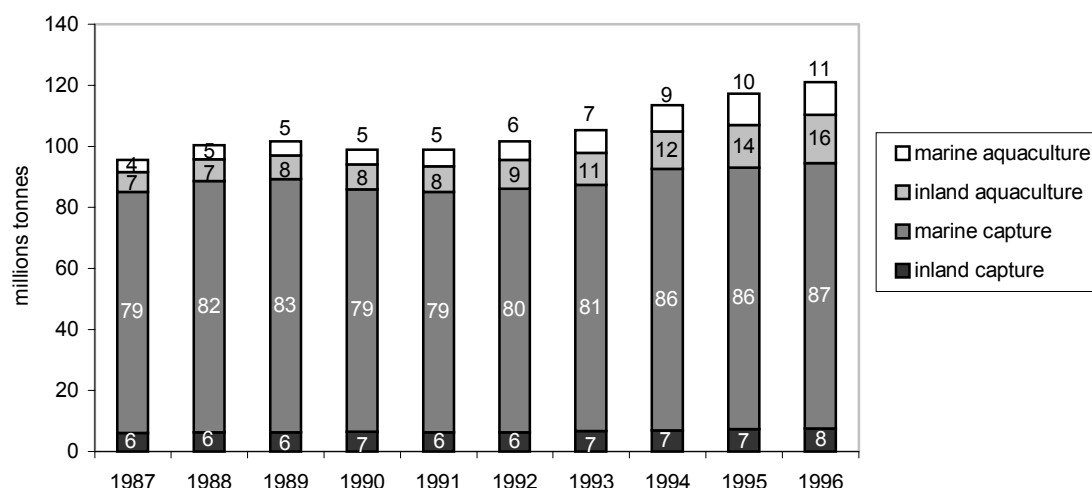


Figure 1-2: Total world production: marine and inland aquaculture and capture fisheries in millions of tonnes. (Data source: FAO, 1998a, 1998b.)

1.3.1. Capture Fisheries

Marine production grew very rapidly during the 1950s and 1960s at rates of 6.8% and 7.4% a year respectively. The rate of growth dropped to an average of 1.7% in the 1970s, which reflects the collapse of the anchoveta resource off Peru and the oil crisis of 1974, which had a marked effect on the distant-water fleet. The average rate picked up a little in the 1980s to 3.6% but production actually shrunk by 1.5% between 1990 and 1992, mainly due to a decrease in the catch of Japanese and South American pilchard and overfishing of important demersal resources (Garcia and Newton, 1994). The average marine production of 84.77 million tonnes for the years 1993–6 represents a 6.9% increase over the early 1990s. The global marine catch has since levelled off and it would seem that it has probably peaked.

The practice of disposing of unwanted fish at sea represents a significant loss to many fish stocks. The extent of discarding is difficult to estimate as it tends to be unreported catch, sometimes dumped to avoid it being counted as part of a quota, at other times just not considered worth landing. Recent FAO analysis suggests that about 20 million tonnes of fish are discarded annually (Garcia and DeLeiva Moreno, 1999). This represents nearly 20% of the total quantity of fish removed from the marine environment each year.

Inland capture grew by an average of 2.35% a year between 1987 and 1996, from 6.59 to 7.55 million tonnes. This represents an increase from 7.67% to 7.98% in the share of inland capture fisheries in total capture fisheries over the decade (FAO, 1998a).

1.3.2. Aquaculture Production

The balance of total production is made up from aquaculture production. Aquaculture, both marine and inland, plays an

increasingly important role in the provision of animal protein from aquatic resources (FAO, 1996). This is evident from Figure 1-2.

In 1987 aquaculture production was 11.13% of total world production but by 1996 it had grown to 21.8% of total world fisheries production. It should be noted, however, that 81.6% of the 15.75 million tonne increase between 1987 and 1996 was due to China alone (FAO, 1998b).

1.4. Present Status of Marine Fish Stocks

1.4.1. The Global Figures

Marine capture remains the largest source, but a diminishing percentage, of total fisheries production. The sustained global marine catch hides important trends.

1.4.1.1. Change in Catch Composition

The pelagic component of the marine catch has risen from 50% of the total catch in 1950 to 60% of total catch in 1994. This observation is consistent with the finding that the mean trophic level of the species groups reported in the FAO's global fisheries statistics declined from 1950 to 1994 (Pauley *et al.*, 1998).

Five major pelagic or semipelagic species, anchoveta, Alaska pollock, Chilean jack mackerel, and South American and Japanese pilchard, are responsible for most of the increase in the marine catch since the early 1980s (Garcia and Newton, 1994). Of the 186 species recorded by the FAO as those exploited by pelagic fisheries, 50% of the average total pelagic landings were made up of just seven species (anchoveta, Atlantic herring, Japanese pilchard, South American pilchard, chub mackerel, capelin and Chilean jack

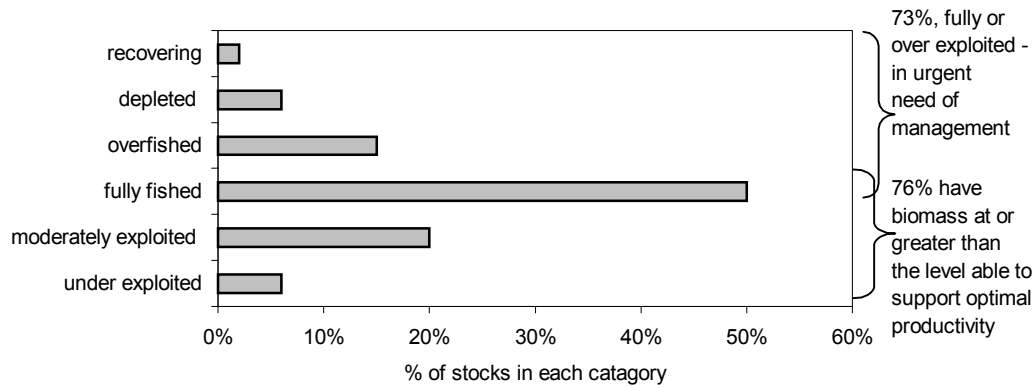


Figure 1-3: State of stocks in 1996 (adapted from Garcia and DeLeiva Moreno (1999), Figure 2).

mackerel) between 1950 and 1994. These species account for most of the variation in catch; the remaining 180 species taken together represent a smoother, more continuous growth in catch (FAO, 1997).

In contrast to the growth of the pelagic catch, the catch of four major demersal species (silver hake (*Merluccius bilinearis*), haddock (*Melanogrammus aeglefinus*), Cape hake (*Merluccius capensis*) and Atlantic cod (*Gadus morhua*)) declined by 67% between 1970 and 1992 (Garcia and Newton, 1994). If the two most important demersal species (Alaska pollock, which migrates vertically and is caught in both demersal and semipelagic fisheries, and Atlantic cod) are excluded, the remaining 405 resource items (area–species combinations) recorded by the FAO as making up the global demersal landings show a clear pattern of increase up until the early 1970s, and stability since then (FAO, 1997).

It is apparent that the world supply of fish is increasingly reliant on low-value species, which have high annual fluctuations in productivity. Global aggregations of catches have concealed the evidence of the decline of high-value demersal species (Garcia and Newton, 1994).

1.4.1.2. Status of Major Fisheries

The FAO (1997) results of an analysis of the landings of 200 species from particular oceanic areas (species–area combinations, referred to below as ‘resources’), accounting for 77% of world marine production, offers an important additional perspective on the ever-increasing total catch. Four examples of the 12 groups used in the analysis are presented, reflecting phases in the development of a fishery: namely, the undeveloped, developing, mature and senescent phases. These phases reflect the evolution of a fishery from the state of a stable, as yet undeveloped one, to one in which the productivity rapidly rises (with increasing landings) and then falls as landings reach a maximum. Finally, in the senescent stage, the productivity rate becomes negative as the level of landings falls.

The results showed that 35% of these 200 major fisheries resources were senescent, showing declining yields. A further 25% were mature (or fully exploited). 40% were still developing and there were none that remained at a low exploitation level (FAO, 1997). Thus, about 60% of the world's major fisheries resources were found to be either fully exploited or experiencing declining yields. As few countries have effective control over fishing capacity, these resources are in urgent need of management to end overfishing or to restore depleted stocks.

1.4.1.3. Status of Stocks

The FAO holds information on the state of 392 of the 696 stock items recorded in their database. This represents a wider set of resource items than that above. The quality of this information is neither uniform nor is the information necessarily recent. A more recent analysis of these 392 items, summarised in Figure 1-3, shows that 6% of these stocks appear to be underexploited (see the glossary in Appendix D for definitions), 20% moderately exploited, 50% fully exploited, 15% overfished, 6% depleted and 2% are recovering (Garcia and DeLeiva Moreno, 1999).

An important point that emerges from this is that while some 76% of these stocks are at, or greater than, a biomass level approximating that needed to harvest at an optimal level, there are some 73% of these stocks that are in need of management if they are to avoid becoming overfished or, in the case of those that have already been overfished, if they are to be rebuilt. Some fisheries in this position are under effective management, where access to the fisheries has been limited, thus limiting pressure on stocks. But many fully fished resources are not adequately managed and are thus vulnerable to rapidly moving into decline, becoming overfished or depleted. A major concern is the presence of excessive fishing effort.

It should be noted that the population dynamic in which per capita reproductive success declines at low populations levels,

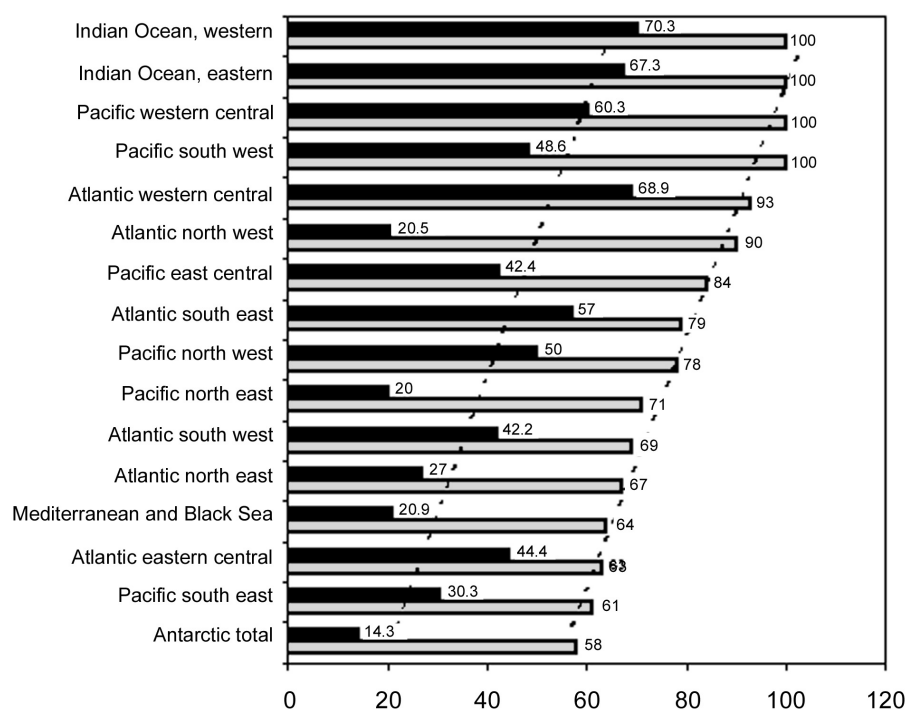


Figure 1-4: Percentage of stocks in each FAO region exploited at MSY level or below: □ percentage of known stocks; ■ percentage of stocks in unknown state (adapted from Garcia and DeLeiva Moreno (1999)).

referred to as depensation, does not seem to be a common phenomenon. A study of spawner abundance and the number of surviving progeny of 128 depleted fish stocks (Myers *et al.*, 1995) established that only 3 of the 128 stocks indicated significant depensation. The implication of this is that, with careful and effective management and with time, many depleted stock should be able to recover.

1.4.2. The Regional Picture

Regional analysis of the data reveals that in 12 of the 16 FAO statistical regions, between about 70% and 90% of stocks are fully exploited or more than fully exploited (Garcia and DeLeiva Moreno, 1999). Between 37% and 58% of stocks in the four remaining regions are fully exploited or more.

Figure 1-4 compares the percentage of stocks in each FAO statistical region, on the basis of the limited information available, that are being exploited at about their MSY level or below and compares these results with the percentage of stocks that are in an unknown state. It reflects a general trend (see trendlines) that tells us that the smaller the number of stocks of known status, the greater the likelihood that, on the basis of that more limited knowledge, they will be found to be in a healthy state. This begs the question as to how many of the stocks whose state is not known have been overfished!

It is evident that these data need to be given cautious consideration. In some regions, where this analysis suggests that a high percentage of stocks are being exploited at MSY

level or below, the condition of a high percentage of stock items is not known.

1.4.3. The Status of Stocks in Developing Countries

The fisheries of developing countries are diverse, knowledge of the status of stocks varies from country to country and the condition of targeted species differs widely.

Of the 28.5 million people engaged in the fisheries sector globally in 1990, some 95% were from developing countries, which produced 58% of the total production of 98 million tonnes (see <http://www.fao.org/fi/highlight/fisher/>). About 84% of the world's fishers and fish farmers are from Asia. The number engaged in fishing and fish farming has risen steadily in developing countries while it has halved in some high-income countries such as Japan and Norway.

In most regions of the world, fishers in the offshore and deep-sea fisheries are predominantly male. In some regions, women fish inshore from small boats or collect shellfish and seaweed. In addition, in artisanal fishing communities women are mainly responsible for activities such as net making and mending, and the processing and marketing of the catch (<http://www.fao.org/gender/en/fishb3-e.htm>).

Hundreds of millions of people are dependent on the fish they harvest for an essential part of their diet. Fishing communities in the small-scale sector of developing countries often grow faster than the natural increase in population due to the sector frequently being regarded as an employer of last resort. This

adds to the difficulty of limiting entry and reducing participation in overexploited small-scale fisheries.

A further difficulty for most developing countries is that the fisheries remain open-access and there are too few resources available to introduce adequate conservation and management approaches used in some developed countries. While some large temperate water fisheries and small pelagic fisheries have a propensity for sudden precipitous collapse, tropical water multi-species demersal fisheries have not shown such tendencies (Williams, 1996). However, these tropical fisheries gradually decline under heavy fishing pressure with a shift in the species composition in favour of smaller species lower on the trophic scale. The end result is depleted stocks of less desirable species.

With high rates of population growth in most developing countries and increased pressure to export fish coupled with no control over increased fishing pressure, a crisis appears to be looming. Without urgent pre-emptive action, there will be increasing decline in the productivity of many developing country fisheries, on which millions of people are critically dependent for food and livelihood. Millions of tonnes of high-quality protein food will be lost and the livelihoods of millions of poor people will be destroyed.

1.4.4. *Status of Stocks: Implications for the Future*

Although conditions differ widely across the globe, many fisheries are subject to excessive fishing effort, with the result that there is considerable pressure to harvest at a level well in excess of what the stocks can sustain at an optimal level (see Section 3). If about three-quarters of targeted fish stocks (see Figure 1-3) are indeed being harvested at about MSY level or beyond that optimum level, then some three-quarters of commercial fisheries are in need of management to restrict access to the stocks. In some cases this is already happening. In most, however, it does not yet happen or the limitations are not adequate, in which case it is simply a matter of time before such stocks collapse.

1.5. The Evolving Need for Management

In conditions where the demand for a natural renewable living resource is lower than the optimum productivity of resource, there is no need to limit the use of it and, therefore, no need to manage access to it. When demand exceeds the capacity of the resource to supply, or when this threatens to happen, then optimal usage can only be maintained if access to the resource is limited (see Section 4). In most parts of the world there has not been a need, until the relatively recent past, to limit access to the resource.

1.5.1. *The Paradigm of Free and Open Access*

It is thus understandable that a widely held view existed that fisheries resources were inexhaustible. Given the relative abundance in relation to demand over the centuries, this must have appeared to be the case a century or more ago. This perception was reinforced by the statements of eminent scientists. Thomas Huxley, the influential scientific philosopher, for example, at the opening of the 1883 International Fisheries Exhibition in London, famously dismissed fear of overfishing as erroneous:

I believe that the cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery and probably all the great sea fisheries are inexhaustible; that is to say, that nothing we do seriously affects the number of fish...
(cited in Lees, 1969).

At about this time there were already examples of stock collapses due to overfishing, such as that of the Atlantic halibut. Biologists started to challenge the claim that fisheries resources are inexhaustible around the turn of the century. The issue was debated around that time by the International Council for the Exploration of the Seas (ICES). It is probably true, however, to say that recognition that fisheries resources are exhaustible only became common after World War Two when fears emerged that certain stocks of fish were collapsing (Pearse, 1992).

Free, open and unrestricted access to fisheries resources, which became the widespread practice among states both within territorial waters and on the high seas, meant that there was no management of these resources. Fishers have harvested freely from the oceans from time immemorial. This practice was entrenched through legal argument in the seventeenth century with the emergence of the doctrine of the 'freedom of the high seas'.

During the fifteenth and sixteenth centuries many claims had been made to large areas of ocean, such as the division of the Atlantic Ocean between Spain and Portugal in the Treaty of Tordesillas in 1494, a move sanctioned by Pope Alexander VI (Churchill and Lowe, 1992). Early in the seventeenth century the emerging maritime powers began to oppose such claims. The Dutch jurist, Hugo Grotius, an employee of the Dutch East India Company, argued in his well known treatise, *Mare Liberum*, that property rights could exist only if the holder was able to defend them against others. As no one was able to defend, occupy or exclude others from the oceans beyond a narrow strip along the coast, he argued for what became known as the doctrine of the freedom of the high seas (Grotius, 1608). Grotius also argued that fishery resources were so abundant that no benefit would accrue from exclusive jurisdiction.

It became accepted in customary international law that the high seas are open to all states: the high seas and the fish within it belong to no one: they are *res nullius* (Churchill and Lowe, 1992). The narrow strip of sea along the coast, the width of a cannon shot, with which it could be defended, became known as the territorial sea. This defensible strip of sea was regarded as sovereign territory of the coastal state. For most of the period between the time of Grotius and the middle of the twentieth century the territorial sea was generally three nautical miles wide. (There were exceptions: Russia, for example, declared a territorial sea of 12 nautical miles in 1909 (Churchill and Lowe, 1992)).

Thus, the regime that became globally recognised was one in which everyone had an open-access right, shared with compatriots, to fish in their own country's territorial sea and, in addition, an open-access right, shared with people of all nations, to harvest fish found in the high seas.

This general position should not be understood to deny a widespread phenomenon among coastal fishing communities, whereby fishers established rights to exclusive use of coastal fishing grounds. These were usually based on known good fishing areas that were relatively close to the community. Over time these became recognised as exclusive rights, which were and are vigorously defended. Usually these rights did not have associated with them either a right to a share of the catch or a right to a share of the fishing effort deployed. In other words, these rights are not sufficient in themselves to stop the race for fish as they often still have associated with them an incentive to race for as large a share of the catch as possible. Such rights would need to be built upon in a rights-based system of management.

The principle of free and open access to fisheries was thus entrenched and widely accepted among nations until the middle of the twentieth century. Open access does not present a serious problem of resource management if stocks are plentiful in relation to demand. But it was this circumstance, together with vastly improved harvesting technology, that changed after the Second World War. It is now widely accepted that fishery resources are exhaustible, and the principle of free, open access to fisheries is now regarded as erroneous. Despite this, many fisheries continue to have open-access regimes.

1.5.2. *Changes in Demand*

The world's population in the middle of the nineteenth century was about 1.3 billion people (UN, 1996), very much smaller than it is today at about 6 billion people. Population increase has clearly contributed considerably to the increase in demand for fish and, in some places, it is probably the primary contributing factor. Improvements in technology have made harvesting more efficient and the widespread use of refrigeration and improved transportation have facilitated a vast expansion of markets. As a consequence, demand for fish

has grown beyond the productive capacity of aquatic environments. While the global population grew 4.6-fold between 1850 and 2000, global fish production grew about 58-fold between 1850, when total fish production is estimated to have been about 2 millions tonnes (McGoodwin, 1990), and 1996 when total production was 117 million tonnes (FAO, 1998a). This suggests that increase in world trade has played a significant role in the growth in demand for fish.

The huge growth in demand, in a context of open access, increased the incentive to race for fish, to catch as much of the available fish as possible before anyone else harvested it. The increasing value of the catch helped fuel the development of fleet overcapacity, which in turn led to growing pressure on fish stocks.

The belief in the inexhaustibility of fisheries resources consequently led to the development of a global regime that, on the whole, could not accommodate limiting access to marine fisheries resources when this became necessary. (The only exception to this was the possibility of managing sedentary stocks close inshore or stocks whose range did not go beyond the territorial sea.) Open access has led to the development of overcapacity in many fisheries, of too many people and boats and too much fishing gear chasing a diminishing number of fish. The resulting social and economic pressures in turn lead to risk-prone decision making. Pressure from fishers facing mounting costs and a diminishing resource base, coupled with scientific uncertainty, tends to result in decisions which put the resource at further risk, embodying the antithesis of a precautionary approach.

The vast majority of the world's fishers are small-scale fishers working in tropical waters, often living in poor communities. There are often long-standing use rights to fish held by fishing communities, but these do not necessarily mean a reduction in fishing pressure when this is needed. Open access cultivates the notion that the fishery can be an employer of last resort for members of a community. Small advances in technology (for example, the introduction of outboard motors) often lead to either a reduction in employment or to an increase in fishing effort applied to a resource that is already being overfished. In many cases the poverty of small-scale fishers has been exacerbated by the intrusion of larger-scale trawlers into areas that have been traditionally worked by the small-scale sector. The need to end the race for fish and to establish clear, defensible use rights which focus on producing greater benefits for fishing communities is evident.

1.5.3. *Towards a New Global Framework*

The historical development of exploitation of the global marine commons led to depletion of many major stocks and to the recognition, by a large number of global players, of the need to take global collective action to limit exploitation of

the commons, both for organic and inorganic resources. Developments in the international law of the sea, and particularly the emergence of the LOSC in 1982 and other associated agreements, were essential first steps towards establishing a more adequate system of ocean governance.

The customary international law of the sea developed over centuries based on the concepts of territorial seas and high seas. A territorial sea forms part of a coastal state's territory, subject only to the right of innocent passage for foreign vessels. The coastal state enjoyed exclusive rights over fish stocks found within its territorial sea. The general principle of the doctrine of freedom of the high seas was that users were at liberty to do as they pleased (Churchill and Lowe, 1992); the only restriction was that states should exercise this freedom with 'reasonable regard to the interests of other states in their exercise of the freedom of the high seas' (UNCLOS I, 1958, Art. 2). The 1958 Convention on the High Seas listed specifically the freedoms of navigation, fishing, laying of submarine cables and pipelines and of over-flight as examples of 'freedoms' established in customary international law. The freedom of the high seas allowed fishing fleets from anywhere in the world to fish as much as they wished off the coast of any state beyond the territorial sea of that state.

The First UN Conference on the Law of the Sea took place in 1958 and adopted four conventions: on the High Seas, the Continental Shelf, the Territorial Sea and the Contiguous Zone. It failed to reach agreement on the contentious issue of the breadth of the territorial sea. Thus the Second UN Conference on the Law of the Sea was convened in 1960 to again discuss the breadth of the territorial sea and that of a proposed fishing zone. This conference too ended in failure (Churchill and Lowe, 1992).

The Third UN Conference on the Law of the Sea was called to agree on a comprehensive convention on the law of the sea. It took place between 1972 and 1982 on a different basis to those that had preceded it and agreed on the LOSC in 1982. It was seen as primarily a political exercise, as opposed to a narrowly legal one. Several factors had converged. A number of states, particularly in Africa, had become independent and had joined the UN. There was growing realisation of the extent of mineral wealth on the sea bed and a belief that the technology was becoming available to commercially exploit these deposits. There was a desire by developing states to secure a fair share of this wealth. Overfishing and the collapse of fish stocks was also of concern, as was the activity of the distant-water fleets of a relatively small number of wealthy states. The climate of a 'new international economic order' and the concept of 'the common heritage of mankind' also contributed to the momentum.

1.6. The New Regime

The LOSC is the principal international legal agreement now constituting the governance framework in the fisheries sector.

(A summary of the principal treaties and other international legal agreements governing fisheries is contained in Appendix A.)

1.6.1. The LOSC

The LOSC outlines a comprehensive regime, incorporating previous conventions and codified customary international law. It comprises 320 articles and nine annexes covering all aspects of ocean space from delimitation to environmental control, scientific research, fishing and other economic and commercial activities, technology and the settlement of disputes relating to ocean matters. The LOSC entered into force on 16th November 1994, following the 60th ratification of the convention a year earlier. There are now 132 states party to the convention (25th April 2000). It is notable that the USA and Peru are among the states that have not yet acceded to the convention. The UN General Assembly has called on all states that have not yet acceded to the Convention to do so in order to increase its efficacy (Res. 53/32).

The LOSC represents a major step forward for governance of the global fisheries sector. It codified customary international law relating to fisheries, clarified rules over which a clear consensus had not yet been reached and established the possibility of individual coastal states exercising control over their marine fisheries resources to a degree that had not been possible before.

The LOSC provides for coastal states to declare a territorial sea not exceeding 12 nautical miles from the coastal baseline (Art. 3). Prior to the LOSC, states declared territorial seas which varied in breadth from 3 to 200 nautical miles, although most were 12 nautical miles.

The exclusive economic zone (EEZ), 'an area beyond and adjacent to the territorial sea' (Art. 55) which 'shall not extend beyond 200 nautical miles from the baseline from which the breadth of the territorial sea is measured' (Art. 57) was the most significant innovation in relation to ocean governance during the second half of the twentieth century. By the time that the LOSC was agreed in 1982, more than 80 coastal states had declared an EEZ, mostly of 200 nautical miles. (Some states declared exclusive fisheries zones which are consistent with the EEZ provisions of the LOSC.) Within this zone the coastal state enjoys 'sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or nonliving...' (Art. 56). The coastal state has the right to set a total allowable catch (TAC) on the basis of the best scientific evidence available to it (Art. 61).

In cases where the same stocks occur within the EEZ of more than one state (transboundary stocks), 'these States shall seek...to agree upon the measures necessary to co-ordinate and ensure the conservation and development of such

stocks...' (Art. 63(1)). Problems occur when states sharing a stock do not agree on a management strategy and have no mechanism to settle their disputed positions. Similarly, where such stocks occur both within the EEZ and 'in an area beyond and adjacent to the zone' (straddling stocks), the coastal state and the states fishing for such stocks in the high seas 'shall seek...to agree upon the measures necessary for the conservation of these stocks in the adjacent area' (Art. 63(2)).

The coastal state thus does not have complete jurisdiction over a straddling stock that it is attempting to manage within its own EEZ and must co-operate with other states to effectively manage such stocks. Co-operative arrangements for the management of straddling stocks have not always worked well because of the absence of jurisdiction on the high seas, except through the flag state of the vessels involved, and because of the absence of effective dispute settlement mechanisms to resolve differences between states. Although adjacent states have complete jurisdiction between them over the harvesting of a stock whose whole range is within their waters, shared management of transboundary stocks has frequently been problematic because of the lack of a mechanism to resolve disputes between states over measures that may need to be taken.

Agreement was reached in the LOSC on conservation of fish stocks, consideration of ecosystem issues and the sharing of scientific information. There are particular rules relating to highly migratory species of fish, to anadromous, catadromous and sedentary species and to marine mammals. Further rules set out provisions on the optimum utilisation of fisheries resources and on the control that can be exercised by the coastal state (see Appendix A).

In the early 1990s a consensus among states developed that the general provisions of the LOSC requiring co-operation between states in the conservation and management of high seas fisheries resources (Arts. 117–20) needed strengthening. The UN convened a conference on the matter which in 1995 concluded an agreement intended to strengthen the LOSC provisions on straddling and highly migratory fish stocks (UN, 1995).

1.6.2. *Agreement for Implementation*

The agreement for implementation of the provisions of the UN LOSC Relating to the Conservation and Management of Straddling and Highly Migratory Fish Stocks will enter into force 30 days after the deposit of the 30th instrument of ratification or accession (Art. 37). So far (April 2000) it has been ratified or acceded to by 26 states.

The agreement seeks to build upon two provisions of the LOSC. The first is that all states have a duty to ensure that their nationals comply with conservation measures adopted for high seas stocks (UNLOSC, 1982, Art. 117) and that states whose nationals exploit stocks in a particular area of the

high seas have an obligation to negotiate with other states exploiting those stocks: measures necessary to ensure conservation of the fisheries resources concerned (Art. 118). The second is that the only jurisdiction that can be exercised on the high seas by a state is over a vessel flying the flag of that state (Arts. 90–98).

The agreement provides for the establishment of regional or subregional fisheries management organisations (RFMOs) (Part III). It sets out comprehensive areas in which such a management organisation will have competence covering scientific research, stock assessment, monitoring, surveillance, control and enforcement (Art. 10). The organisation can limit participation by new entrants according to a set of criteria listed in Article 11, although Article 17(4) leaves it unclear what effective measures can be taken in the event of noncompliance by appropriators not party to the agreement. Only states which agree to apply the management measures can have access to the fisheries.

A state may authorise a vessel flying its flag to fish on the high seas only where it is able to exercise effectively its responsibilities of enforcement under the agreement (Art. 18(2)). However, provision is made for the flag state to permit access by inspectors from other states (Art. 18(3)(g)(i)) and the use of onboard observers from other states ((Art. 18(3)(g)(ii)). The flag state must take action against a vessel reported to have committed a serious violation, detailed in Article 21(11). Failure to do so gives the inspecting state the right to take action and the procedures for doing so are detailed in Article 22. Article 21 further provides for inspectors from a member state of a regional organisation established under the agreement to board and inspect any vessel of another state party to the agreement.

1.6.3. *Other Agreements*

A number of other multilateral agreements further elaborate the evolving set of rules for the governance of fisheries. The Code of Conduct for Responsible Fishing (1995) *inter alia* spells out flag state responsibilities for the activities of fishing vessels flying its flag and seeks to advance management measures, by agreement among states, that improve the optimal and sustainable use of fisheries resources. The Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Res. 15/93) (FAO, 1993) similarly builds on flag state responsibility for fishing vessels flying its flag (Art. III) and operating on the high seas.

Other important agreements which have important implications for the management of fisheries resources are the 1992 Biological Diversity Convention, the 1982 Convention on the Conservation of Antarctic Marine Living Resources and the 1972 World Heritage Convention. A range of other global and regional treaties exist which, in some cases, have a direct bearing on the governance of the fisheries sector.

BOX 1-1: COLLAPSE OF THE NORTHERN COD OF NEWFOUNDLAND

It is instructive to examine what brought about the collapse of the northern cod, perhaps one of the world's most studied species. Overfishing of these stocks was clearly the primary problem. It appears that adverse environmental conditions off Newfoundland and Labrador during the late 1980s and early 1990s contributed to the collapse. There was a decline in the individual growth rates of several cod stocks and the fish appeared to be thinner (Parsons and Beckett, 1997). Catch by weight meant that there was an increase in the number of individuals taken from the stock per unit of TAC.

In the 1960s there was a rapid expansion of fishing effort and catches to an unsustainable level, mainly by factory fleets from Eastern Europe and the Soviet Union. The establishment of the 200-mile EEZ was perceived simultaneously as an opportunity to deal with this and to increase the Canadian share of the catch. As the foreign fishing fleets were driven out of the Canadian 200-mile zone the Canadians expanded their own fishing fleets, perceiving this as being necessary in order to assure that the largest possible share of the catch went to Canada. A contributing factor may have been the stipulation in the LOSC that whatever surplus the coastal state is not able to catch itself has to be made available to other countries.

The Canadian government embarked on a conservative management strategy but the stock appears to have been consistently overestimated, so the exploitation rate was much greater than intended. When this error was discovered in the late 1980s, the Canadian government delayed taking the necessary corrective measures, because of reluctance to increase unemployment in Newfoundland (Hannesson, 1996). When the stock had virtually vanished in 1992, all catches were banned, and there are at the time of writing (mid-1999) few signs of recovery of the stock (Hutchings and Meyers, 1994; Steele *et al.*, 1992).

1.7. Inadequacies of Global Governance

We have seen how, prior to the 1970s, there existed a regime governing ocean space that had become inadequate for the second half of the twentieth century. The LOSC and other associated agreements represent a global, negotiated arrangement aimed at establishing a framework within which states take action to resolve, among other things, the problems associated with the open-access exploitation of common fisheries resources. The LOSC in itself is not sufficient as a solution, but contributes a framework, albeit with weaknesses, within which states are nested, establishing state rights over fisheries resources that were previously subject to open-access exploitation, often without any rights defined.

1.7.1. Continuing Failure within National Jurisdictions

The global framework for the governance of fisheries resources goes no further than making fisheries management possible. It does not impose a management system within the jurisdiction of the coastal state. In itself, therefore, it does not solve, and was never intended to solve, problems arising from the failure of management within national jurisdiction. Its function in relation to fisheries is to facilitate fisheries management by making it possible.

Despite the fundamental changes that have taken place in the global regime, establishing a system of governance for fisheries resources, there remains a widespread failure to manage fisheries adequately in many areas of the world.

The state must ensure that fisheries resources within its jurisdiction are adequately managed. It must recognise the established rights of fishers, where these exist, and must define them where they do not. It must establish management institutions which, *inter alia*, ensure that these rights are effectively enforced and it has ultimate responsibility for ensuring the proper regulation of fisheries resources.

The causes of continuing failure may be divided into those arising from mistaken management policies and methods on the one hand and, on the other, the mismatch of management institutions and objectives.

1.7.1.1. Mistaken Management Policies and Methods

Employment at the expense of overexploitation: In general, the need for management of fisheries has only been recognised when a fish stock is already in crisis. In order to reduce fishing effort directed at the target fish stock, the number of fishers and the number of fishing boats needs to be reduced. This involves forfeiting some of the catch today in order to enable the fish stock concerned to regenerate with the promise of net gains tomorrow. Resistance to change often arises because of the resistance by those who will lose in the short run if not altogether, often because the change threatens their only chance of a livelihood (see Box 1-1). The promise of improved catches in three or four years means little to those whose concern is to survive now and who see the benefit of their sacrifice possibly accruing to others. Governments have failed to address these transitional issues and have instead maintained employment at the expense of

overexploiting the stock, imposing a long-term loss for fishing communities and for society as a whole.

Inappropriate Incentives: Management measures introduced in response to the biomass of a stock becoming dangerously low have often only addressed biological issues and have ignored the socio-economic aspects of the problem, resulting in inappropriate incentives that encourage growth in overcapacity. The imposition of a TAC without limiting fishing effort means that, as time goes by, the season gets shorter and shorter as increasing fishing effort is deployed in the race for the available fish. This has sometimes taken on ridiculous proportions, well illustrated by the annual halibut derby off the US West Coast, where the fishing season eventually lasted only for two days because of the excessive fishing effort deployed to harvest the catch (Pearse, 1992).

1.7.1.2. Mismatch of Objectives

The global system of governance does not create jurisdictions that correspond to the range of fisheries resources. Rather, it takes account of an array of other factors, principally the political divisions of the world dominated by the nation state. Thus, the rules for the delimitation of marine boundaries are designed to create a fair distribution of coastal waters between opposite and adjacent states and do not take account of ecosystems. Marine ecosystems are often bisected by these boundaries with the result that the ranges of many fish stocks do not fall within the jurisdiction of a single state. The arbitrary distance of 200 nautical miles from the coastal baseline, marking the seaward limit of the EEZ, also often divides habitats. This mismatch between jurisdiction and the habitat of fish stocks creates difficulties in the management of stocks. The LOSC requires that coastal states must co-operate in the management of such stocks (Art. 63(1)) but establishes no rules for doing so. It is up to the states concerned to agree to the rules for the joint management of transboundary resources. International customary law does not yet provide any precise rules applicable in the absence of such an agreement (Churchill and Lowe, 1992).

The consequences of states not reaching proper agreement over the shares of a stock may be illustrated by the case of the West Coast whiting resource which is shared by the US and Canada as a transboundary stock. A coast-wide stock assessment establishing an allowable biological catch was calculated at 290,000 tonnes for 1999. The US claims rights to 80% of the ABC and sets its TAC accordingly at 232,000 tonnes. Canada claims rights to 30% and sets its TAC accordingly at about 90,000 tonnes. The sum of the TACs is about 322,000 tonnes, which exceeds the scientifically assessed limit by about 11%. Thus, there is an unresolved issue relating to the share of the harvest between the two countries that stems from a failure of governance at the international level. No binding mechanism exists to resolve such issues.

BOX 1-2: RESTORATION OF THE ARCTO-NORWEGIAN COD STOCK

Unlike the cod of Newfoundland, the Barents Sea cod recovered from a severe depletion caused by ocean cooling and overfishing. In 1989, the governments of Norway and the Soviet Union, co-operating in a bilateral governance arrangement, realised that the cod stock was in serious decline and made the decision to severely restrict the fishery. Crucially, they did not wait for the collapse of the stock and tackled the problem while the stock was still commercially viable and with a spawning biomass still of reasonable size.

The stock recovered gradually from a low point in 1990. The recovery was helped by increasingly favourable conditions in the Barents Sea, which is characterised by fluctuations in temperature and primary production driven by ocean currents. Such factors were undoubtedly in part responsible for the stock decline in the late 1980s and are now again at work: the stock has declined since 1997. It is possible that the difference between the fate of the cod stocks at Newfoundland and in the Barents Sea lies in an appropriate cut in the catches of Barents Sea cod before it was too late (Hannesson, 1996; IMR, 1999).

There are many other instances where co-operative arrangements have not been made at all for the management of transboundary stocks, sometimes as a result of one party having less interest than the other party in establishing such arrangements. There is no redress if one party does not wish to co-operate in a management arrangement.

There are instances where co-operative management of transboundary stocks has been successful, at least as far as sharing of a TAC is concerned, such as the arrangement between Norway and Russia. (see Box 1-2). When shared stocks are confined within the EEZs of a given number of states those states have an incentive to come to agreement on the management of the stocks, as any gains they might achieve cannot be eroded by a third party.

Jurisdiction is also shared in the case of straddling stocks, but there is the additional problem that third parties may erode an agreement reached to harvest a stock sustainably (e.g., Patagonian toothfish). The Agreement on Straddling and Highly Migratory Fish Stocks does not offer any effective means of excluding from participation in high seas fisheries vessels from states not party to the agreement which choose not to comply with the rules established by a regional fisheries management organisation. No other instruments of international law are available to exclude such vessels either. This can only happen if all states involved in fishing ratify or accede to the agreement as this would enable a RFMO to act against any vessel not abiding by the rules agreed by the

RFMO. As only 26 states have so far ratified or acceded to the agreement, it is far from being effective yet. The problem of open access within a RFMO is not resolved automatically by the establishment of such an organisation. Imaginative techniques will need to be agreed to fairly distribute access to the targeted fish stocks and to the benefits of such an agreement (see Recommendation 5).

1.7.1.3. Management Conflicts within Government

Failure to adopt a coherent policy framework, co-ordinating fisheries management with the management of economic activities that may have an impact on the fisheries, may have a negative impact on the capacity to manage the fisheries effectively. An example is the failure to co-ordinate regulation of sea-bed mining activity with that of fisheries management. Industrial pollution and agricultural run-off are known to have a substantial impact on certain fisheries, particularly where there is a high ratio of land run-off to sea surface area, such as in the Black Sea (Ben-Yami, 1999). Often these impacts are not considered.

1.7.2. Continuing Failure on the High Seas

The importance of the political will to make effective fisheries management possible on the part of governments by acceding to the 1995 Agreement was discussed above in the context of effective management of access to straddling stocks. It should be noted that open access remains available for high seas fisheries that target stocks that are neither highly migratory nor straddling stocks. If this problem is left unresolved, it has the potential of becoming much more significant. The potential of fisheries on sea mounts and ocean ridges is not well known and there is the possibility of fishing a large biomass of mesopelagic fishes on the high seas. There are such stocks for which management regimes have been established by regional fisheries management organisations, many of which predate the agreement, but without the authority of international law other than the general duty on states to co-operate in the management and conservation of high seas fishery resources. An example of this happening is the management of the shrimp fishery on the Flemish Cap by the North-west Atlantic Fisheries Organisation. It would be consistent with the provisions of Articles 117–20 of the LOSC to have the provisions of the 1995 agreement apply to these stocks as well as to straddling and highly migratory stocks.

1.8. Conclusion

Great advances have been made in the development of a system of global governance for fisheries and these advances have enabled a degree of management of these resources that was not possible prior to their development.

As most fish are caught in waters falling within the national jurisdiction of states, the failure to develop effective management by states constitutes the most serious problem of the global governance of fisheries resources. The jurisdiction to achieve vastly improved management arrangements exists but is often not adequately used by national fisheries authorities. This may be for a wide range of reasons, some of which have been described above. There are governance difficulties for coastal states in the management of stocks that cross maritime borders which relate to difficulties of co-operative management of fish stocks and, particularly, to the resolution of management disputes between states.

A second area of difficulty relates to the regime governing the high seas. There does not yet exist an adequate mechanism for the enforcement of the authority of a regional fisheries management organisation in the case of straddling and highly migratory stocks. The possibility for this to develop rests with a decision by all states to support the 1995 Agreement on Highly Migratory and Straddling Stocks.

A realistic assessment of the state of world fisheries leads to the conclusion that it is possible, through careful and thoughtful improvement in the governance of fisheries resources, to achieve greater reliability of supply, vastly improved economic viability and the generation of increased benefits for fishers and for society as a whole. Failure to achieve improvements in governance could result in further deterioration in food security, particularly for the most vulnerable people in the developing world, and in increasing impoverishment of the fishing industry.

2. The Case for Rights-based Fisheries Management

2.1. Introduction

Exploitation of wild fish stocks results in undesirable outcomes when there is open access to such stocks and demand exceeds the long-term productive capacity of the stocks to supply. The amount of fish that one person removes from the sea benefits that one fisher but affects the productivity of the stock. It does so in such a way that the negative effect of that one person's activity is shared more or less equally between all those who are engaged in fishing that stock. The incentive for each person to take the full consequences of his or her actions into account, therefore, is weak.

Fisheries management is necessary to deal with the harmful effects on the productivity of fish stocks that result from open access. This can only be done by restricting the amount of

fish removed from each stock, compared with what would otherwise occur. This, in turn, implies restricting the access to the stocks, directly or indirectly.

We seek to manage living aquatic resources for the long-term, sustainable and optimal benefit of people. We do not recommend fisheries management for the sake of some nebulous objective to do with nature for its own sake. Humankind is part of nature and is inextricably bound up in its dynamics. One consequence of the success of human beings as a species is that the size of the global human population has grown much larger than it might otherwise have done, in large part because of improved healthcare and nutrition. Our capacity to intervene in natural processes must be built upon solid knowledge and due regard for the future.

2.2. The Objectives of Fisheries Management

The need to ensure the viability of fisheries resources is common to all the uses to which we put these resources. There is little doubt that fisheries resources globally will continue to be used principally as a source of food, and the discussion in this section is dominated by the use of these resources as food, although sight should not be lost of the fact that optimal biomass levels might be different for other uses of living aquatic resources and that there is the potential for conflict between different uses.

Even when it is accepted that a fishery is in need of management, the objectives often amount to nothing much more than a set of biological goals for management. All too often, economic and social objectives are neglected. The lack of clearly defined objectives can lead to irresolvable debates about management alternatives when participants in the debate disagree on objectives, which are often confused or not stated. Failure to clearly define objectives also makes it impossible to judge the performance of fisheries management.

If humanity is to gain maximum benefit from fisheries resources used as a food source, it is necessary to harvest the

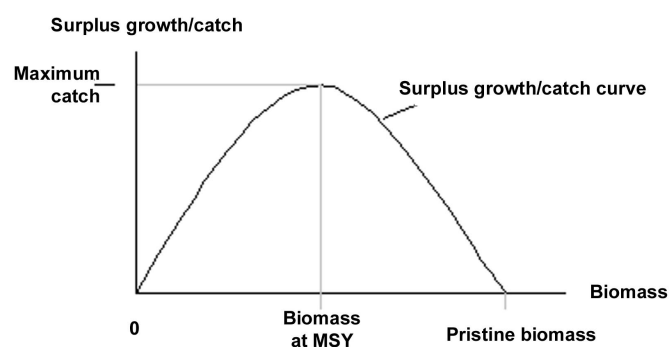


Figure 2-1: The relationship between size of the biomass and surplus growth.

target species at a level approximating a sustainable optimum. It is not sufficient that the level of harvesting only be sustainable, as there are many harvest levels that are sustainable but far from optimal and, therefore, far from producing the greatest benefit for society.

2.3. The Sustainable Optimum

As a pristine biomass is fished down, the productivity of the stock rises until it reaches a point at which it is at a maximum. This is at some intermediate size of biomass between it being in a pristine state and the stock ceasing to exist. If the harvest is increased further, the catch will be greater than the productivity of the stock, the biomass will decrease further and the productive yield from the stock will decline. If the catch is reduced so that it again matches the surplus growth (i.e. production in excess of that needed to replace natural mortality), then that level could be at a sustainable equilibrium, even if it is not optimal. Although there is a balance between harvest and surplus production, it might be suboptimal because it is not producing at the biomass level that produces the largest surplus production (and, therefore, the largest potential sustainable harvest) or because the biomass level is too small and the fishing is too costly. It becomes evident that, at any point where the size of the harvest is exactly matched by the productivity of the stock, the level of fishing is sustainable. It is also evident that there are harvest levels that are sustainable but not optimal.

There is an optimum stock size, at some intermediate population size, where surplus growth of a stock is at a maximum. One can graphically represent the relationship, as in Figure 2-1. The simplifying assumption is made that as long as there are some fish of that stock left in the sea, the stock will grow. (Some stocks are thought to have a critical minimum biomass below which the stock does not grow.)

If the quantity of fish caught equals the surplus growth, that is if the harvest level is at any point on the surplus growth (or productivity) curve between zero and the pristine biomass, then that harvest level may be considered to be at sustainable equilibrium. It becomes clear that a sustainable yield may be achieved that is not necessarily the optimum sustainable yield. There are possible sustainable yields from a stock ranging from nothing, as the population approaches zero or where the stock is at its pristine size (where productivity just replaces natural mortality), to a maximum when the biomass of a population is at an intermediate size. The maximum surplus growth, which makes possible the biological maximum sustainable yield (MSY) or catch, will be at some intermediate stock level between zero and the pristine biomass level.

The biomass objective in fishing for food supply is to harvest at a stock size that produces maximum sustainable yield. An economic optimum might be at a biomass level greater than that needed to produce a MSY (see Appendix B). Clearly,

fishing implies interference with a natural equilibrium, and the objective of responsible fishing can never be to return the environment to a pristine state. It is also not particularly useful to refer simply to a sustainable harvest, as this clearly can be decidedly suboptimal.

What is of interest in fishing for food supply is to optimise production from the resource. The objective might be different if the resource is used as a tourist attraction. In that case it is likely that a stock size approaching the maximum would be desirable. This could produce a conflict for which an optimal solution would depend on costs and revenues and the particular circumstances surrounding the resource.

In an open-access fishery, where there is no limitation on the harvesting of fish, fishing effort increases as the stock is fished down from its pristine state. This process continues beyond the point where an economic optimum is reached and stops only when marginal revenue for the fishers equals marginal costs. When this point is reached, overfishing has occurred and resource rents are dissipated (see Appendix B).

2.3.1. The Problem of Variability

It is generally the case that determining the sustainable optimum is very problematic, in part because the size of a population varies, sometimes enormously, as environmental conditions fluctuate and because the determination of stock size involves techniques associated with a large margin of error. This has resulted in a management strategy of focusing on achieving a constant harvest rate rather than a constant size of catch. The risks associated with harvesting a constant catch from a resource that is variable have long been appreciated.

What the environment can support may vary a great deal from year to year when we are dealing with short-lived species. When we are dealing with fish with a long life span, where the stock consists of a number of distinct year classes, the variation may occur over a period of several years. The recruitment of young fish appears in most cases to be extremely sensitive to environmental factors that we know little about and are not able to control, such as the temperature of the sea, anoxic water and salinity. Growth of individual fish may vary a great deal from year to year, depending on the availability of food and other environmental conditions. There is also a growing body of opinion that the marine environment is subject to longer-term than annual variations, implying variations in the abundance of fish stocks on a longer, perhaps decadal, time scale.

The importance of environmental variations is well illustrated in the case of Namibia's pilchard, which dominates the pelagic stocks. Fluctuations in biomass of Namibia's pelagic stocks are largely due to environmental variability. Seabird populations have been shown to vary according to the availability of pelagic fish (Field, 1980). A study of the records of guano deposits collected off the southern African

west coast over an 80-year period suggests that the biomass of pelagic populations varied tenfold naturally before the start of pelagic fishing in Namibian waters in 1943 (Crawford and Shelton, 1978). While it is true that the main cause of the decline in biomass at a particular time may be prevailing environmental conditions, it is also true that fishing has a dramatic effect on the chances of revival of a stock. If the stock has been depleted by poor environmental conditions, to then harvest a large portion of the remaining biomass clearly diminishes the chances of the stock reviving.

The biological processes which determine the growth or decline of a stock are not well understood. In addition, the growth of a stock is affected by complex relationships between species as competitors for food and as predator and prey. While conceptually it might be relatively simple to consider a sustainable optimal yield, it is much more difficult to apply the concept. It is important to recognise that uncertainty is an inevitable factor in fisheries management decision making and to establish approaches to decision making that accommodate this uncertainty.

Excessive fishing effort can add considerably to the pressure to set a TAC too high in relation to the condition of the stock in order to ameliorate the economic and social problems of having too many people and too much capital tied up in the fisheries sector. If the stock is variable, which to a greater or lesser extent is the norm, then the optimal fishing effort appropriate for the fishery will generally be less than that which is needed in order to harvest the TAC in years when the stock is at its most productive. (For a fuller discussion of this see Appendix B.)

2.3.2. Uncertainty in Fisheries Stock Assessments

Stock assessments, aimed at providing as accurate an estimate as possible of the size of a particular fish stock, are subject to considerable uncertainty. Apart from uncertainty arising from the physical and biological processes affecting stocks, other sources of uncertainty in fisheries stock assessments have been identified as arising from measurements (reliability of data), model parameters (such as associating available data with types of stock dynamics) and model structures (for example, whether recognising compensatory recruitment or not) (Hilborn, 1997). Uncertainty implies risk. Hilborn suggests that scientists should assign probabilities to possible outcomes to minimise the risk of managers making decisions on the basis of political and economic factors and justifying the choice by exploiting scientific uncertainty.

The complexity (and often the size) of marine ecosystems, coupled with the difficulty and consequent expense of measuring parameters of an aquatic population, the dynamics of which are inherently variable, makes uncertainty about the status of the resource intrinsic to its harvesting. Managers tend to interpret scientific advice in the most favourable light when confronted with political and economic pressures to

maintain or increase the level of harvest (Hilborn, 1997; Butterworth, 1997). It is now widely considered important for management that scientists include probabilities of outcomes in scientific advice, thus directly confronting uncertainty (see Recommendation 3).

Most states regard wild fisheries resources found within its waters as public property, a position consistent with the LOSC. In this case the right to the benefits accruing from them belongs to the people as a whole. Thus, rent from this resource belongs to the people and it is for the state, acting on behalf of the people, to ensure that this rent is used for the optimal benefit of society. The state may in turn recognise rights established by fishers over these resources; it is up to each society to decide how it uses them. It may decide to spend the rent by maintaining, as a type of social security net, a larger number of fishers in the sector than are necessary to harvest the catch. In whatever way the rent might be used, it is important that it is recognised as being potentially substantial (and available for use in some other way).

Depending on the particular circumstances of the country and the fishery, the collection of rent by the state is an option that should be given serious consideration. Rent taxation and the collection of user fees for most resource-based industries are the rule rather than the exception. The collection of user fees and taxation of resource rent as part of a management system are discussed in Section 3 (see Recommendation 1(iii)).

2.3.3. What Happens to the Rent?

If an open-access fishery has commercial potential, is not subject to effective regulation and is competitively exploited by more than an optimal number of fishers, then there will be inevitable market failure in the sense that the fishery will expand to the point that economic, and usually biological, overfishing has occurred. Each fishing enterprise races to extract as much as it can from limited fish stocks, reducing the harvesting possibilities of other fishers, thus increasing their own fishing costs and imposing production externalities on each other. In marine fisheries, this race for the fish is so pervasive that, in the long term, there is often complete dissipation of economic rents, irrespective of the potential productivity of the fisheries. In other words, there will be competition for the highest possible share of the resource rent until most of it, and possibly all it, has been wasted by unnecessary production, processing and marketing costs and on the rent-seeking activity itself.

The resource rent of a fishery is the revenue that is in excess of that needed to cover all costs, including a reasonable return to capital, labour, entrepreneurship and risk, and should take into account variability of resource availability. This would be maximised at the point described as the maximum economic yield (see Appendix B) and is where the difference between the marginal revenue and marginal cost is greatest.

The maximisation of the value of production obtainable from the resources a society disposes is a legitimate social objective, as this maximises the potential of that society to satisfy the needs of its members. In that situation the rent in the fishery would in fact be maximised, which means that we can find the socially optimal level of fishing effort by maximising the rent. The rent may, however, be used as a source of income for a government seeking revenues to finance the provision of public goods. Furthermore, lost rent in a fishery is a proxy for the value of production forgone by using more manpower and capital than needed in the fishery.

The dissipation of resource rents is not confined to open-access fisheries. Considerable dissipation of resource rents also takes place in regulated fisheries, as will be discussed below. Stopping unrestricted open access to the resource is an essential, though not a sufficient, condition for solving the problem. Property rights and institutions that surround these rights must create a set of incentives that encourage limiting fishing effort to what is consistent with the long-term optimal sustainable productivity of the resource.

The scale of resource rent loss will vary considerably but can be extraordinarily large as potential rents can be very large. Rents ranging between 11% and 60% of gross revenues, with a weighted average of 30%, were estimated for the Australian fisheries (Campbell and Haynes, 1990). The US National Marine Fisheries Service estimated that the gross revenue for the New England groundfish fishery could increase from \$US170 million to US \$200 million while net revenue, which was being dissipated, could be about US\$130 million, that is about 65% of gross revenue for the New England groundfish fishery (FAO, 1992). In a study of rent dissipation in the Canadian West Coast salmon fishery, for which there is restricted access, Dupont illustrates how rent of some Can\$69.4 million could be earned from total revenues for the salmon fishery of some Can\$164.9 million in 1982. A negative rent of Can\$38.7 million was actually occurring because of inefficient regulation (Dupont, 1990).

Various estimates of potential rent for the world's fisheries have been made. The FAO, using the Australian ratio of rent to gross revenues quoted above, estimates that annual resource rents for the world's fisheries would be about US\$54,000 million a year. Arnason (1991) estimates a more moderate figure of US\$25,000–50,000 million per year. If global revenues are about US\$70,000 million (FAO, 1992), then potential rents are extraordinarily large as a percentage of gross revenue.

2.4. Limiting Access Requires Rights-based Management

It is clear from the analysis above that, once demand in a fishery exceeds the natural capacity of the resource to supply, there is a need to limit, in some way, the harvesting of the fisheries resources. This means limiting fishing effort—the

combination of people, fishing gear, boats and ancillary equipment needed to harvest the fish. In essence, it means an end to open access and that some people, using a combination of fishing gear, boats and other equipment, will have the right to fish while others will be excluded (see Recommendation 1(i)). A 'right' refers to the capacity to assert a claim and have others respect it (Kurien, 1998a). Allowing some to continue in the fishery while excluding others is the process of establishing rights to the stream of benefits that arise from the use of the resource. Rights define relationships between individuals with respect to a resource rather than between an individual and a resource (Schmid, 1995, p. 46). These rights are to property, which 'describes a legally and socially endorsed concentration of power over things and resources' (Kurien, 1998a, p. 7). Property rights thus constitute the essential basis for effective management of fisheries.

The particular case in which open access exists (and no negotiations take place leading to collective decisions that limit use of the resource (Ostrom, 1999)) is in reality that of a fisheries regime in which no rights exist. It represents an example of the failure of the market to deal with 'social dilemmas', a reference to the kinds of problems that arise when the rational choice of the individual produces an outcome that is socially irrational. In order to overcome this failure of the market to produce a socially optimal outcome, it is necessary that society devises nonmarket institutions that provide incentives that induce individuals to act in a socially rational manner.

By institutions we mean 'the humanly devised constraints that structure human interaction'. They include formal rules, such as laws and regulations, less formal constraints, such as norms of behaviour, social conventions and locally agreed sets of rules, and the enforcement practices relating to them, whether state sanctioned or not.

Property rights are an example of such 'humanly devised constraints'. Thus, when we examine the open-access regime for a fishery (that is, a regime in which no property rights exist) it becomes clear that the solution lies in limiting the fishing effort applied to the resource so that the harvesting of the resource is limited to the productive capacity of the resource. Limiting access means creating the right of some to the stream of benefits that arises out of use of the resource and, conversely, excluding others from the use of the resource.

It is thus axiomatic that, if we urge the end to open-access regimes for fisheries resources, we are advocating property rights over these resources. A property rights regime in a particular society may change over time as the particular circumstances of each society changes, calling for an adjustment in this set of ordered relationships (Kurien, 1998a). Rights vested in a community may become individual property rights or the state may claim public property rights to resources over which no property rights existed. Similarly, the conditions attached to the rights may change as the condition

of the resource changes or the circumstances of particular groups within society change.

Inextricably linked to the concept of a property right is enforcement or the capacity to insist that the claim to the benefit be respected. The rights-based system must be able to exclude non-rights-holders from access to the resource. In the absence of enforcement, open access occurs as anyone may lay claim to the benefit of the resource.

2.5. Public Education—Addressing Transition Arrangements

The wastefulness of open access and the considerable benefits that should accrue as a result of a change to a rights-based management system may not be evident to key stakeholders and decision makers. Public education, aimed particularly at stakeholders and politicians, is an important part of a successful transition process. It should raise awareness of the gains that could be made as a result of the introduction of a rights-based system and should directly address the equitable distribution of those gains (see Recommendation 2). Failure fairly and openly to debate and resolve the question of the equitable distribution of these gains will almost inevitably result in resistance to change, possibly on a scale that prevents the change from taking place.

2.6. Characteristics of Rights-based Fisheries

Property rights must be clearly defined, enforceable and should provide an appropriate set of incentives for promoting efficient management. A management system that allocates rights to shares of a fishery can take many forms. It can be characterised by the nature of entities that hold rights, the type of the right and the rules about transferability. A rights-based system involves the definition of rights, the determination of rights holders and a management authority to undertake certain tasks.

Property rights to harvest fisheries resources should explicitly state the extent of the right, be it to a percentage of the catch, to deploy a certain limited fishing effort or to harvest in a particular geographic area, if that is deemed appropriate and feasible. The less clear the rights are, the more difficult it is to enforce them, as ambiguity breeds debate and uncertainty. The rights should be structured in such a way as to make enforcement a realistic and cost-effective proposition (see Recommendation 4(i)).

The rights created or recognised must provide the correct incentives to achieve optimal use of fisheries resources by encouraging the use of just sufficient fishing effort to achieve optimal harvesting in the long term. The more permanent the right, the greater will be the incentive to nurture and conserve the resource.

Where traditional rights exist in some developing countries and among coastal communities of some developed countries, they are often not sufficient to provide the incentives needed to achieve effective management. They should not be ignored, however, because they generally provide the best foundation on which to establish the correct set of incentives. Simply replacing existing rights in such communities with other rights may set back the cause of effective management of fisheries.

Without properly defined rights, though even with some limitation on access, participants in a fishery will tend to compete for as large a share of the resource as possible up to the point where the additional revenue produced is used in competing for the resource. Competing to harvest fish before others do increases the cost of fishing, but it cannot increase the yield, in the long term, above the long-term sustainable optimal level and is thus wasteful. Overcapitalised fisheries are inefficient and generate economic and political pressure to catch more fish than the resource can sustain. Often the result is overfishing. If fishers compete for a share of the catch, they have little incentive to conserve for the future since others may take the catch they have not taken. A management system must allocate rights to specific shares of the fishery so as to eliminate the wasteful competition for a share and to encourage shares to be used efficiently (see Recommendation 1(ii)).

2.6.1. The Form of the Property Rights

People live with a set of social, cultural and economic relations. The form that the property rights take should be compatible with that set of relationships. It should also take account of the ecosystem in which the resource is found and the characteristics of the resources that are part of that ecosystem. These characteristics will make some forms of property rights more appropriate than others to the particular socio-ecological environment in which the resource is found. The form the property right should take depends on the particular circumstances of the fishery, including the traditions and the form of organisation of the society in which it is embedded. The right may be to a particular share of the output of the resource, to use a specific amount of fishing effort or it may be a territorial right to fish a specific area. No one form of property rights is best-suited for all fisheries.

The type of the right should be defined in the same units as are used to conserve the resource. This is most practical for units of catch and fishing effort. It is also possible for areas and times where and when fishing is allowed. Unless the nature of the right is in terms of output, there will still be some wasteful competition, but less than if there was not a right to a share. The total of the shares should not result in the catch exceeding the conservation limit. Schlager and Ostrom (1992) have identified five features of rights, graded from the weakest to the strongest:

- *access*: the right to enter a defined area but not to fish,
- *withdrawal*: the right to obtain resource units or products of a resource system,
- *management*: the right to regulate patterns of usage and transform the resource by making improvements,
- *exclusion*: the right to determine who will have an access right, and how they might be transferred and
- *alienation*: the right to sell or lease management and exclusion rights.

According to the authors, various types of property rights holders typically have 'bundles of rights'. For example, an 'owner' will possess all five features of rights, a 'proprietor' all but the last feature and so on down to an 'authorised entrant' who will only have the first feature. In order to be effective, use rights in fisheries need to include all five features. It is not possible to fully individualise all these features: this applies in particular to rights to manage the fish stock as this must be held by the management authority, however it might be constituted (see Section 2.6.3).

2.6.2. The Rights Holders

Property rights may be vested with the state or a group of states as public property, as the common property of a group of individuals or with a community, or they may be held by individuals or companies as private property rights (see Recommendation 4(iii)). Common property does not imply open access but is, in essence, 'the private property of a group of co-owners who have both rights and duties with respect to their use rates and the management of the resource claimed by them' (Kurien, 1998a, p. 9). The effectiveness of community or group rights depends to some extent on the how clearly defined the group is, on its cohesiveness, and thus on its capacity to limit effectively its share of the harvest to its share of the productive capacity of fisheries resources.

Kurien (1998a, p. 11) provides a checklist for examining the appropriateness of a particular property rights regime:

- (1) Does the property rights regime fit 'the innate characteristics' of the resource to be managed?
- (2) Will the property rights regime ensure a balance between productivity of the resource and the state of the stock?
- (3) Is the property rights regime consonant with existing international law?
- (4) Will it help balance likely conflicts between multiple economic and social uses of the resource?
- (5) Will the property rights regime optimise costs of monitoring, information gathering and surveillance (the transaction costs) of management of the resource?
- (6) Can it foster societal priorities without discouraging 'the fair spirit of individual actions'?
- (7) Will the regime lead to greater equity and participation among resource users?

2.6.3. The Management Authority

A rights-based system of management needs a management authority which will be responsible for recognising existing rights where these already exist or for defining and assigning rights where they do not or where a change is required in the rights-based system arising out of the changing social and economic circumstances of the fishery. Management tasks should include the formulation of policy, ensuring that stock assessments, harvesting regulations and other management decisions are based on sound science, providing opportunities for stakeholder participation in fisheries management decisions, general administration and monitoring compliance, ensuring enforcement and, where appropriate, dispute settlement (see Recommendation 4). All of these functions must be appropriately discharged.

Management authority functions may be vested in more than one body. The selection of the body fulfilling management functions should be based on the body's legitimacy, its compatibility with legal jurisdiction, and its political capacity to operate effectively.

It is critical for a management authority to have control of harvesting of the resources item over the whole of its range, otherwise limitations exercised in one part of the range may be undermined by lack of restraint elsewhere. This is frequently a complication as the ranges of marine fish often cross jurisdictions, straddling the jurisdiction of one or more coastal states and the high seas, or may not fit neatly into existing rights of coastal communities within a state. However, it is a necessary condition for effective management of fisheries resources and, if not met, can easily lead to failure of the management system. It has implications that reinforce the need for a nested structure of institutions to accommodate both the range of the stock and the socio-economic realities of those harvesting the resource.

The functions of the management authority may be vested in intergovernmental organisations, national governments, subnational governments, community organisations or rights-holder or stakeholder representative bodies, or an amalgam of these. In many instances, a management authority may in practice reflect 'co-management' arrangements with an appropriate division of functions.

Co-management may be defined as 'an arrangement where responsibility for resource management is shared between the government and user groups' (Sen and Nielsen, 1996, p. 406). Other similar definitions exist (Pinkerton, 1992; Berkes and Kislalioglu, 1991; Feeny *et al.*, 1990; Jentoft, 1989). Although the co-management concept tends to be broad in its definition, it does tend to convey, in common usage, the idea that substantial management functions are exercised by both government and user groups.

Sen and Nielsen (1996, p. 407) offer five generalised types of co-management in their study classifying 22 co-management

arrangements. In doing so they develop work by McCay (1993) and Berkes (1994). An *instructive* type of co-management differs from centralised management only in that mechanisms have been established for dialogue with users, although the process remains one of government informing users of planned decisions. A *consultative* type co-management arrangement exists when mechanisms for consultation between government and users have been established but where decisions are still taken by government. *Co-operative* type co-management describes arrangements where government and users co-operate on an equal basis in decision making. *Advisory* co-management arrangements are those where the users advise government of decisions to be taken and government endorses them. Finally, *informative* co-management occurs when government has delegated responsibility to user groups who are responsible for informing government of their decisions.

The above typology is clearly a simplification, for purposes of facilitating understanding, of a wide range of complex management scenarios. Each of these could encompass different management tasks with different roles taken by the state and the other interest groups depending on the nature of the management task and the makeup and abilities of the interest groups. Using this classification, many resource management systems employ some sort of co-management arrangement. It is unusual to find a resource managed purely by the appropriators of the resource without rules made by an outside authority affecting the key decisions.

A co-management system should include in the management process user groups and others who have a stake in what happens to the resource, such as natural and social scientists, trade unions and those representing the public interest. The role that these groups might play depends on who they are and how they are represented (Jentoft and McCay, 1995).

Different management tasks may require the involvement of different interests. While some decisions could be taken at a local level, others may need to be taken at a national or even supranational level (Nielsen and Vedsmand, 1995). A principal concern in establishing an effective management authority is that its geographical reach should match the range of the resource it seeks to manage. The particular makeup of a management authority should be based on jurisdictional considerations, the political efficacy of the authority and (related to this) the legitimacy of the authority.

This approach is compatible with the insights offered by Coase (1960) and Lipton (1985). Lipton, reflecting on Coase's work, considers the problem of common pool resources in developing countries and argues that through democratic or participatory systems it becomes easier to move away from the more expensive coercive systems of control or regulation of common pool resources and towards the more cost effective 'control with consensus' (for empirical support for this view see Kuperan and Sutinen (1998)).

The concept of the nestedness of management arrangements is important if the system of governance is to permit management to have authority over the whole range of the target stock and yet also be compatible with the social, cultural and economic characteristics of the fishing communities and the broader society that utilise the resource. The international law of the sea, particularly the LOSC and other associated agreements, constitute negotiated agreements for settling problems of the global marine commons, including those of the fisheries sector. The law of the sea, though not sufficient in itself as a solution, provides a framework within which states can take action to resolve, among other things, the problems associated with open-access exploitation of common pool fisheries resources. The LOSC contributes a framework within which national fisheries management arrangements are nested. In turn, a whole range of local fisheries management arrangements may be nested within the national institution, differing in the geographic areas they may cover, the target stocks and other particular circumstances of the fishery.

2.6.4. Transferability of Rights

Theoretically, transferability (see Section 3) increases efficiency since market forces will tend to allocate the rights to the most efficient entities if there do not exist serious distorting influences in the market, such as certain types of subsidies (see Section 4). Restrictions on transferability may be appropriate to achieve social objectives other than economic efficiency.

2.7. Conclusions

The need to limit the harvesting of fish to match the optimal capacity of nature to produce the resource leads to the recognition of the central importance of a rights-based system of fisheries management. We have identified what we believe should be the main features of such a system. In the next section we evaluate some existing and proposed fisheries management systems from this perspective.

3. Rights-based Fisheries Management: Options for Implementation

3.1. Introduction

Property or use rights are an essential element of an effective system of fisheries management. The importance of such rights, the characteristics that they should have, and the

factors that determine the most appropriate form that use rights should take in any particular fisheries were established in the previous section. This section reviews options for a rights-based system of management. The application of the principles of a rights-based system will find different expressions in practice, depending on the characteristics of the resource and the societal setting of the fisheries. The latter includes social organisation, any existing use rights, the practicality of using particular methods in each context, the availability of good scientific advice and the means available for monitoring and control. The extent to which they create incentives that make fishing mortality consistent with resource productivity within a rights-based system is critical.

The efficacy of the system of global governance of fisheries resources rests on whether institutions can be agreed and practical arrangements made to resolve conflicts and co-ordinate and manage resource use. The capacity to form management authorities for fisheries resources with authority over the whole of the range of a fish stock and able to fulfil the functions described in the previous section is crucial to the effective creation of a rights-based system of management.

3.2. The Nature of the Resource

The nature of the resource should influence the decision regarding the particular characteristics of any rights-based system. Temperate water fisheries tend to have larger aggregations of a single species which become the target of a particular fishery, with only a small percentage of bycatch. In these circumstances it is much easier to establish restrictions on output than is the case in most tropical fisheries.

Tropical fisheries tend to be characterised by a rich mix of species, which makes output restrictions much more problematic to implement. In such instances, restricting fishing effort might be the more appropriate way of limiting the harvest. The multi-species nature of tropical fisheries also lends itself to smaller-scale fishing methods, which are able to employ techniques that are more selective than might otherwise be possible.

3.3. The Societal Setting of the Fishery

The distinctive demographic, social and cultural characteristics of the community harvesting the resource will necessarily influence the form that the rights should take.

3.3.1. Small-scale Fisheries

The larger the number of small-scale fishers in a fishery, the more difficult it is likely to be to achieve cost-effective enforcement of the rights-based system. This points to the need for a greater degree of peer monitoring, the need for legitimacy to be established, and thus the importance of

participatory methods of management. In the populous coastal regions of Asia, for example, effective enforcement of any set of rules can only be successful if a critical number of fishers support them and recognise the benefit that can accrue from co-operation of all fishers in their implementation. Thus there is a need for fishing communities to be actively involved in decision making and enforcement.

3.3.2. *Scientific Capacity*

Scientific capacity is important for effective management; the greater the understanding of the dynamics of the resource and its relationship to its environment, the more informed management decisions are likely to be. Good scientific advice may not always be available and this may limit the form that user rights may take. Indigenous knowledge of the resource can play an important role in understanding what is happening to it and should be regarded as complementary to formal scientific advice.

3.3.3. *Cultural Contexts*

The compatibility of methods of regulation with the culture and traditions of a particular society will have a bearing on the likelihood of it being effectively implemented. Sensitivity to culture has profoundly practical implications for acceptance by a community of a fisheries management regime and consequently on compliance with rules adopted.

3.3.4. *Management and Enforcement Capacity*

The form of use rights decided upon must be consistent with the management capacity available to ensure effective implementation. If output is being regulated, it must be possible to be able to monitor it effectively, otherwise the rules will readily be flouted and the management system will break down. In such an instance it might be better to adopt an alternative form of use rights, such as limitations on fishing effort deployed.

3.4. Use Rights

The above issues must be taken into account when deciding on a rights-based regime. They should determine the form that the use rights should take, who the rights holders are, the nature and makeup of the management authority or nested set of authorities, and the arrangements that are needed in order to ensure that the transition takes place.

An effective governance regime for fisheries is necessarily complex. Increasingly, it involves many more players than before, when fisheries issues tended to be solely the concern of fishers, marine biologists and fisheries managers. Consumer groups, conservation and development NGOs at

every level within a country, governmental and nongovernmental international organisations, broader community interests, the aquaculture industry and regional economic groupings have now also involved themselves in the fisheries sector. In addition, public concern for fisheries is evident at local, national, regional and global levels (Williams, 1998).

Use rights are essentially aimed at limiting the harvest to the productivity of the resource in a manner most appropriate to the particular circumstances of the fishery. Whatever the form of the rights-based system, it should be designed so that, when implemented, it (1) defines the conditions of access to the resource, especially as deemed necessary to protect it, (2) excludes non-rights-holders from access to the resource, (3) ensures that the conditions are enforced, (4) allows for adjustments to the rights that have been allocated because of changes needed due to changing conditions and (5) contains a mechanism for resolving disputes.

Recognising existing rights of fishing communities is a fundamental element in building a successful fisheries management system. Doing so provides a basis of legitimacy which, if absent, is likely to result in poor compliance.

A combination of management measures is generally needed to achieve effective management of the fishery. Rights must be supplemented by biological and technological measures such as protecting juveniles, selectivity of fishing gear and other measures.

3.4.1. Territorial Use Rights

Territorial use rights in fishing (TURFs) are exclusive rights to fish, assigned to a community or individual, within certain limits of sea territory. Such rights may constitute an essential building block in a rights-based management system among coastal communities, *inter alia*, where territorially defined rights to fisheries resources have been long established. A TURF in itself does not necessarily constitute a sufficient limitation on harvesting. While outsiders may be excluded from the geographic area covered by the TURF, providing some limitation on catch, without further rules harvesting is not necessarily limited to the productivity of the resources being targeted.

In many instances such a right would not cover the whole of the range of the fish stock and a management authority would need to be established to fulfil the function of managing the stock. If the range of the stock is around a large bay area, for example, and several villages enjoy territorial use rights to fish the stock, it would probably be appropriate to establish an authority involving representatives of each community having a TURF. Responsibility for decisions on a division of the catch, whether directly or through limiting fishing effort, would need to be shared by the villages, while responsibility for controlling fishing in each area might devolve to each of

the village communities that have the TURFs. Monitoring, control and surveillance would need to work in such a way as to offer an assurance to each community that other villages are complying with the agreed rules. Thus the TURFs would be nested in a wider management arrangement.

TURFs are best suited to resources that are relatively immobile or whose location at a particular time is predictable. In that case the rights holders might have an incentive to assume responsibility for the development and management of the resource in question.

The management authority would need to satisfy itself that the responsibility would be exercised by the rights holders to institute rules that provide a set of incentives that ensure that the harvest does not exceed the capacity of the resource to supply. A system for interpreting those rules and resolving difference of interpretation would still be required.

3.4.2. Proportion of Catch Rights—Limiting Outputs

Output controls directly limit the catch and, in so doing, limit the mortality of a fish population. A TAC is often decided as a percentage of the estimated biomass. A TAC introduced into an open-access fishery, where no limit is placed on effort but where fishing for the species is banned once the TAC had been reached, might succeed in the biological objective of ensuring that the stock remains relatively healthy, but is likely to be economically very wasteful. This can lead to absurd situations such as the annual ‘derby’ that existed in the Alaska halibut fishery, where a large number of vessels were eventually deployed for only a couple of days in the year before the season was again closed. Individual fishing quotas were introduced for the Alaska halibut fishery in 1995. The race to catch the available fish before anyone else does so would result in committing more fishing effort than is needed to catch the TAC and will ultimately result in the dissipation of all the rent on excess capacity (Rettig, 1991).

An individual catch quota (IQ), a right to catch a certain quantity of fish within a certain time frame, creates an incentive to harvest the TAC more efficiently. IQ rights are usually defined as shares of the TAC of a given species of fish. A catch quota of a given species may be further subdivided geographically. With the introduction of IQs the race for fish is reduced and possibly eliminated. With the guarantee to the fisher that he be permitted to catch a specific percentage of the TAC in a certain time period, the incentive is created to reduce costs. If catch quota rights are short-term, however, there will remain a residual incentive towards excess capacity if there exists a perception that the size of a future new quota might depend on the boat’s capacity.

IQs that are assigned permanently, or at least for a long period, provide an incentive for fishers to achieve greater economic efficiency. Catch quotas eliminate the incentive to

race to catch the largest possible share of a limited quantity of fish and thus reduce the incentive to invest in equipment and boats for the purpose of winning that race. With long-term catch quotas the investor is left with the task of finding the most cost-effective level of fishing effort to catch the quota.

3.4.2.1. Transferability of IQs

If an IQ is divisible and transferable it facilitates greater efficiency (see Recommendation 1(iv)). A boat owner with a quota insufficient to operate the boat at its optimum can purchase additional quota so as to operate at that optimal level and not waste the potential rent on capacity in excess of what is needed to harvest the quota. In addition, in an efficient quota market there would be a tendency for quota to go to the most efficient fishing firms (Arnason, 1993). This is true only if the market is free and open and no distorting factors, such as subsidies, exist which could mean quotas ultimately going to the most heavily subsidised firms.

If the quota is granted permanently then there will be a tendency to adjust the fishing effort and fleet capacity to the socially optimal level. In the long term, only the most efficient firms will harvest the fish and these firms will not hold excessive fishing capital. If they are not fully efficient it will be to the mutual advantage of firms to sell or buy, with the outcome that the most efficient firms harvest the fish. The capital stock of the fishing fleet would tend towards the socially optimal level (Arnason, 1993).

ITQs, divisible, transferable and tradable quotas, evolved from the regulatory practice of setting a TAC and then dividing the TAC into IQs. In an ITQ system, quota holders own rights to specific percentage shares of the total catch. Usually, depending on how the system is designed, they can buy, sell, lease or inherit these user rights in the same way as would be possible with other forms of property. The quotas will tend to gravitate to those who can pay the highest price for them, which typically would be those who can provide the most valuable product and/or produce at the lowest possible cost. This is unlikely to create problems of monopoly in the product market but may give large quota holders too much power in the local labour markets.

Long-term tradable catch quotas can accommodate technological progress: under this regime there is no point in investing in more fishing effort with a capacity greater than the quota held, unless one has secured a sufficient quota allocation to use that additional effort efficiently. New purchases are based on trimming fishing effort to that which is needed to harvest the allocated catch.

An intuitive argument in favour of ITQs is that, if fishers have a direct stake in the long-term health of a fish stock, then collectively there can be a sense of stewardship in the resource and an incentive to use the resource at a level approximating the maximum economic yield. If the holder of

a quota has a permanent right to a percentage of the TAC then as the TAC rises with improvement in the biomass of the stock the value of the quota will increase, as it would represent a right to a larger quantity of fish. Theoretically, this should hold true until an optimal level of fishing is reached.

The logic of the theory suggests that the group of quota holders could be entrusted ultimately with determining the size of the TAC as part of the self-management process that could evolve. If the TAC is optimal then an increase in the TAC will result in a fall in the biomass and will ultimately lead to a fall in the value of quota holdings (Pearse and Walters, 1992; Anderson, 1995). Thus there would theoretically exist an incentive not to set the TAC beyond a level that approximates the MSY.

Some empirical evidence suggests otherwise. Francis *et al.* (1993) noted that New Zealand quota holders have shown a strong tendency to reject scientific assessments showing a serious decline in a profitable fishery. Decisions which fishers may make are not solely related to the value of the quota they may hold. Fishers will be reluctant to trade uncertain future stock recovery for near-certain bankruptcy.

3.4.2.2. Problems of Implementing an IQ System

Effective monitoring, control and surveillance, however it might be achieved, is essential for an IQ system to be effective. A number of other problems of implementation associated with catch quotas point to this need.

There is an incentive to under-report catches. The severity of this problem will depend on how easy it is to monitor catches and the fishing process itself, and to impose effective penalties on violators. If scientists are relying on catch data received from the industry, under-reporting may seriously bias their advice.

Any IQ system, regardless of whether the quota is tradable or not, encourages the phenomenon of dumping usable catch for economic advantage. This may take place for a number of reasons. Firstly, there is the practice of dumping fish at sea which may be of lesser value than other specimens—sometimes referred to as *high-grading* the catch. This happens in order to obtain the greatest net value from a quota. A fisher will wish to fill the quota with fish of the quota species that fetch the highest price per tonne. This may mean dumping the smaller fish if larger fish of the same species fetch a higher price.

A mechanism must be established either to eliminate or to take account of discards. A quota accounting system based only on retention of catch will undermine the basic principle that the sum of the quotas accounts for the full off-take from the stock. Possible remedies would be putting observers on all vessels, as is done in some US fisheries, or making it

obligatory to land all catches, and selling catches outside of quota at a value that discourages such catches.

Price dumping may occur as a result of prices dropping below a point where it is economically worthwhile to land the fish—fluctuating prices may cause a skipper to decide to dump the catch instead of bringing it ashore and having it counted against the allocated quota.

A quota system may also result in the dumping of bycatch, in instances where the fisher does not have quota to cover the bycatch. This is a particularly significant problem in EU waters (EC, 1991).

A quota system is critically dependent on effective policing of the system. The problem of misreporting catches tends to be greater where there are a large number of small boats operating and where there are many landing sites and channels through which to dispose of the fish. The black market for fish is said to be extensive within the EU. In cases where monitoring of landings is difficult or costly, catch quotas may not be a good option, despite their theoretical attractions. However, technological developments allow increasingly cost-effective monitoring methods to be introduced, enhancing the effective use of catch quotas. In addition, enhancing the legitimacy of the rules increases compliance with them and allows more cost-effective enforcement methods to be adopted.

Beddington (1996) demonstrates the problem of achieving effective enforcement with output regulation, using data for Scottish fishing vessels. He shows how the low probability of detection of infringements of fisheries regulations in the first instance, the low rate of successful prosecution of offences, and the judiciary's view that penalties be in line with benefits obtained from committing the offence, but too low to constitute a deterrent, all contribute to an economic incentive to misreport catch. (Note that in other jurisdictions (e.g., Namibia) the courts have considered the damage done to the stock by committing the offence and the need for a deterrent.) If stock assessments are dependent on data collected from the industry, then the reliability of the stock assessments are seriously undermined. In contrast, Beddington argues, 'effort regulations are vastly easier to enforce than TACs as the probability of detection of an offence is high and thus the deterrent effect is significantly greater'. Regulating a fishery by limiting output also requires that there be scientific capacity sufficient to make a reasonably accurate estimate of biomass. If this is not available, it may be more advisable to adopt other means of regulation.

3.4.3. Licences—Limiting Inputs

The principal advantage of developing rights-based effort limitation is that it may be easier to regulate than output limitations (Beddington, 1996). Fishing effort is a function of the size and type of boat, its power, the type of gear used, the

size of the crew, the fishing skills of the captain and crew and the time and location during which fishing takes place (Anderson, 1977). In practice, some proxy for fishing effort is often used, such as the gross registered tonnage of the vessels or horsepower of the engine.

Fishing licences, the most commonly used device for restraining input, limit access to the fishery directly by limiting the number of boats that may participate in the fishery and usually specify other restrictions on fishing effort. Licences must make some allowance for variation in the parameters defining the fishing effort of a boat.

Licensing a specific number of boats or sets of fishing gear with just sufficient fishing effort to harvest the target species does not create an incentive for the fisher to limit fishing effort as is the case with catch quotas. In practice, if the number of boats in a fishery is limited by licence control without additional regulations, there will be a tendency to increase harvesting capacity through technological improvements (McConnell and Norton, 1978). If gross registered tonnage is restricted, for example, then the boat owner may increase fishing effort by increasing the horsepower of the main engine or using more sophisticated electronic fish-finding equipment and additional fishing gear. The result is movement back towards overcapacity and dissipation of any rents present in the fishery.

Although there is likely to be some increase in fishing effort after an initial reduction of effort following licensing, it is likely to be at greater cost than would be the case if capacity was increased through the use of more boats, and there would be a tendency not to return to the original effort level (Crutchfield, 1979). The new equilibrium will thus be achieved at a lower level of effort.

A variation on the licence limitation approach is to attempt to limit effort by limiting the number of days at sea. This will have the same effect as limiting the number of boats in the fishery but with one important exception. The same stock of capital in the form of boats will be retained but will be used less efficiently. Furthermore, the number of boats will be increased unless it is limited as well. Rent and possibly other forms of subsidy are absorbed in the process.

Licence limitation may also result in the dissipation of resource rents if the regulator allows a suboptimal mix of heterogeneous boats to participate in the fishery (Dupont, 1990).

3.4.3.1. Gear Restrictions

A further drawback of licences is that they do not readily accommodate technological change; in general, the more successful one has been in controlling fishing power by a detailed specification of the boats, the more one may have stifled the introduction of improved technology.

Gear restrictions limit the usage of particular fishing equipment by either type or amount. They restrict elements of what constitutes fishing effort which some have regarded as proscribing 'certain cost-effective ways of operating' (Anderson, 1977, p. 204) which Anderson characterises as 'regulation by inefficiency'. By increasing the costs of fishing, the restriction succeeds in reducing effort, reducing the catch and improving the state of the stock but does nothing to promote greater economic efficiency. With time, other technological improvements are made which again bring down the cost of effort, and effort then expands. The regulating authority then imposes new gear restrictions in order to reduce the level of effort and the process is repeated.

While Anderson's characterisation of gear restrictions is true in many instances, gear restrictions can also be desirable in their own right for the purpose of better utilising the growth potential of fish or for avoiding bycatch. An example in shrimp fisheries is the banning of nets to which excluders are not fitted. A net without an excluder will catch up to 90% 'trash' fish, often juveniles of species which may be commercially valuable when they have grown. These are generally dumped. The cost of damage done to the ecosystem is not borne by the fisher. In instances such as this, Anderson's characterisation of gear restrictions is inappropriate if the full costs are taken into account. It could also be argued that more selective gear, which is the most efficient when all costs are taken into account, can be squeezed out by the introduction of gear that is less selective because externalised costs are not considered. An example is the use of trawlers in tropical waters, displacing more selective gear targeting specific species.

Regulating the size of fish caught through restricting mesh size is an example of a regulation offering both economic and biological advantage. Imposing a larger mesh size allows the smaller individuals to escape and concentrates the harvest on larger size individuals allowing growth in biomass in subsequent years (Beverton and Holt, 1957). Initially catch rates fall, but the benefits of increased catches at the larger size of fish become apparent over a period of anything between several months and several years, depending on the biological characteristics of the species being caught (Beddington and Rettig, 1984). Regulations on gear design for the purpose of better utilising the growth potential of fish or to avoid taking undersized individuals of unwanted species are complementary to various types of input and output regulation.

Regulating mesh size is more problematic in the multi-species trawl fisheries more typical of tropical waters. A single mesh size would need to be selected to catch several different species which are likely to have a whole range of optimal mesh sizes associated with them (Beddington and Rettig, 1984). This problem highlights the argument that the ecosystem characteristic in tropical waters of a high level of species mix favours harvesting by small-scale fisheries, where more selective gear can be used to target different species at

different times of the year in different localities (Kurien, 1996).

If restrictions on fishing effort through licensing takes place at an early stage in the development of a fishery before capacity becomes excessive it will be more successful, as it will avoid having to get rid of excess capacity at a later stage. Where considerable overcapacity has already developed, it is often politically difficult to reduce the fishing effort to an optimal size.

3.4.3.2. *Closed Areas and Closed Seasons*

Licence limitations may also include conditions that limit the amount of fishing effort directed at a particular species in the form of closed seasons and closed areas. Two distinct types of closed season exist. The first occurs when particular periods of the year are closed to fishing for a specific species so as to protect the stock during critical stages of the life cycle, such as when the shoals are dominated by juvenile fish. The second type of closed season occurs when access to the fishery remains open, but the catch is limited by closing the season when the catch rate declines to a predetermined point. This method relies heavily on a strong relationship existing between catch per unit of effort (CPUE) and the size of the biomass and cannot work from a biological perspective if this relationship is weak. The method, for example, would be inappropriate for most small pelagics, which continue to aggregate densely as population decreases. Both these types of closed season can have some biological advantage but both increase costs of effort as the limit on the duration of the use of boats and gear lowers the CPUE used (Anderson, 1977).

Closed areas have much the same effect as closed seasons of the first type. They may raise costs to the individual fisher if the closure of one area means that the fisher must deploy more effort per unit of catch than might have been deployed in the closed area. Usually, such restrictions are introduced for conservation reasons such as protecting spawning grounds. Again, this imposes what may appear to the fisher to be greater inefficiency, but in many instances the effect of the regulation is to make the fisher bear the cost instead of it being a negative externality to be borne by society. Again, such biologically based regulations may complement other regulations.

If rights to use specified quantities of fishing effort are made transferable, it becomes possible for effort to gravitate towards the more efficient rights holders. As is the case for rights based on a share of the output, this assumes a fair and open market for the rights and is dependent on the market not being distorted by an unequal availability of subsidies.

Despite their many drawbacks, vessel licenses and time limits on fishing do have the advantage of being relatively easy to monitor and control. In addition, the incentive which catch quotas create to misreport actual catch is not present.

3.5. Other Issues

3.5.1. *Allocation of Rights*

The initial allocation of rights is generally made by administrative decision. Allocating by administrative decision has the advantage of allowing the administrative authority to take into account social objectives such as addressing questions of equity, but it also carries with it some serious disadvantages, such as an incentive towards rent-seeking behaviour.

In such a case the management authority would need to decide upon a set of criteria for an initial allocation of rights (see Recommendation 2(ii)). The criteria decided upon could be historical participation in the fishery, residence history, experience or investment in the fishery. Rights can also be restricted to those actually fishing at sea, as was done in the coastal fishery in Norway and is now being attempted in Kerala State, India. They could include other socially appropriate criteria such as the selection of those that had been excluded from the fishery by discriminatory laws or practices, such as has been the case in South Africa and Namibia. In some instances where historical participation in a fishery has been the principal criteria used, the rights have been assigned only to the owners of capital. Initial allocation schemes should be designed to compensate those who do not obtain rights and to treat labour and capital on an equitable basis.

A successful rights-based system will produce greater profitability in the fishery, and in some instances this is associated with the generation of high values of resource rent. This may call for the collection of resource rent through taxation.

An alternative suggestion for initial allocation is through auction. As right-based systems tend to be introduced when the fishery is in crisis, a fisher may value a right at less than what it may be worth to society. It is possible that the best financed, rather than necessarily the most efficient, will secure the rights in such instances. Auctioning may have some attractions for impartial and effective distribution of rights in some circumstances, but in instances where other social objectives need to be met it is probably not an advisable option.

3.5.2. *Transferability of Rights*

Making rights transferable can help to generate funds which can be used to compensate rights holders who want to leave the fishery. The compensation will then be driven by the expectation of the future gains by the purchasers of the rights. Since these gains are uncertain and occur in the future, some financial mechanism to facilitate restructuring may be required. For example, in developing-country fisheries innovative mechanisms might be created in order to

compensate those who might otherwise lose from the introduction of fishing rights. The international development banks should be looked to for leadership in creating such compensation mechanisms in developing countries, with loan repayments to be derived from value created by the rights-based resource management system.

A successful rights-based regime will make fishing rights valuable as a result of increased efficiency. The expectation of such gains will help ensure the commitment of fishers to accept a transition to a rights-based management regime.

Rights must be transferable in order to ensure efficiency. However, unrestricted transferability may lead to outcomes such as concentration of rights, possibly into the hands of wealthy, large-scale operators. Consolidation may have a negative effect on local labour markets ('the single company town problem'). If such outcomes are regarded as undesirable, it would be preferable to deal with them by means other than restricting transferability of rights.

3.5.3. *Amendment*

Use rights should be allocated for a long period and should preferably be of indefinite duration so as to provide an incentive for appropriate capital investment. However, in input-managed fisheries, mechanisms will be needed to accommodate technical innovation and should preferably be specified in the conditions relating to the initial grant of rights to individuals or other entities. The management authority should have the power to amend the conditions of allocated rights in order to maintain the sustainability of a fishery, for example in the event of a stock collapse. Such amendments should not be subject to inappropriate political interference.

3.5.4. *User Fees and Rent Extraction*

Fisheries management requires the outlay of funds for various purposes, such as stock assessment, administration of the rights-based system, monitoring and enforcement. It seems appropriate that the rights holders should be charged for management costs on a user-pays basis. In some cases the gains from effective management may be substantial, with the generation of large rents. In some circumstances there may be a case for distributing rents more evenly among society at large or targeting specific communities: for example, through taxation or auction of fishing rights (Recommendation 1(iii)).

3.5.5. *Scientific Advice*

Fishery science has a credibility problem that threatens to undermine fishery management which itself has a credibility problem which, to some degree, is to be expected when science is used as the basis for regulation. Making science independent of management authorities and subjecting it to

peer review modelled after processes used to judge basic research (e.g., publications in primary journals) is often advocated as a means of increasing credibility. Scientific advice should be independent of management agendas, but there must be mechanisms in place to ensure that it is relevant and responsive. Peer review is also important for improving credibility and improving quality, but the traditional publication-oriented approach familiar to most scientists is not practical for most fishery management advice. Alternative mechanisms are required, such as open and transparent scientific working groups that involve 'independent' scientists, and the development of standards and/or certification (see Recommendation 3(ii)).

Advocates of peer review often overlook an important difference between the way in which it applies to publications and its application to fisheries management advice. With the former, there is almost always some criticism of the work under review, but the process is confidential (between author, referees and editor). No one announces that a paper has been rejected, nor are nonfatal criticisms of accepted papers known. Recent peer reviews of scientific advice on fishery management have been a very public process with nonfatal flaws being raised about advice that has, overall, been accepted by peer review. The scientists involved in providing advice are encouraged to go out on a limb and give advice in the face of uncertainty but are then subjected to severe scrutiny, so that, in delivering the advice, they take a large professional and personal risk (criticisms are often personalised—see the review of Atlantic bluefin tuna assessments by Sissenwine *et al.* (1998)).

The Commission believes that peer review can help improve or keep at a high standard the quality of scientific advice, but that care should be taken to structure the peer review process in such a way that it gives an explicit assessment of risk and does not otherwise hinder the objective of informed decision making.

3.5.6. *Monitoring and Enforcement*

All rights-based systems must be backed with an effective monitoring and enforcement mechanism, although compliance relies also on the fishers' understanding of the objectives and plans of the management system and the credibility and moral authority of the management authority. The management authority should be vested with the power to revoke rights; this would be a powerful deterrent to breaking the rules. The monitoring and enforcement mechanisms will influence the types of rights that can be used. For example, if it is impossible to monitor landings, a catch quota system will not be effective. Monitoring and enforcement must be cost effective and affordable. Information gathered through monitoring will provide feedback on the performance of the system and will suggest appropriate adjustments that could be made to management measures.

When rights-based regimes are based on international agreements, disputes over the legality of actions taken by participants need to be settled through a dispute settlement mechanism agreed upon by the co-operating states.

3.6. Conclusion

Governments have responsibility for ensuring the good governance of fisheries that fall within the jurisdiction, or partly within the jurisdiction, of the state. Governments must take initiatives, therefore, that will ensure effective management of the sector within the maritime zones for which they have responsibility.

In most instances this is likely to involve a set of different management arrangements, each of which is designed to best suit the particular biological characteristics of the fisheries resources concerned and the socio-economic characteristics of the society. Some such management arrangements will deal with the particular circumstances of a specific locality while others may be over-arching, in order to deal with wider management concerns. Some of the management arrangements will be nested within others. The nested set of national fisheries management arrangements constitutes the management within national jurisdiction.

In cases where the fisheries resource straddle a maritime border, the responsibility for management is shared by the states concerned in accordance with the provisions of the LOSC and other associated agreements. The need to strengthen the global governance framework that will enable the shared responsibilities of states to be exercised effectively becomes more apparent when the conditions for effective rights-based management, detailed in this section, are applied to the high seas fisheries and those under the management of regional fisheries organisations.

4. Trade and Subsidies

4.1. Introduction

Consideration of global governance of the fisheries sector must include analysis of the impact of trade, the related topic of subsidies and other barriers that may inhibit free trade in the sector. Trade in the fisheries sector, and movement towards liberalisation of trade, needs to be considered in the context of subsidies existing within the industry. Free trade is widely accepted as a desirable objective in principle. If subsidies that reduce costs and lead to increasing excess capacity are present, then it is more likely to be the best subsidised, and not the most efficient, that survive. Potential benefits from free trade are then negated.

4.2. Free Trade

Increased trade has the potential to benefit all those involved in it (see Recommendation 6). Increased foreign trade has accompanied the unparalleled rise in the standard of living among industrialised nations in the last half-century, and in the newly industrialised countries in the last two or three decades.

Trade in fish has taken place from time immemorial. It is common to all societies, as the fisher returning with more fish than is needed for personal consumption will need to exchange surplus fish for other goods or services. The global distribution of fish is also very uneven, some places enjoying an abundance far beyond the needs of the local population, while others may have no direct access to fisheries resources. Few would oppose the notion that trade is necessary in order to achieve a more even distribution of fish across the globe. Trade has always been an important part of the fishers livelihood, even in the so-called 'subsistence' fisheries. International fish trade has been increasing very fast and about 45% of the world catch is now traded internationally. The share of some developing countries in this trade is increasing, representing a significant proportion of their foreign exchange earning.

Free trade in the fisheries sector, however, is frequently vehemently contested. The domestic industry is often concentrated in specific localities so that generally the political pressure arising from anticipated decline in the domestic fishing industry is greater than the political pressure that can be generated as a result of anticipated gains for society as a whole from greater liberalisation of trade. This type of political conflict often arises out of a failure to address the equitable distribution of the gains of free trade, usually at the expense of the poorest and most marginalised fishing communities.

The benefits of international trade are best realised by each country specialising according to its comparative advantage, each doing what it does best. Both parties in the trade relationship then benefit from having goods and services provided most efficiently and at lowest cost. International trade in the fishing industry could obviously extend beyond trade in fish products and include trading in harvesting capacity, access rights and in other fishing industry services. The theory of international trade tells us that through such free and unhindered trade we could optimise the benefits of fisheries resources for society as a whole.

There are, however, a number of potentially harmful consequences of fish trade: (1) increased pressure on stocks, (2) enhanced incentives for destructive fishing practices, (3) increased inequity in wealth distribution and (4) the threat to food security. These are briefly dealt with below.

The forces of globalisation present increasing challenges for fisheries management. Increased liberalisation of trade,

improved market access and rising fish prices have increased profitability of fishing operations. This, in turn, provides incentives for fishermen to increase their effort. In the absence of effective management, this will only cause or exacerbate overfishing and in the long term reduce yields, income and welfare. In order to benefit from the opportunities offered by trade liberalisation, countries need to introduce or improve their fisheries management. That challenge is of a high order, particularly in the developing countries where administrative capacity and resources are lacking.

Another aspect of increased market demand for fish is the increased incentive for illegal behaviour (misreporting, noncompliance, high-grading), destructive practices (use of pesticides, cyanide or dynamite, coastal trawling in fragile habitats) and even fishing far beyond the safety limits of the vessels, endangering many lives. Higher prices or easier market access will, needless to say, further strengthen these incentives.

While the overall benefit to the country as a whole may be very large, there are likely to be losers and winners, including those in the fishery sector itself. The most efficient agents in the industry are likely to be those best able to capitalise on improved market access, better information on market opportunities, and more effective technologies. The poorer and most vulnerable parts of the sector (especially women and children) could become further marginalised. Where fish is an important source of protein for a large proportion of the consumers, including the poorer consumers, increase in international and internal trade (from rural to urban markets) can significantly reduce access to food and, in the populous developing countries, is a potential threat to food security.

With varying degrees of severity, these consequences are evident in all countries, developed and developing. However, increased trade offers such important benefits that its potentially negative effects should be addressed through more effective fisheries management and a better income distribution, and not by measures such as trade restrictions. In an increasingly favourable environment for trading fish, particularly for developing countries, a sustainable stock and a competent industry are the best assets.

4.3. Subsidies

Subsidies are a well known theme in international trade negotiations and disputes. Subsidies affect the relative competitive position of countries; a country that subsidises the production of a certain commodity or service may be able to undercut its competitors, even if it would be less competitive in the absence of subsidies. In the absence of a rights-based regime, this practice erodes the global gains from trade and has the potential to harm countries that have a comparative advantage in producing a particular commodity or service.

The GATT, and later the WTO, have formulated codes on what are and are not acceptable subsidies relating to international trade. Not surprisingly, the focus has been on whether or not subsidies have damaged a country in international trade.

Subsidies can be either direct or indirect. Direct subsidies involve direct payments in the form of price support, cost rebates, grants for investment, etc. Indirect subsidies involve the provision of goods or services below market price, or not collecting fees or taxes when this would ordinarily be done. Trade restrictions such as tariffs or import quotas also amount to subsidies to domestic producers, in that they raise the market price of fish above what it would be otherwise. Generally, tariffs and import quotas are much less significant in fisheries than for agriculture, but they still exist.

The most important kind of indirect subsidies, at least in developed countries, may be the provision of fisheries management. This is typically undertaken by government institutions and paid for from general government revenue with only nominal charges to the industry. Since management benefits the industry directly, to the extent that it is successful, this can be regarded as subsidisation. Some countries, most notably Australia, New Zealand and Namibia, do now recover a significant part of management expenses from industry. It must only be a matter of time before the issue is raised whether failure to do so causes damage to international trade in contravention of GATT/WTO rules.

In properly managed fisheries there will emerge a resource rent (that is, a difference between the price of fish and all costs necessary to obtain it). This rent can be seen as the 'price' of the productivity of fish stocks. To whom it should accrue is primarily a political issue, and in the absence of special arrangements (taxes or auctions of fishing licenses or quotas) it will accrue to holders of fishing rights and possibly to fishers through a share system of remuneration. It could be argued that these rents should be taxed away by the government involved, acting in trust for its citizens as the ultimate owners of the fish resources. It could then be argued that the failure of doing so constitutes a subsidy.

This is a much more controversial argument than the one pertaining to cost recovery: firstly, because it will never be possible to design tax systems that confiscate all rents, and secondly because the question of resource ownership is a political one. Different countries might choose to resolve that question in different ways, with some regarding owners of fishing rights as owners of the fish resources and therefore entitled to the rent.

With respect to fisheries, subsidies could, of course, nullify or impair the trade benefits that flow from comparative advantage. For example, a free market in access rights to resources could result in the best subsidised gaining those rights at the expense of countries which would be able to produce the fish at a lower cost. There is, however, a different

effect of subsidies that has been in focus for a number of years, namely the effect on the fish stocks. Subsidies artificially enhance the profitability of fisheries and thus lead to a greater investment in fishing boats, and more intensive use of existing boats. This exacerbates the overfishing problem that occurs under open access and helps to push fish stocks below their sustainable yield level, perhaps to the point of collapse. In this scenario, subsidies will ultimately lead to less fish being caught and in fact to a higher price of fish. This is contrary to what happens in agriculture, for example, where subsidies lead to greater production and lower prices on world markets.

It is important to note that this detrimental effect of subsidies happens under open access but is much less likely to happen, or will not happen at all, when the total catch of fish is controlled effectively. In fisheries where there is free competition for a given TAC, both fishing effort and fleet capacity may be expected to increase in response to subsidies, but if the TAC is effectively controlled they will not decimate the fish stock, provided the TAC is set adequately. The subsidies may, however, have an indirect effect on the stocks in that they may produce a political pressure to set the TAC irresponsibly high, which would decimate the stock. In TAC-controlled fisheries the main effect of subsidies is to waste productive resources—manpower, capital and other inputs—on chasing fish that could be taken at a much lower cost.

What has been said so far about subsidies implies that they lead to increased profitability, either through higher prices (price support) or lower costs (for example, through fuel rebates or tax exemptions). Some subsidies are not of this kind, such as the so-called structural adjustment support, by which redundant fishing boats are bought and removed from the fishery. This would seemingly be beneficial for the fish stocks, as fishing effort would be reduced and less fish would be caught. For this to happen it must be the case, however, that the payments for structural adjustment do not flow back to the industry in the form of investment in new boats or improvements to existing ones. Furthermore, such structural adjustment programmes could increase investment in the industry by giving the players the impression that investing in fishing boats is much less risky than they would otherwise consider it to be. Structural adjustment payments may therefore not be as innocuous as they seem.

4.4. Subsidies in Practice

Reliable and sufficiently comprehensive data simply are not readily available to go beyond rough estimations of subsidies but the exercise is useful as it illustrates the scale of the problem. The discussion in this section draws on the 1998 World Bank's study of subsidies in world fisheries (Milazzo, 1998).

4.4.1. Budgeted Subsidies

A major objective of the study was to examine the relationship between trade rules on subsidies and the sustainability of wild fisheries resources. The study was confined to a consideration of fisheries subsidies provided to the harvesting sector. It also drew a distinction between subsidies that tend to promote and enhance harvesting operations and capacity ('effort and capacity enhancing subsidies') and 'conservation subsidies'.

The study examined fisheries sector subsidies identifiable in government's fisheries agency budgets, those that do not appear in fisheries agency budgets (unbudgeted) and revenues not collected. Those subsidies that have the effect of promoting excess capacity in the fisheries harvesting sector were examined. These could be regarded as actionable subsidies according to the WTO criteria (see Appendix C). The subsidies were assessed as to whether (1) they meet the WTO's definition of subsidies, (2) confer a benefit, (3) pass the specificity test and (4) could reasonably be placed in the actionable category. In other words the WTO approach was applied, save for establishing economic injury, which requires specific data in each instance. Milazzo undertook six case studies: of Japan, the EU, Norway, USA, Russia and China. He found that budgeted domestic sector subsidies amounted to a global high estimate of US\$3,500 million and a low estimate of US\$3,000 million a year.

Budgeted subsidies also include subsidies for foreign access which were estimated at US\$500–1,000 million globally. These are also subsidies in terms of the 1994 WTO Subsidies Agreement (WTO, 1994a) and in many cases could be considered to have the effect of transferring excess fishing capacity to developing countries.

4.4.2. Unbudgeted or Underbudgeted Subsidies

These subsidies primarily take the form of subsidised loans and tax preferences. Based on an estimate that economic benefits to the recipients of all forms of *subsidised loans* was 10% of the value of the loans, whose annual payments were estimated at US\$50,000 million, then the aggregate impact would be US\$5,000 million a year. As these serve to lower operating and capital costs, they are subsidies that aggravate the excess capacity problem. The second category of unbudgeted subsidies are *tax preferences* which take three major forms: exemptions from fuel taxes, accelerated depreciation of capital assets (i.e. boats) and deferral of income taxes. The estimate arrived at for these taxes was US\$1,000 million globally.

Thus, the total for unbudgeted and underbudgeted subsidies came to US\$6,000 million, which was considered a low estimate, as it was thought to under-report the incidence of these subsidies in some developing countries. Milazzo thus offers a high estimate of US\$7,000 million.

4.4.3. Cross-sectoral Subsidies

Cross-sectoral subsidies are subsidies which are not granted directly to fishers but which benefit them indirectly and tend to stimulate fishing effort and capacity: for example, subsidies to shipbuilding and fisheries infrastructure (particularly ports). In arriving at these estimates it is necessary to show that the subsidy targets the fisheries sector and is therefore 'specific' under the terms of the WTO 1994 agreement.

4.4.3.1. Shipbuilding

The FAO's 1993 (FAO, 1993) analysis of global fisheries estimated that the replacement value of the world's fleet was US\$320,000 million. To accommodate criticisms that this estimate was too high, a significantly lower value of US\$200,000 million was used in this estimation. If 20 years is accepted as the average useful life of a fishing vessel, then US\$10,000 million would be spent annually in new construction. If it is assumed that the average level of subsidisation in shipbuilding is about 20%, then shipbuilding subsidies amount to about US\$2,000 million a year. As part of the subsidy accrues to the benefit of the shipbuilder, it is assumed in the study that half the benefit, or US\$1,000 million, accrues to the fishing industry.

4.4.3.2. Infrastructure

Article 1.1(a)(iii) of the 1994 WTO Subsidies Agreement permits subsidies for 'general infrastructure' as it is considered a responsibility of government to provide such infrastructure. If, however, the infrastructure is *specific* ('benefiting an enterprise, or industry, or group of enterprises or industries' (Art. 2)) as opposed to general and is made available to commercial users at less than the prevailing market prices, then a subsidy may be considered an actionable subsidy. It is known that Japan spends nearly US\$2,500 million on fisheries infrastructure annually (Milazzo, 1998). In the EU some US\$40 million of the fisheries budget was spent on 'port facilities'. Milazzo makes a conservative guess of US\$10,000 million worldwide for infrastructure that specifically targets the fishing industry. If it is then assumed that only 5–10% of this qualifies as a subsidy that excessively promotes effort and capacity in the sector, then such subsidy would be US\$500–1,000 million a year.

Cross-sectoral subsidies globally thus amount to US\$1,500–2,000 million annually.

4.4.4. Management Costs

The WTO Subsidies Agreement tells us that a subsidy exists where 'government revenue that is otherwise due is forgone or not collected' (Art. 1.1(a)(ii)) and where 'government

provides goods or services other than general infrastructure' (Art. 1.1(a)(iii)).

It could be argued that, in principle, resource rent from a publicly owned natural resource belongs to the people as a whole and should be collected by government to be used for the public good. This is the principle behind royalties paid in most countries, for example, in the mining sector. Government recovery of resource rents has not been an accepted principle in the fisheries sector, largely for the historical reason that a large part of the fisheries sector fell outside of the jurisdiction of a coastal state. In principle, then, uncollected resource rent could be described as a subsidy in terms of Article 1.1(a)(ii), which in many instances is now used to finance overcapacity.

The World Bank study takes a more limited view, where both of the above definitions of a subsidy would apply, namely the failure or otherwise of governments to collect user fees and recover costs in fisheries. A range of costs of managing fisheries resources were examined and an assessment made that a reasonable level of management costs would be about 10% of the value of the catch. Few countries apply such levels of fees if they apply any at all but, to accommodate the few that charge a fee and to create high and low estimates, it could be argued that the revenue forgone is between 5% and 10% of total revenue. Applying this to the global revenue of the fishing industry estimated by the FAO as US\$70,000 million (FAO, 1992), uncollected fees in the industry would amount to between US\$3,500 million and US\$7,000 million a year globally.

4.4.5. Subsidies Total Estimate

The aggregates of the low and high estimates given above are summarised in Table 4-1 (Milazzo, 1998).

Table 4-1: Estimates of total global fisheries subsidies (US\$ billions) in the fisheries harvesting sector.

Category	Low	High
Budgeted subsidies:		
domestic	3.0	3.5
foreign access	0.5	1.0
Unbudgeted subsidies	6.0	7.0
Cross-sectoral subsidies	1.5	2.0
Management costs	3.0	7.0
Total	14.0	20.5

If global annual revenues in fisheries are about US\$80,000 million (FAO, 1994), then subsidies that promote overcapacity in harvesting amount to 20–25% of the revenues of global fisheries.

4.5. Environmental Subsidies

On the face of it, there are a range of subsidies made in the fisheries sector that are theoretically designed to protect the environment. These subsidies are to finance programmes that, for example, enhance the resource base or reduce fishing effort or promote 'cleaner' technology in harvesting resources. Vessel- and fishing-permit buyback schemes and programmes to refit vessels for use in less stressed fisheries are examples of these. However, such schemes often do not meet their intended targets. The EU's Multiannual Guidance Programme (running since 1987), designed to substantially reduce the size of the EU fleet in terms of gross tonnage and engine power at the cost of about US\$170 million a year, has in many instances witnessed a growth in the size of the fleet in terms of gross reported tonnage (Concerted Action, 1999).

Questions can clearly be raised about the appropriateness or acceptability of these sorts of environmental subsidies.

4.6. Conclusion

The estimates given above cannot be taken as anything more than a rough guide to the scale of the problem of subsidies. In addition to having a profoundly negative effect on greater liberalisation of trade, these subsidies have played, and continue to play, a major role in the development and the maintenance of overcapacity in the fisheries sector. They thus undermine attempts at developing adequate systems of management for the sector.

Global rules for dealing with the issues exist but it would seem that better information systems need to be developed to enable identification of the violations of the rules as a prerequisite to ensuring their implementation (see Recommendation 6).

5. Some Alternative Approaches: How Well Would They Work?

5.1. Introduction

The problems of fisheries governance and the need for rights-based management systems have been described in previous sections. Many ideas have been proposed to address the problems of overfishing, habitat degradation and the impoverishment of fishing communities. It is often the case that the solutions proposed do not go to the root of the problems of the fisheries sector but may be useful complements to the rights-based approach needed for effective fisheries

management. Many of those who have promoted other particular solutions themselves recognise the limited contribution that they might offer. Often they have not sought to claim that they offer a complete solution to the problems of the fisheries sector but then find that the ideas are adopted by others as a panacea for the future of fisheries.

The Commission is concerned that there are many proposals gaining momentum without sufficient critical examination. Most of these proposals have some merit. Although it is not feasible for the Commission to review fully the arguments relating to these proposals, it wishes to offer its evaluation of them and to highlight some aspects that it believes deserve more attention. In some cases, the proposals have a narrow focus on certain aspects of the fisheries, while other proposals are advocated for the more general impact that they might have.

The Commission has identified those proposed solutions that it believes are most commonly advocated and offers its opinion on each of them.

5.2. An End to Subsidies

An end to subsidies in the fisheries sector has been increasingly seen as a solution to overcapitalisation in the sector, which creates pressure to overfish. The Commission agrees that in general subsidies should be ended, but this should not be seen as a panacea heralding an end to overcapitalisation. The call to end subsidies should not divert attention from the underlying cause of the overcapitalisation problem, which is nonexistent or poorly defined rights. With well defined rights, subsidies will not in general lead to overcapitalisation. While there are no analyses that quantify the relative importance of the lack of rights and subsidies as causes of overcapitalisation, it is the Commission's judgement that the former is the more important problem.

Subsidies are still a fact of life in many industries, the fishing industry being one of them. Typically, subsidies are put in place to bolster the incomes of groups that for some reason have fallen behind others. It is tempting to view subsidies simply as income transfers from those who have enough to those who are found deserving. Yet this is a superficial and misleading view. Subsidies have a number of negative side effects which, to some extent at least, defeat their purpose.

First, subsidies do not grow out of nothing; they must be financed by taxes, or by government budget deficits. Raising taxes has negative side effects; taxes discourage work effort to the extent they reduce labour incomes of the objects being taxed, and they reduce investment and economic growth to the extent they affect the return on capital. Obviously, no country can do without taxes, but these negative side effects of taxes are reasons enough to critically examine government expenditure, including that on subsidies. Budget deficits cause inflation or raise the rate of interest, or both, which

again has negative effects on investment and economic growth. The effects on growth are particularly important, since economic growth is a prerequisite for raising the overall level of income in any society.

Secondly, subsidies will blunt the incentives of those who work in the subsidised industry to seek better employment opportunities. Economic growth is to a large extent driven by a reallocation of labour from less productive to more productive sectors of the economy. Low incomes in a particular sector are typically associated with low productivity of labour. To improve the productivity of labour in an industry that cannot or should not expand, it is necessary to move labour out of the industry. This will raise the productivity of those who remain in the industry and, in addition, increase the value of goods and services produced in the economy, which in turn raises the overall level of income.

Subsidies, therefore, retard economic growth and the rise in overall incomes that goes with it, unless they are being especially targeted at industries with a large growth potential which may need to be nurtured in an initial phase. In most instances the fisheries sector is not likely to need that kind of support.

Subsidies in fisheries may in fact have much more adverse effects than in many other industries, such as agriculture, for example. Subsidies to agriculture have typically led to increased production (unless they are paid in return for removing land from agricultural production or slaughtering of livestock). Due to the inelasticity of demand for food products this has at times led to falling food prices and lower incomes for farmers, thus increasing the need for subsidies in a vicious circle. In other cases the surplus production has been dumped on the world market, causing adverse effects for some developing countries. In fisheries, where there is little or no control on entry and fishing effort, subsidies cause effort and fleet capacity to expand. This does not necessarily lead to increased production; on the contrary, it is likely to lead to falling catches of fish through stock depletion, and perhaps even to a collapse of the stocks. Elimination of subsidies, particularly in badly managed fisheries, is therefore highly desirable for reasons of conservation.

These adverse effects of subsidies notwithstanding, there is reason to acknowledge the possibility that subsidies to a particular industry may be the only avenue open to assist disadvantaged groups in some developing countries, because a system of income transfers to needy individuals is either imperfect or does not exist. This is, in one sense, an argument for developing such systems and avoiding the aforementioned negative effects of subsidies. The elimination of subsidies, therefore, may have to take place gradually and cautiously under such conditions, with due regard to the distributional effects such an elimination would have.

5.3. Ecosystem-based Management

Applying an ecosystem approach to solve fishery problems has become a common theme proposed by many groups. The recent US National Research Council report on Sustaining Fisheries (NRC, 1999) and the Report to the US Congress on the Application of Ecosystem Principles to Fisheries (EPAP, 1999) are examples. Advocates often point to the failure of single-species stock assessments and management as a justification for applying an ecosystem approach.

An ecosystem approach seeks to take into consideration the complexity of the ecosystem, those communities of organisms in a specified environment depending on and interacting with this environment and with each other (Laevastu and Larkins, 1981), in which the target fish stock is found.

An ecosystem approach is generally characterised as one that takes account of (a) factors other than fishing on fishery resources, such as climate variability or pollution, (b) the effects of fishing on ecosystem goods and services in addition to fishery yield, and (c) the effects of fishing on other components of ecosystems through trophic interactions or habitat alterations (e.g., effects of mobile fishing gear on the benthos).

Theoretically it makes good sense to take account of predator-prey relationships and the myriad factors that might have an impact on the ecosystem and the implications of possible ecosystem responses to these impacts. We need to recognise that humankind is the most successful species on the planet such that it cannot be benign with respect to the rest of the biosphere, including the oceans. However, we also need to recognise that there are limits beyond which we risk the resilience of the ecosystem, 'the ability of a system to maintain its structure and patterns of behaviour in the face of disturbance' (Holling, 1986).

Unfortunately, there are no operational definitions of an ecosystem approach; thus it is hard to guide managers on how to apply the approach. For aquatic ecosystems, which are more complex than terrestrial ecosystems since fish hold different positions in the trophic web for each life stage (eggs and larvae are prey for fish species that they prey on as adults), it is hard to even judge the direction of interactions between species. The complexity of these systems and the paucity of knowledge about them make practical application of the approach difficult.

The Commission feels that actually applying the conservation measures identified through the use of less complex single-species models and reversing the tendency towards risk-prone decisions could make a substantial difference to effectiveness of the management effort. This is likely to be much more cost effective than the information-hungry, and therefore costly, ecosystem models that would be needed.

The Commission is supportive in principle of an ecosystem approach, but it should not be emphasised at the expense of fully applying models and fishery management methods that are operational now, but have not yet been used to their full potential to solve problems.

5.4. Marine Protected Areas

Marine protected areas (MPAs) are strongly advocated for multiple objectives, although these are not always stated. In general they are seen as a means of (a) conserving fishery resources, (b) protecting biodiversity and (c) maintaining naturalness. In some societies, cultural reasons are cited as the reason why some areas have been off-limits to fishing, areas which, in effect, are MPAs. MPAs can have some use in conserving fisheries resources and protecting biodiversity, but the fluxes of organisms and substances across their boundaries are an important factor determining their effectiveness.

With respect to conserving fishery resources, MPAs are not new. Fishery managers have used closed areas as a fishery management tool since the early history of fishing. MPAs can provide a useful hedge against stock collapse and can be an important part, along with effort reductions, of a rebuilding plan for severely overfished fishery resources such as those of the Georges Banks off the north-eastern USA. This plan seems to be working as fishing mortality has been reduced by a factor of two or more, and biomass is increasing.

Fishery scientists and fishery managers have long recognised that closing some areas to fishing was not an adequate form of conservation unless the areas closed were unrealistically large. It has been shown if a MPA, as the only conservation measure being used, is to achieve a conservation effect on a par with an optimally controlled fishery, it would need to be very large, possibly 70–80% of the entire fishing area (Hannesson 1998). This means that they would have to be much larger than the 20% level called for by MPA advocates if they are to be effective as the principal means of conserving fish stocks.

An advantage of MPAs is that they are probably more robust to uncertainty in stock assessments than some other forms of management, such as TACs, and should be easier to enforce. They may also be the only practical form of management for some fisheries in developing countries. MPAs seem particularly useful for some environments such as for coral reef systems.

MPAs will not end the race for the fish and, in the absence of controls that limit fishing capacity and effort, any economic benefit derived from them would be lost. They are a limited, but useful, multipurpose tool that is compatible with a rights-based approach to fisheries management, though not a substitute for it.

5.5. Artificial Reefs

An important controversy has surrounded the issue of construction of artificial reefs: do they contribute to resource rejuvenation or only to resource aggregation? It is difficult to give a clear answer to this question because there seems to be a lot of location-specific data to prove the point either way. If they merely serve as fish aggregating devices they could make fish more vulnerable to fishing in which case, unless they are set within an effective fishery management system, they may contribute to overfishing.

In the tropical waters of developing countries, many traditional fishing communities have had a long history of fishing over natural reefs and also of placing artificial fish habitats (AFHs) in the near-shore waters. Some governments have also promoted AFH construction in a big way. The evidence from the wide variety of initiatives taken by fishing communities, with or without the help of governments and other bodies, points unmistakably to the fact that AFHs are *not* a panacea for declining fish harvests. Except in unique circumstances, it is highly unlikely that artificial reefs can replace enough habitat or boost fish production sufficiently to negate overfishing.

However, it is also true that they serve a variety of purposes other than that of just being fish habitats. For example, in countries like Thailand and Malaysia, large AFHs have proved to be effective barriers to prevent bottom trawling in near-shore waters. In Kerala State, India they have become the rallying point for fishing communities to come together and undertake collective restoration of the damaged coastal seabed flora, while at the same time becoming a 'living pension fund' as a fishing ground for the elderly in the community who have been displaced by the modernisation of the artisanal fishing units.

In the totality of a fisheries development and management plan, AFHs have a role to play which must be recognised and tailored according to the specific local resource and community context. They cannot replace the need for a rights-based management system.

5.6. Enhancement and Aquaculture

5.6.1. Enhancement

Enhancement, including culture-based fisheries, is potentially very important as an alternative source of food and employment. Enhancement and ranching or restocking should be subordinate to, and driven by, the needs of ecologically sound fisheries management, in conjunction with social, economic and environmental objectives. There have been increasing moves to concentrate on the management of wild stocks through restocking or culture-based fisheries adopted as a supporting mechanism to augment depleted stocks, compensate for losses from hydroelectric projects or

degradation of habitat, and maintain and improve harvests in fresh and marine waters.

In many countries, there has been a long history of stock enhancement practices in inland water fisheries in traditional fishing communities. In some cases it has been conducted for hundreds of years and is still in practice. Earliest records come from China and Europe during the Middle Ages where fish were stocked into water bodies in which they grew without supplementary feeding. However, marine ranching as a modern concept has only been around for the last 100 years or so. Japan is currently regarded as the world leader in marine ranching activities and China takes the lead in inland water restocking, and others among the most advanced in this area are the USA, Canada, the UK, Ireland and Norway. So far, marine ranching has not had the same degree of emphasis and continuity in other countries, largely due to differing perceptions of success and viability.

It is imperative to establish the legal and institutional framework and a comprehensive regulatory regime for the management of enhancement activities, although many countries lack a dedicated framework. To ensure that enhancement satisfies the underlying objectives and makes a significant contribution to fishery production, it is also necessary to develop a rigorous planning process to accompany the development of an enhancement programme and a thorough management framework. A precautionary approach should be taken when exotic species are introduced, in relation to the impact on biodiversity and animal health management. And there is a need to strengthen research on the economic aspects of marine ranching operations.

5.6.2. Aquaculture

Aquaculture is the fastest growing food production sector. Since 1986, the sector has been expanding at a rate of about 10% a year. Aquaculture production increased from 12 million tonnes in 1984 to 39 million tonnes in 1998, the first-sale value being US\$54,000 million.

Aquaculture provides an increasingly significant share of total fisheries production. In 1998, over a quarter of the world's food fish products originated from farming activities. The aquaculture share of total fisheries production is predicted to increase further in the near term. Indicators pointing to good growth potential include good demand for fish, increasing recognition of the contribution of aquaculture to food security, employment and income generation, socio-economic development (especially in rural areas) and increased investment opportunities.

At a time when only slight increases in output from capture fisheries are expected, the global projection for future supplies from aquaculture based on a 5% annual growth rate is estimated at 47 million tonnes by the year 2010. There is recognition that, in the long run, aquaculture can play an

important role in bridging the gap between production and demand for fishery products and contribute to food security and rural development.

Sustainable aquaculture development can be optimised through, *inter alia*,

- focused human resource development and capacity building,
- dissemination and utilisation of appropriate technologies and efficient use of natural resources,
- better political recognition and effective institutional support,
- better provision of, and improved access to, technical information,
- ensuring minimal adverse environmental impact,
- greater recognition of the importance of the provisions of the FAO Code of Conduct for Responsible Fisheries (FAO, 1995b) for aquaculture development,
- improved regional co-operation.

Enhancement and aquaculture are areas of growth in fisheries that are leading to a substantial increase in total fisheries production and are an important supplement to the harvest available from capture fisheries. They are not, however, a substitute for developing effective management of capture fisheries. There are numerous concerns associated with these practices that need to be appropriately addressed and there is a need for management measures to be developed that will meet the particular characteristics of these growing areas of fisheries production. More extensive discussion of these concerns and their implications for effective management go beyond the remit of this report.

5.7. Community-based Management

There are many advocates for assigning rights and management responsibilities to communities. People will be more supportive of management measures that they have helped to develop and which they understand. This is more likely with community-level management than at higher organisational levels.

There are at least three aspects which need clear definition for community-based management to become a reality: the community must be clearly defined, its territory must be demarcated and a set of rights of the community over the territory has to be clearly spelt out and given social and/or legal sanction.

Facilitating a *community*-based approach to fisheries management hinges crucially around clear definition and demarcation of the concept of 'community'. This can be viewed at two levels: the core community and the outer community. Historically, in most fishing villages in developing countries there was considerable overlap between

these two levels. Consequently, in the surviving examples of traditional community-based management, a significant proportion of the adult (most often male) members in the village were, in the initial stages, involved as key participants in the formation of these systems. However, over time and space, the process of socio-economic differentiation in fishing communities has led to a context where a section of the community leave direct involvement in fish harvesting activities to enter other part-time occupations, and another section specialises in related activities of processing, marketing, and provision of equipment and credit. They tend to form the community elite. As the economic and social distance between those who fish and those who do not increases, the sense of 'community' diminishes. This is often the starting point for the breakdown of the passive and active elements of these traditional community-based fishery management systems.

Attempting to revive the values and elements of these erstwhile community-based management systems requires a redefining of the new 'core community'. In the present-day context this can include only those who are actually involved in fish harvesting for a livelihood. The role which the 'outer community'—the elite—will play needs to be separately defined according to the local context.

Attempting to create the values and elements necessary for a community-based fishery management system, particularly in a context where it has never existed, is obviously a difficult task, though not impossible. In the developing countries some form of aquarian reforms may become necessary to achieve this. These reforms must grant the right to ownership of fishing assets only to those who actually fish and the right of first sale of the fish to such a group of fish harvesters. Such measures are an important institutional underpinning for the move towards the creation of a community-based fishery management system.

The physical *territory* over which a local community will exercise management control must be clearly demarcated. It is advantageous if this territory is coterminous with the community's traditional realm of activity. By definition therefore, the territory is unlikely to be a large expanse of aquatic terrain.

If the community's control over its territory is to be exercised in a judicious and sustainable manner, then a structure of *rights* must be in place. These include

- the right of exclusion: that is, the right to limit access to the territory,
- the right to determine the amount and the nature of the use rights in the territory,
- the right to extract benefits from the use of the resources within the territory,
- the right to future returns from the use of the territory.

Community-based management has a crucial role in the effective management of fisheries resources in particular social circumstances. It remains essential to define, implement and enforce rights if management is to be effective in overcoming the problems faced by the fisheries concerned.

Communities usually do not have a sphere of influence large enough to exert management control over the range of a fish stock. Some higher organisational level of management is usually required in order to establish an overall conservation regime. Communities may not be cohesive enough to prevent a wasteful race for the fish among the members of the community. Thus, community-based management is not a panacea, but the Commission generally supports it in the context of delegating responsibility and obligations to the lowest organisational level that is practicable.

5.8. Co-management or Participatory Management

The term co-management has been used to define a wide variety of arrangements whereby fishing communities have some sort of involvement in management. Co-management ranges from *instructive* arrangements, where the state creates mechanisms for dialogue with users to inform them of government management decisions, to *informative* arrangements, where the user group informs government of its decisions and the role of the state is reduced (Sen and Nielsen, 1996). A large number of fisheries management arrangements could fall within the broad categorisation used above. The arrangement by which certain tasks, such as the allocation of fish quotas, have been delegated to so-called producer organisations in the EU is an example of co-management. The consultative process of the US Regional Fisheries Management Councils is another.

A co-management system should include in the management process user groups and others who have a stake in what happens to the resource, such as trade unions, those representing the public interest in relation to the resource, and natural and social scientists. The role that these groups might play depends on who they are and how they are represented (Jentoft and McCay, 1995; Lipton, 1985). Different management tasks may require the involvement of different interests. While some decisions could be taken at a local level, others may need to be taken at a national or even supranational level (Nielsen and Vedsmand, 1995).

This approach to management can be complex and time consuming, particularly when participants who do not like decisions try to undo them by using political influence or nuisance litigation. The particular arrangements for co-management will determine whether there is a positive payoff, establishing greater legitimacy for the management rules, and therefore improved compliance. Co-management, important though it may be as the social framework in which

management occurs, still requires that rights be clearly defined and other regulatory instruments used.

5.9. Eco-labelling

There is widespread and growing concern among the general public with regard to the practices employed in world fisheries. Some fish stocks have collapsed even when they were supposedly being managed with the best of intentions and with the aid of the most advanced fisheries science in the world. An example is the northern cod of Newfoundland. Furthermore, the public has increasingly been alerted to doubtful practices, such as the incidental killing of unwanted species and ghost fishing (by discarded fishing gear).

Against this background the question arises, how can the public concern regarding these issues could be translated into incentives for those who catch fish to improve their fishing methods and make them more sustainable and less harmful? A straightforward method for doing this is by way of labelling fish products so that unsustainable and environmentally harmful methods can be identified by the public which can then boycott products that do not satisfy the criteria of sustainability and acceptable environmental interference. This mechanism could simply make unsustainable and environmentally unacceptable practices unprofitable and thus might be the safest way to ensure that they come to a halt.

While this mechanism works well enough in theory, in reality it is fraught with dangers. There is no way that the concerned public can assemble and evaluate the information necessary to determine whether a particular fishing practice is sustainable or environmentally acceptable. For this purpose the general public has to rely on specialists who have the necessary training and experience to decide whether a given product is derived from fish caught in a way that meets the required criteria and hence gets labelled as 'ecologically safe'. Clearly, the outcome depends critically on the integrity of the institutions entrusted with making the necessary evaluation and issuing the required certificates. There is some reason for concern on this point, since deliberate misinformation and provision of partial and distorted information have become commonplace in the modern world. It is possible to envisage pressure for distorted information about fishing practices and fisheries management coming both from the industry itself and overzealous groups with their own agendas, not necessarily in the interest of marine resources and environment.

More important, perhaps, is the fact that the criteria for sustainable utilisation of fisheries resources are anything but clear. The major reason for this is the environmentally driven fluctuations of fish stocks, most importantly the ones on a relatively short time scale (months or years, depending on the turnover rate of biomass), but also longer ones on a decadal scale or even longer. This makes it undesirable or even impossible to always catch a fixed amount from a given

stock. Observing a fish stock going down, perhaps even rapidly, over a certain time frame is not sufficient evidence of unsustainable exploitation: it could just as well be the effect of temporarily adverse conditions in the environment. It is, or can be, exceedingly difficult to disentangle the effects of overexploitation from the effects of environmentally adverse changes. Furthermore, the evidence of what lies behind the depletion of a given fish stock may not be available until after the fact, and then it is too late to save the stock, whether by boycotting the products derived from it or otherwise.

It is thus possible to imagine two opposite scenarios of how eco-labelling might lead to undesirable outcomes. At one extreme the eco-labelling certification procedure would be overly cautious, condoning harmful and unsustainable practices. This would gradually erode the credibility of eco-labelling. At the other extreme it would be overzealous and crude, undermining or endangering the livelihood of those whose income is derived from acceptable and sustainable fishing practices.

The idea is difficult to make operational in an effective manner. The risk exists that the world market for fisheries products could become fragmented, with one world market made up primarily of developed nations, in which eco-labelled, higher-priced seafood was prevalent and another, made up mostly of developing nations, in which non-eco-labelled and lower-priced seafood was dominant. The operational difficulties of implementing the eco-labelling concept and the risk of different standards being applied could lead to consumer confusion, then consumer cynicism, followed by consumer rejection of the labels (Wessels, 1998).

Furthermore, eco-labelling or certification schemes have the potential to adversely affect trade flows. By their very nature, these schemes favour some products or processes (e.g., failing to achieve a seal of approval can give rise to non-tariff barriers). Such regimes should be discouraged. In the event that they proceed, they should be applied in a manner which is consistent with WTO rules. Voluntary or nongovernmental schemes should also comply with the spirit, if not the letter, of the Technical Barriers to Trade (TBT) Agreement (WTO, 1994b), including the Code of Good Practice for the Preparation, Adoption and Application of Standards.

5.10. Conclusion

Fisheries management is complex and there is a range of tools that can be used to achieve the objectives of effective fisheries management. Most of the above approaches could be counted among these tools but they should be seen as complements to and not as substitutes for the fundamental elements of effective fisheries management: that is, limited access and long-term access rights which provide incentives to avoid overinvestment in fishing fleets and overexploitation of resources.

6. Recommendations

6.1. Introduction

The Commission is convinced that clearly defined and enforceable rights are the foundation on which effective fisheries governance must be built. We address the difficult issues that arise in the transition process to rights-based management, the importance of sound and transparent scientific advice and the application of rights-based fisheries management both within national jurisdictions and on the high seas. We make recommendations on trade and subsidies because of their importance for fisheries worldwide. Finally, we recommend a summit meeting on the fisheries of the world to highlight the problems encountered, the importance of fisheries, particularly in the developing world, and the need to find solutions to these problems.

6.2. Sustainability and Rights-based Management

The central challenge to the management of capture fisheries lies in the growing pressure on fish stocks generated by continuously improving technology and the rising demand for fish. The productivity of nature is limited, and cannot easily be augmented. In the face of these pressures there is a tendency to risk-prone decision making. These problems are exacerbated in many developing countries by the existence of a surplus of labour, by fisheries often being an employer of last resort, and because alternative sources of nutrition and livelihood are scarce. In addition, lack of personnel and financial resources for fisheries management and research further constrain the capacity to meet the challenge of fisheries management.

Open-access regimes in fisheries result in destructive competition and are based on the long-outdated notion that fishing has a negligible impact on fish stocks. The historical erosion of pre-existing rights and their replacement by open-access regimes has occurred in many established fisheries.

The answer to the problem of limiting the catches of fish to the productive capacity of nature does not lie in rejecting positive technological innovation and forgoing the benefits it can bring; it lies in adopting management systems that deal with these pressures, maintaining their impact at a level commensurate with the resilience of the biological resources.

Recommendation 1. We recommend that

- open access should be eliminated by introducing explicit and secure access rights or recognising rights where these already exist. This process requires clearly

defining who holds the rights, what the precise limits of the rights are and how to enforce those rights, preferably with the full co-operation of the rights holders;

- management systems should be designed in such a way as to ensure that incentives are established that will eliminate overcapacity, limit investment in fishing effort and processing capacity to what would be commensurate with long-term optimal harvesting of fish stocks, and encourage the interest of the fishers in resource rebuilding and conservation. The system should include cost-effective enforcement;
- the benefits of the allocation process and better management should be distributed equitably;
- rights should be made transferable and divisible wherever social, economic and ecological conditions permit, to facilitate achieving maximum benefits for society.

6.3. The Transition Process

Globally, fisheries are in transition from open-access, poor-management regimes to more effective regimes based on access rights. This transition will bring clear gains to people involved in fisheries and to society as a whole; but it takes time to realise these gains.

Such change may involve losses of income for labour and capital and revenue losses for those whose fishing gear, boats and processing plants become redundant and catches forgone while fish stocks are being rebuilt. Transitional costs are incurred as a result of the elimination of overcapitalisation and the need to rebuild fish stocks, processes necessary in order to gain greater long-term benefits for the fishery and for society. There will be resistance to change unless the rights-based regime is perceived as equitable and there is confidence that the system will be fully implemented. If this resistance to a clearly beneficial change is to be overcome, it is essential to address the above issues.

Recommendation 2. Transitional plans should

- (i) include a programme to educate and raise awareness among stakeholders and politicians of the benefits to be gained as a result of change;
- (ii) establish a set of criteria for determining who will be included in the rights system;
- (iii) recognise and assess the costs and benefits of transition and their assignment in an equitable manner such that
 - the allocation of rights is done in such a way that monetary transition costs (e.g., elimination of overcapitalisation) are incurred in the long run by those that will benefit from the transition;
 - any tax income is used in the first instance to compensate those who would otherwise lose and cover other costs incurred in the transition process

and thereafter for defraying the costs of management and for the benefit of society as a whole;

- (iv) assess and control the potential impact of the change on the poorer and most vulnerable strata of the population;
- (v) recognise that the impact of transition may not be contained within the fisheries sector; and
- (vi) avoid delaying transitions, since delay may increase the cost, but should recognise that when there are insufficient alternative opportunities for labour and capital the transition can be slow and painful and needs to be carefully planned.

6.4. Informed Decision Making

Our understanding of aquatic species and ecosystems has advanced considerably in recent decades. However, it is inevitable that fishery managers will be required to make decisions in the face of a high degree of uncertainty. This uncertainty has two fundamental causes. Firstly, information about the status of fishery resources is uncertain because of statistical variability associated with the problem of sampling organisms over vast areas of ocean. Secondly, the complexity of marine ecosystems means that our understanding of the processes determining the future state of the system will always be very incomplete. Thus predictions, particularly when they apply to multiple components of ecosystems, are highly uncertain. In the past, the common response to uncertainty was reluctance to act to conserve and manage fisheries until problems became so severe that they could no longer be denied. This problem is exacerbated when the scientific information itself is controversial—that is, when it lacks credibility with those impacted by it and/or the decision makers that use it.

Recommendation 3. We recommend

- (i) investing in scientific monitoring and research to reduce uncertainty by
 - establishing effective systems for routine monitoring and reporting fishery-dependent data (e.g., catch, effort, discards, size and age composition);
 - conducting fishery-independent resource surveys and ecosystem monitoring;
 - conducting research aimed at understanding the ecosystem effects of fishing and at the early detection of adverse effects, including a better discrimination between natural and man-induced changes;
 - determining the effects of habitat degradation on productivity of fishery resources;
 - designing and implementing research programmes to fill the gap between the level of scientific knowledge available in developed and developing countries;
 - studying socio-economic aspects of fisheries, an area still largely ignored, yet a major source of uncertainty and risk.

- (ii) increasing confidence in scientific information by
 - ensuring safeguards so that the institutions providing scientific advice for fisheries management can do so independently of nonscientific influences, yet remain relevant and responsive to management needs;
 - increasing transparency of scientific procedures, findings and advice to the public and extending the involvement of stakeholders and users in the formulation and provision of that advice;
 - adopting professional codes of conduct and standards, drawn up by the international scientific community, in the provision of scientific findings and advice to enable users to be assured of its quality;
 - adopting peer review procedures for advice and the process by which the latter is derived, underpinning policy that recognises a right of those with relevant expertise to engage in the process;
- (iii) applying the precautionary approach in the face of uncertainty, at every step of the management process, by
 - recognising that negative changes in fisheries systems may take many years to reverse, that changes may be difficult to control, that the dynamics of the change are often not well understood and that they are subject to natural environmental variation. Thus the exercise of caution is needed without overreaction;
 - exercising prudent foresight to limit the probability of undesirable outcomes to acceptable levels;
 - agreeing in advance to the actions that will be taken in response to evidence of undesirable outcomes.

Guidelines on the Precautionary Approach to Capture Fisheries and Species Introduction (FAO, 1995a) provides useful guidance on how the precautionary approach can be put into practice.

6.5. Governance within National Jurisdiction

Our central recommendation, that rights-based fisheries management systems be established, should be adopted by governments within national jurisdictions.

Good governance systems are characterised by an appropriate and transparent division of tasks between stakeholders and governments. ‘Good practice’ must feature a system of incentives which encourages decisions by fishers that fully account for the consequences of their actions on the long-term productivity of the fish stocks. For their successful implementation, rights-based systems require national-level debates and an understanding of the objectives by all stakeholders including key national officials in the central finance and policy ministries. Governance within national jurisdictions must be congruent with relevant international and regional governance regimes and should involve devolution of functions and responsibilities to appropriate

subnational levels. 'Best practice' principles must be adopted for the many elements of rights-based systems to be effective.

National and subnational governments are traditionally responsible for the public good aspects of fisheries management, such as the general health of marine ecosystems and the oversight of nonconsumptive and other uses of all marine living resources, including marine mammals (e.g., tourism, recreational fishing). Governments must also safeguard future productivity of the resource by controlling fishing effort, and by monitoring and enforcing the management arrangements. Within this framework, fishers should be given incentives to maximise net benefits, including nonmonetary benefits, avoid the damaging side effects of fishing and preserve the long-term productivity of resources.

Recommendation 4. We recommend that clearly defined and enforceable fishing rights that provide incentives to reduce costs and increase efficiency should be introduced. The precise form of the rights of access will depend on the particular circumstances of the fishery and should be particularly conditioned to the types of social circumstances in which the fishery exists and the social objectives for its management.

A rights-based system should have the following features:

- (i) An enforceable system of exclusion of non-rights-holders;
 - (ii) A management authority that can assign rights, manage information and financing, ensure that resource-related research is undertaken to provide a scientific basis for management decisions, provide for stakeholder participation in management decisions, co-ordinate rights holders' activities, ensure the resource's sustainable usage and guarantee the interests of rights holders in a manner consistent with public policy. Management authority functions may be vested in intergovernmental organisations, national government, subnational government, rights-holder and community or stakeholder representative bodies;
 - (iii) The rights holder can be an individual (natural or legal person), community, collective, or nominated representatives of a group. In many parts of the world it will be appropriate to vest these rights in the local community of which the active fish harvesters and fishworkers are members. This community then takes responsibility for further allocation and monitoring of the use of the resource. In such fisheries, peer monitoring may be important in the monitoring and control of the fishery. This is particularly true of many developing countries where most of the world's fishers work;
 - (iv) The rights-based system must develop efficient and effective rights allocation, registration, transfer, amendment, revocation, monitoring and enforcement mechanisms. The initial implementation of a rights-based system will require an explicit transition arrangement.
- (v) Initial allocations of rights should be designed to compensate those who do not obtain access or catch rights and should treat labour and capital equitably. For example, innovative mechanisms may be created to compensate those who do not obtain rights or whose assignment of rights is below a minimum threshold. International development banks should provide leadership in financing compensation in developing countries if such assistance is requested, with loan repayments to be derived from additional value created by the rights-based resource management system;
 - (vi) To increase efficiency, rights should be transferable. Transferability, however, may lead to outcomes such as the concentration of rights. Such problems should not be dealt with by general restrictions on transferability but by measures that address concentration directly, such as a cap on quota holdings by any one firm in a quota management system;
 - (vii) Allocated rights should be long-term, preferably of indefinite duration. However, mechanisms may be needed to accommodate technical innovation, especially where the right relates to inputs of fishing effort, and should be specified in the initial grant of rights to individuals or other entities. The management authority must have the power to amend the conditions of allocated rights to maintain the sustainability of a fishery, for, including in the formulation, review and audit of policy, in the design of the management system in which rights-based access and the precautionary example in the event of a stock collapse;
 - (viii) Clearly defined fishing rights, even when nontransferable, can help reduce overcapacity and costs and increase product value by ending or reducing the competition to catch fish. Care should be taken to avoid excess fleet capacity being transferred to a place where it might create or exacerbate an overcapacity problem;
 - (ix) National governance systems should be established that ensure appropriate participation of stakeholders in decision making and the implementation of the management system, which should include the establishment of effective monitoring and enforcement regimes;
 - (x) Clear official policies should be developed and appropriate legislation consistent with those policies be adopted in order to facilitate the implementation of a rights-based management system. The management system should minimise the possibility of political interference in its operations and include checks and balances to prevent corrupt practices.

Countries with good fisheries management capacity should assist those that do not have adequate management capacity to establish the necessary competent authorities. To implement the above features, most countries will need to upgrade their capacity for fisheries management.

6.6. International Governance of Fisheries

The absence of clear jurisdiction over fishing outside the 200 nautical miles exclusive economic or fisheries zone threatens the effective management of stocks that straddle periodically outside 200 nautical miles, as well as those that migrate widely on the high seas. Some 20% of the marine catch globally is affected by the efficacy or otherwise of the regime governing straddling stocks (14.3% of total marine catch in 1994) and highly migratory species (5.4% in 1994).

It should also be noted that there are high-seas fish stocks that are neither highly migratory nor straddling (e.g., orange roughly on the Mid-Atlantic Ridge) and which remain, inevitably, under conditions of open access without the possibility of management. This problem is minor in economic terms, inasmuch as it pertains to only a very small percentage of the total global marine catch, and when compared with the far more pressing issues of adequate management of fisheries resources within the jurisdiction of states, either at a national or regional level. It may not be considered minor, however, from a biodiversity perspective. Unless this problem is addressed, the fate of these stocks is no different to that of any others that lack adequate management, and the hopes for sustainable management are practically nil.

The way by which nations have chosen to deal with the problem of straddling and highly migratory stocks is through the establishment of regional fisheries management organisations (RFMOs) in terms of the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN, 1995).

The effectiveness of this agreement, which is dependent on enforcement through the state whose flag the vessel is flying, has still to be tested. The Commission believes that this agreement does not adequately deal with the major problems that need to be resolved. The agreement is inadequate because it does not address the problem of fish stocks that are neither highly migratory nor straddling, because it does not adequately deal with the problem of restricting access and because it does not make provision for the enforcement necessary to protect the rights that have been established, except in the event of all fishing states ratifying or acceding to the agreement. The agreement needs to be strengthened in order to deal with these weaknesses.

Member states of the FAO agreed to an international Code of Conduct for Responsible Fishing in 1995, in order to advance effective management measures. The efficacy of the measures recommended in the code is dependent on the extent to which the code becomes the basis for accepted practice.

Recommendation 5. The Commission recommends

- (i) that all states ratify or accede to the UN 1995 agreement (for implementation of LOSC 1982) in order to make its provisions universally applicable, thus enabling a RFMO to exclude a nonmember from the fisheries over which it has authority;
- (ii) that the agreement's application should be extended to stocks that are neither highly migratory nor straddling and that new RFMOs must be negotiated to cover stocks found around high seas sea mounts and oceanic ridges;
- (iii) that the agreement be strengthened to include provisions for binding arbitration in cases of dispute and for appropriate sanctions in cases of violation of the agreement (e.g., trade restrictions);
- (iv) that equity criteria or market-based methods for allocating fishing opportunities should be established that prevent competition for the limited available catch;
- (v) that all fishing states should fully support and abide by the provisions of the Code of Conduct for Responsible Fishing.

6.7. Trade and Subsidies

Subsidies are granted for the purpose of achieving specific development objectives or enhancing the incomes or other benefits for certain targeted groups. When subsidies are tied to certain types of activity they are likely to have a harmful effect on economic efficiency and conservation. Subsidies to farming typically cause overproduction of agricultural products. In fisheries that are not effectively managed to control capacity, subsidies cause excessive fishing effort to develop, which encourages overfishing and may result in stock depletion and falling catches of fish over time. While recognising the legitimacy of supporting disadvantaged groups, such support should be designed in a way that minimises the detrimental effects on efficiency. It is recognised that this may be difficult in some developing countries, particularly in small-scale fisheries.

When rights are not clearly defined and enforceable, subsidy will tend to allow greater inefficiency, rather than raise incomes. The negative effects of subsidies arise essentially as a result of rights to the resource not being clearly defined and enforced.

Trade liberalisation has the capacity to increase global prosperity in the fisheries sector, provided that an appropriate fisheries management system is in place. Trade liberalisation without some degree of social control, however, particularly with inadequate management of renewable aquatic resources, may have harmful effects for certain groups, including vulnerable fishing communities in some cases. In such instances some compensatory mechanism is needed to ensure that all groups share in the increased prosperity. Again, it is recognised that this may be more difficult in some developing countries than elsewhere.

Recommendation 6. We recommend that

- as a general rule, subsidies that cause harm to fisheries resources should be identified and phased out. Those subsidies that cause the greatest harm should be phased out first;
- subsidies that feature in income support, and community and regional development programmes, should be recognised as an integral part of a developing country's public policy as it applies to the fisheries sector. Such subsidies should be designed to minimise damage to fisheries resources and their supporting ecosystems. The WTO Agreement on Subsidies and Countervailing Measures (1994) should be interpreted according to these conditions;
- governments should implement measures that make unbudgeted and indirect subsidies more transparent so that they may be properly evaluated;
- WTO negotiations and dispute settlement processes should not undermine international law as it applies to fisheries management. Articles XX(b) and (g) of the GATT (1947) and the WTO Agreement on Technical Barriers to Trade (1994) should be interpreted accordingly.

6.8. A Global Summit on Fisheries

The Commission believes that the benefits and problems associated with fisheries are adequately documented, and that there is broad acceptance within the scientific community of the causes of the problems. Yet, policy makers and the people that depend on fisheries do not share this knowledge to the degree that is necessary to solve them. There is also a wide array of stakeholders (e.g., consumers, environmentalists) that needs to be better informed, and included in the formulation of solutions. Even if a common understanding of problems

and solutions is arrived at, to realise the potential benefits of well managed fisheries will require a substantial commitment of energy and resources on a global scale.

Recommendation 7. The Commission calls for a global summit on *fisheries and the people that depend on them* to forge a global action plan, to be implemented by a partnership of governments, international donor organisations (e.g., the World Bank), NGOs and the fishing industry, in order to reshape the governance of fisheries in a manner consistent with the recommendations above. The summit should

- summarise information on the status of fisheries and the ecosystems in which fisheries are embedded;
- address the situation of the people that depend on fisheries and the potential for improving their wellbeing;
- promote a common understanding of the essential elements of governance, while exploring the full array of governance systems that are necessary to be successful in the context of diverse local conditions. This is especially necessary for developing countries where traditional governance systems have often been dismantled, without being replaced by systems that can function in today's reality;
- marshal commitment to improve fishery management and
- mobilise resources to help developing countries, where people are most critically dependent on fisheries, to establish governance systems tailored to local situations, in order to assure sustainability of fisheries and improve the wellbeing of the people that depend on fisheries.

The opportunities that will result from such a summit, and the risk to survival of millions of people dependent on fisheries, are too great to delay action.

Appendix A: International Law Governing Fisheries

This brief text presents the main elements of international law governing fisheries. The 1982 UN Convention on the Law of the Sea (LOS) is a comprehensive treaty forming the most important body of international law governing fisheries. The 1995 Agreement on Straddling and Highly Migratory Fish Stocks (this unofficial abbreviated title is used for brevity) is an extension of the provisions of the LOS. A range of other multilateral and bilateral agreements also form part of the body of law governing fisheries internationally.

A.1. The Convention on the Law of the Sea

The LOS was agreed and opened for signature on the 10th December 1982 at the end of the Third UN Conference on the Law of the Sea. There are now 132 states that have ratified or acceded to the convention. It came into force on the 16th November 1994, a year after the deposit of the 60th instrument of ratification or succession. The LOS, in part reflecting the body of customary law that it codifies, represents a major step forward for governance of the global fisheries sector. It created the possibility of individual coastal states exercising control over their marine fisheries resources that was not possible before.

The territorial sea forms part of a state's territory (Art. 2) subject only to the right of innocent passage for foreign vessels (Arts. 17–32). Thus, a state enjoys exclusive access to fish stocks found within its territorial sea (Churchill and Lowe, 1992). Every coastal state has a right to establish a territorial sea not exceeding 12 nautical miles (Art. 3). The major significant innovation in ocean governance during the second half of the twentieth century has been the proclamation of exclusive economic zones (EEZs) by a large number of coastal states. The establishment of these zones has been the most fundamental change in the global fisheries regime since the doctrine of the 'freedom of the high seas' was established in international law in the seventeenth century.

An EEZ 'is an area beyond and adjacent to the territorial sea' (Art. 55) which 'shall not extend beyond 200 nautical miles from the baseline from which the breadth of the territorial sea is measured' (Art. 57). Within this zone the coastal state has 'sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or nonliving' (Art. 56).

Some states declared 200 nautical mile exclusive fisheries zones (EFZs) in the 1970s before the conclusion of the LOS (so as not to prejudice their negotiating positions in relation to some LOS provisions on EEZs being negotiated at the Third UN Conference on the Law of the Sea). Some of these later retained EFZs because, between the EFZ and the continental shelf provisions of the LOS, they have jurisdiction sufficiently close to that which they would have if they proclaimed an EEZ. The right to an EFZ is consistent with the provisions of the EEZ regime.

Rights to 'explore and exploit' (Art. 77(1)) sedentary species are provided for in the continental shelf provisions of the LOS (Arts. 76–85). Sedentary species are 'organisms which, at the harvestable stage, either are immobile on or under the sea-bed or are unable to move except in constant physical contact with the sea-bed or the subsoil' (Art. 77(4)). The continental shelf provisions of the LOS extend to 'the outer edge of the continental margin' (Art. 76(1) (this is defined in Art. 76(3) as consisting of the shelf, the slope and the rise and does not include the deep ocean floor with its oceanic ridges) or to 200 nautical miles from the baselines from which the breadth of the territorial sea is measured if the outer edge of the continental margin does not extend that distance.

The LOS establishes rights and duties for coastal states in both the conservation and utilisation of marine fisheries resources. Article 61 of the LOS permits the coastal state to determine the TAC for each species within its EEZ (Art. 61(1)) on the basis of the best scientific evidence available to it (Art. 61(2)). Coastal states have a duty to maintain and restore stocks (Art. 61(3)) and must take into consideration the interdependence of species within an ecosystem (Art. 61(4)). Available scientific information and other data relevant to the conservation of fish stocks should be contributed and exchanged between states through competent international organisations (Art. 61(5)).

Where the same stocks or stocks of associated species occur within the EEZ of more than one state (transboundary stocks), 'these States shall seek...to agree upon the measures necessary to coordinate and ensure the conservation and development of such stocks' (Art. 63(1)). Similarly, where such stocks occur both within the EEZ and 'in an area beyond and adjacent to the zone' (straddling stocks), the coastal state and the states fishing for such stocks in the adjacent area 'shall seek...to agree upon the measures necessary for the

conservation of these stocks in the adjacent area' (Art. 63(2)). Co-operative arrangements for the management of straddling stocks have not worked well, primarily because of the absence of jurisdiction, which can be exercised on the high seas only through the flag state of the vessels involved. The coastal state thus does not have complete jurisdiction over a straddling stock that it is attempting to manage within its own EEZ. Further rules relating to straddling stocks and highly migratory species were agreed at the UN Conference on Straddling Stocks and Highly Migratory Species (see below).

There are particular provisions in the LOSC relating to highly migratory species. The coastal state and other states which harvest highly migratory species listed in Annex 1 of the LOSC 'shall co-operate...with a view to ensuring conservation and promoting the objective of optimum utilisation...both within and beyond the EEZ' (Art. 64).

There are also particular provisions which apply to anadromous, catadromous, sedentary and highly migratory species and to marine mammals. In the case of anadromous species, the state in whose rivers such fish spawn is primarily responsible for their management. In the case of catadromous species, the state in whose waters the species spends the greater part of its life cycle has overall management responsibility (Art. 67). Sedentary species are considered to be part of the resource of the continental shelf (Art. 68). Marine mammals are not subject to the provisions of optimal utilisation (Art. 65) discussed below.

A coastal state must promote the optimum utilisation of its fisheries resources within its EEZ without prejudice to conservation (Art. 62). It must determine its capacity to harvest its TAC and grant access to other states to that part of its TAC which it is not able to harvest (Art. 62(2)). In allowing access to such a surplus, a coastal state must particularly take into account developing, landlocked and geographically disadvantaged states and must consider the position of states whose nationals have 'habitually' fished within its EEZ (Arts. 62(3), 69–72). The coastal state has the right to determine the conditions under which foreign vessels are allowed access to the surplus of the TAC and has full regulatory powers (Art. 62(4)) within its EEZ.

In the exercise of its sovereign rights over the living resources of its EEZ, a coastal state may 'take such measures, including boarding, inspection, arrest and judicial proceedings, as may be necessary to ensure compliance with the laws and regulations adopted by it in conformity with this Convention' (Art. 73(1)). Arrested foreign vessels and their crews must be released upon the payment of 'a reasonable bond or other security' (Art. 73(2)). Penalties imposed for violations of fisheries regulations and laws may in general not include imprisonment (Art. 73(3)).

While this legal framework provides the coastal state with the opportunity to exercise far greater control over the fisheries resources off its coast, it is up to the coastal state to decide

whether and how it will limit fishing within its territorial sea and EEZ. The jurisdiction of a coastal state over its waters does no more than provide the coastal state with the opportunity to exercise control over its fisheries resources. In addition, the coastal state must establish rules and institutions that limit access to the resource in an efficient and effective manner.

However, this jurisdiction is often not sufficient to make it possible for a coastal state to exercise effective management because, in addition to the straddling stock problem discussed above, a fish stock may be found in the waters of more than one state (transboundary stocks), necessitating co-operation in the management of the stock between the relevant neighbouring coastal states. This causes particular problems when the coastal states involved are not equally committed to good management of the stocks involved.

Fishing on the high seas is undertaken on the basis of open access to all, except for the restrictions arising out of the rules for particular species (Arts. 87 and 116) and for sedentary species in instances where the continental shelf extends beyond the 200 nautical mile EEZ (Art. 77). In addition, the LOSC lays down a general duty on states to co-operate in the management and conservation of high-seas fishery resources (Arts. 117–20). The Agreement on Straddling and Highly Migratory Fish Stocks strengthens these provisions, which had proved ineffectual in preventing damaging fishing practices on the high seas.

A.2. Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN, 1995)

This agreement was adopted on 4th August 1995 by the UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. In accordance with its Article 37, the agreement was opened for signature from 4th December 1995 until 4th December 1996. Entry into force of the agreement requires 30 ratifications or accessions. There were 59 signatories and 26 ratifications or accessions by 25th April 2000. In accordance with its Article 40, the agreement will enter into force 30 days after the date of deposit of the 30th instrument of ratification or accession.

The agreement is a 40-page document containing 50 articles and two annexes. It seeks to address a weakness existing in the LOSC relating to these stocks. The term 'straddling stocks' is not explicitly used in the LOSC but it refers to '...where the same stock or stocks of associated species occur both within the exclusive economic zone and in an area

beyond and adjacent to the zone' (Art. 63(2)). The LOSC provisions relating to the conservation and management of the living resources of the high seas are contained, *inter alia*, in Part VII, Section 2, Articles 116–20 and in Articles 63 and 64. Annex I of the LOSC lists 17 highly migratory species to which the provisions apply. These articles of the LOSC declare a right for the nationals of all states to fish on the high seas but establish a general obligation on all states to co-operate in the conservation and management of the living resource of the high seas. All states, either individually or in co-operation with other states, have a duty to ensure that their nationals comply with conservation measures (Art. 117). States whose nationals exploit identical living resources or different living resources in the same area have an obligation to enter into negotiations on necessary measures for conservation of the living resources concerned (Art. 118). These articles go no further than place an undefined obligation on states utilising these stocks to coordinate and co-operate in their conservation and management. This weakness arises from the lack of jurisdiction on the high seas except through the jurisdiction of a state over ships flying its flag.

The catch from the high seas is about 10% of the total catch but has been rising due to the relative lack of regulation and enforcement (FAO, 1992). In essence, open access still prevails. There has been increasing conflict between coastal states and distant-water fleets, the most prominently reported in recent years being between Canada and the EU (Spain) in the northwest Atlantic which culminated in the controversial arrest by Canada of the Spanish vessel, the *Estai*, on the high seas in 1995 (Smith, 1995).

The agreement provides for the establishment of regional or subregional fisheries management organisations (RFMOs) (Part III). States with a 'real interest in the fisheries concerned may become members of such organisations' (Art. 8(3)) and only states which agree to apply the management measures can have access to the fisheries (Art. 8(4)). They need not be members of the organisation. A state which does not agree to apply the management measures '...is not discharged from the obligation to co-operate, in accordance with the Convention and this Agreement, in the conservation and management' of the relevant fish stocks (Art. 17(1)).

The agreement sets out comprehensive areas in which such a management organisation will have competence covering scientific research, stock assessment, monitoring, surveillance, control and enforcement (Art. 10). The organisation can limit participation by new entrants according to a set of criteria listed in Article 11, although Article 17(4) leaves it unclear what effective measures can be taken in the event of noncompliance by appropriators not party to the agreement.

Compliance with the agreement builds on flag state jurisdiction contained in LOSC Articles 90–98. A state may authorise a vessel flying its flag to fish on the high seas only

where it is able to exercise effectively its responsibilities of enforcement under the agreement (Art. 18(2)). However, provision is made for the flag state to permit access by inspectors from other states (Art. 18(3)(g)(i)) and the use of onboard observers from other states (Art. 18(3)(g)(ii)).

Vessels used for inspection and enforcement must be clearly marked and identifiable as being on government service (Art. 21(4)). Article 21 further provides for inspectors from a member state of a regional organisation established under the agreement to board and inspect any vessel of another state party to the agreement. The flag state must take action against a vessel reported to have committed a serious violation, detailed in Article 21(11). Failure to do so gives the inspecting state the right to take action and the procedures for doing so are detailed in Article 22.

Finally, the agreement requires that the precautionary approach be widely applied in managing stocks under this agreement (Art. 6).

In the case of straddling stocks and, at times, highly migratory stocks, sovereign rights of the coastal state apply to a portion of a stock and part of its range, and freedom of access to another portion of the stock and another part of its range. This may be to a greater or lesser proportion of the stock as it migrates backwards and forwards. It is widely accepted that for management to be effective, regulations must apply to an entire stock and to the whole of its range.

The possibility of this agreement being effective is dependent on states with marine fisheries ratifying or acceding to it. Only in this way will a RFMO be able to exclude any vessel not complying with the agreed management arrangements from the fisheries. So far, only 26 states have done so (<http://www.un.org/Depts/los/los164st.htm>, 25th April 2000). The agreement was the outcome of compromise between coastal states, which have an interest in controlling the harvesting of straddling stocks off their coasts, and states with distant-water fleets, wishing to retain free and open access to those fish stocks. Without universal support for the agreement, it is not possible for a RFMO to create clearly defined property rights and, consequently, sufficiently promote conservation, because it is not able to exclude from access to the stocks it manages vessels from states that are not party to the agreement.

As a stock improves, there would be increased interest on the part of vessels from states not included in the RFMO. Allocating a right to these vessels means reducing the proportional share of the catch of the fishing interests already involved in the fishery. By making the fishing opportunities in such a fisheries tradable, this particular problem could be overcome as the new entrant would have the opportunity to buy fishing opportunities from those already in the fishery (Pena-Torres, 1999). However, it remains the case that there is no legal provision compelling a vessel flying the flag of a state which is neither a member of the RFMO nor a party to

the agreement to comply with the management provisions of the RFMO.

A.3. Code of Conduct for Responsible Fishing (1995) and the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (1993)

The Code of Conduct for Responsible Fishing was adopted by the 28th Session of the FAO Conference on the 31st October 1995. The 27th Session of the Conference had two years earlier (24th November 1993) adopted the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Res. 15/93) which declared that it 'will form an integral part of the International Code of Conduct for Responsible Fishing'.

The code *inter alia* spells out flag state responsibilities for the activities of fishing vessels flying its flag and seeks to

advance management measures, by agreement among states, that improve the optimal and sustainable use of fisheries resources. The compliance agreement similarly builds on flag state responsibility for fishing vessels flying its flag (Art. III) and operating on the high seas.

These agreements amount to an international consensus developing on the basic rules between states over how to make the management of fisheries, both within national jurisdiction and on the high seas, more effective. It emphasises the extent to which an evolving, dynamic global set of rules governing global fisheries has emerged with which national fisheries management must be consistent.

A.4. Other Instruments

A range of other global and regional treaties exist which, in some cases, have a direct bearing on the governance of the fisheries sector (e.g., the 1982 Convention on the Conservation of Antarctic Marine Living Resources) while others, such as the 1972 World Heritage Convention and the 1992 Biological Diversity Convention, have more of an indirect influence.

Appendix B: Economic Optimum of Fishing and Fleet Capacity

B.1. Generation of Rent

A difficulty with the standard Schaefer model (Shaefer, 1954) of a fishery is that the biological characteristics of each fish stock can differ considerably and that the growth of fish stocks is much more complicated than is assumed in the model. The Schaefer model has the advantage, however, that it allows one to represent the limited productivity of the environment in a simple and mathematically easily tractable manner.

A general biological difference between many fish stocks is the degree to which the stock will spread over a specific geographic area in response to depletion or whether the stock will aggregate, thus being found at the same density but over a smaller geographic area as the stock diminishes. In that case the catch per unit of effort (CPUE) no longer correctly reflects the size of the exploited stock, and is in fact constant if the area occupied by a stock shrinks in proportion to its size. Some fish stocks tend to remain uniformly spread over a particular geographic area so that, if the stock diminishes in size, the stock becomes less dense and a unit of fishing effort will harvest a proportionately smaller catch. On the other hand, pelagic stocks tend to maintain the same dense

aggregations as the stock diminishes in size so that there tends not to be a reduction in the CPUE. These behaviours have considerable implications for the management of the stocks and the way in which we understand the response of the stocks to fishing.

Consider what may happen in an open-access fishery. Each fisher will seek to maximise his or her own profit. If a fisher decides to leave some fish unharvested today in order that they will be available tomorrow, he or she has no guarantee that someone else would not take them in the meantime. In common with the open-access use of other common pool resources, the social costs of fishing are not all borne by the fisher and consequently there is a tendency towards overfishing. However, if a fish stock is to be harvested sustainably in the long term then the quantity of fish caught cannot exceed the surplus growth.

In Figure B-1, the relationship between sustained fishing effort and sustainable yield is shown for a fish stock where CPUE is proportional to the size of the fish stock. The figure shows surplus growth (G) as a function of stock size (S) and straight lines illustrate that catch is a constant proportion of stock size for a given level of effort. If one increases effort

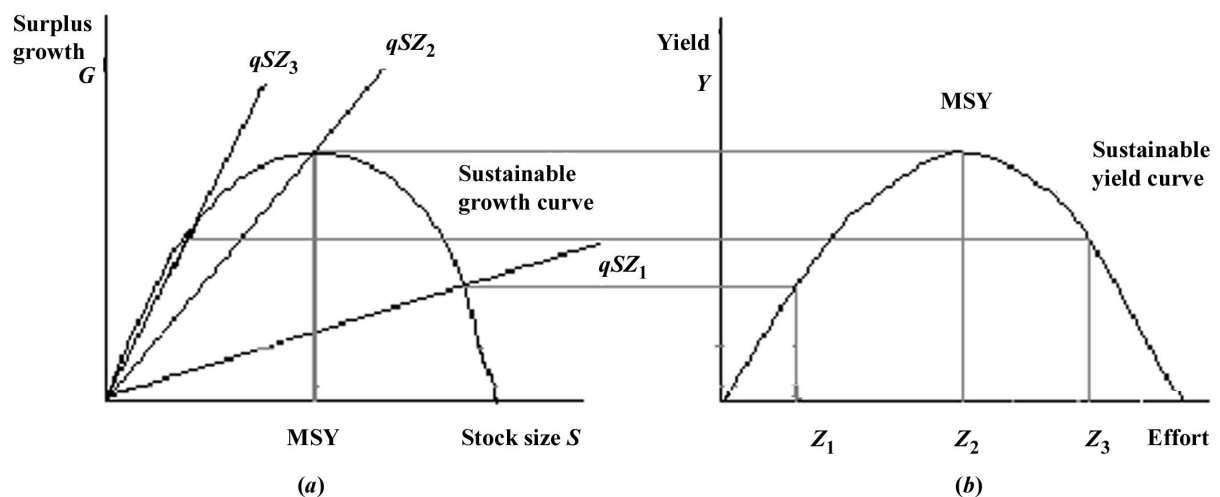


Figure B-1: (a) The relationship between surplus growth (G) and stock size (S). The straight lines, qSZ , represent catch at a constant level of effort (Z_1 , Z_2 etc.) for any stock size. (b) The sustainable yield (Y) as a function of effort derived from the equality between surplus growth (G) and catch (qSZ).
(Adapted from Hannesson (1993, p. 24) and Anderson (1977, p. 21).)

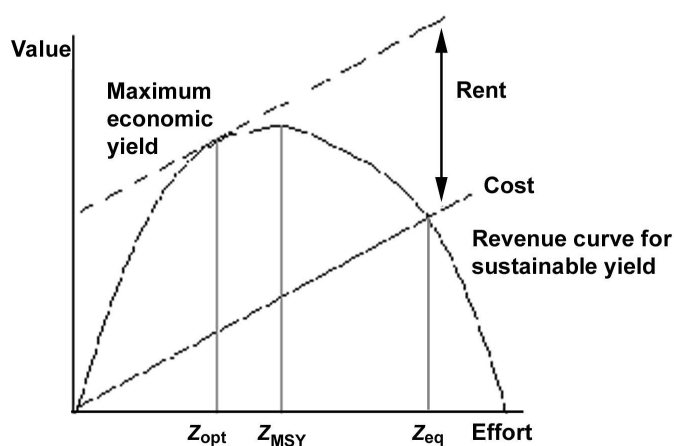


Figure B-2: The relationship between effort in open access (Z_{eq}), optimum effort (Z_{opt}) and that which would produce a maximum sustainable yield (Z_{MSY}). (Adapted from Hannesson (1993, p. 24).)

from, say, Z_1 to Z_2 , the catch would increase for any given level of stock. In this simple model it is assumed that the rate of growth of the catch depends only on the size of the stock at any given level of effort. At each level of yield or catch, one can associate a wide range of levels of effort. However, only one point on each catch function is associated with a sustainable yield. At a particular catch the sustainable yield reaches a maximum, the maximum sustainable yield (MSY), and this is associated with a particular level of effort (Z_2 in Figure B-1). We can thus produce the sustainable yield curve as shown in Figure B-1(b).

If constant prices are assumed and each point on the sustainable yield curve is multiplied by a constant price, it is possible to produce a sustainable revenue curve with the same general shape as the sustainable yield curve (Figure B-2). A constant price for effort is also assumed so that cost increases proportionately to effort. Thus the straight lines denoting

effort in Figure B-1 become cost curves in Figure B-2. The rent associated with a sustainable yield is maximised at the point where the cost line and the total revenue curve are furthest apart. Note that this optimum level of effort (Z_{opt}) is lower than needed to take the biologically determined MSY (Z_{MSY}), and considerably lower than the equilibrium associated with an open-access level of effort (Z_{eq}), where total cost equals total revenue and all resource rent tends to be dissipated.

A similar exercise may be undertaken in the case when the fish stock tends to aggregate as densely after fishing has occurred as before, a reasonable approximation for the behaviour of many pelagic species. In other words, yield per unit of effort is independent of stock size and does not fall as the size of the stock is reduced. This is represented in Figure B-3. The size of the catch is solely dependent on effort. Because the catch is independent of stock size, the lines showing the catch taken by given levels of effort are horizontal. The sustainable yield curve that results is shown in Figure B-3(b). It is a straight line if the CPUE is always the same. However, it will rise at a decreasing rate up to its maximum if the CPUE decreases as more effort is applied, as is shown by the broken curve.

The total revenue and cost curves derived in this way show that the maximum rent is obtained at the level of effort needed to harvest the MSY (see Figure B-4). In these circumstances a fisher will always make some profit so that under open-access conditions there is nothing that will prevent the fishery from expanding to the point where the stock is wiped out.

These deterministic models are based on an assumption that a reliable level of predictability is possible. They may be static models, where no discounting of rents takes place, or dynamic models where there is discounting of future rents. Further modelling has attempted to deal with questions of

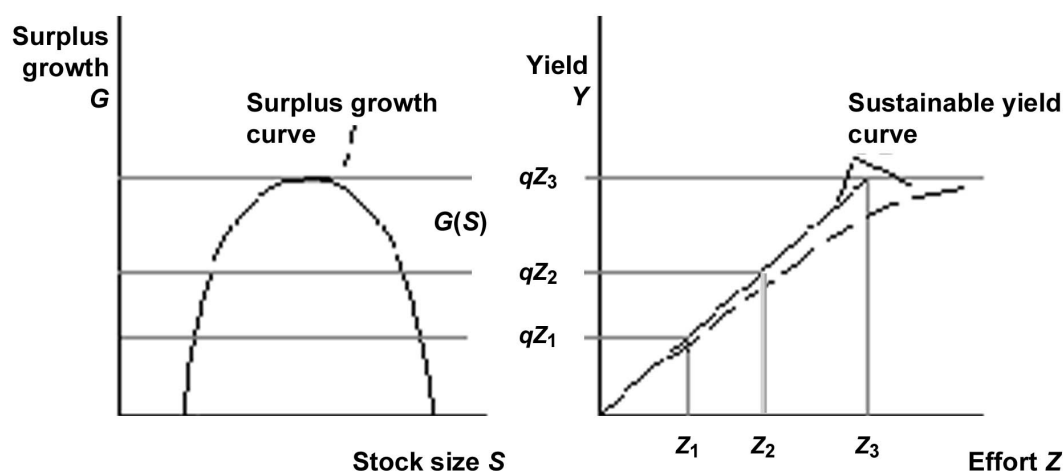


Figure B-3: As figure B-1. The sustainable yield as a function of effort when the CPUE is independent of stock size. The broken curve shows sustainable yield when the CPUE decreases as the effort increases. (Adapted from Hannesson (1993, p. 23).)

uncertainty in fisheries where it is argued that many variables in the growth of a fishery are, for practical purposes, unpredictable due to the dearth of knowledge of them and the complexity of the functioning of the marine environment.

Random fluctuations in the environmental variables that influence growth introduce some new problems. In particular, the choice of fishing capacity is no longer synonymous with choosing the optimal fishing effort. The optimal fishing capacity for a stock subject to random fluctuations in the environment depends on the nature of those fluctuations in addition to economic and technical factors such as costs and prices. It will typically not be optimal to have a capacity to take exceptionally large allowable catches, but then to have idle capacity in years with adverse conditions and low allowable catches. This makes the choice of effort, considered here as the rate of utilisation of existing fleet capacity, a decision variable distinct from fleet capacity itself. We discuss this further below.

The development of an open-access fishery may be summarised as follows. When a virgin stock is first exploited in an open-access fishery, the fishers at first experience high catch rates and high profits. This attracts more fishers to join them and those already in the fishery may commit more or improved gear, vessels or other capital equipment to the fishery. Fishers then tend to intensify their efforts to catch the dwindling stock. If the catch is greater than the surplus growth of the stock, the stock will dwindle until a point is reached when the stock becomes depleted. Catch rates and profits fall to a point where most of the fishers just break even. If further fishing effort is committed to the fishery, it brings about losses and forces some of the fishers to leave the fishery and a break-even point for the fishery as a whole is attained. At this point all the economic rent potentially available in the fishery is being dissipated.

While the concepts of MSY and maximum economic yield may be useful in informing conservation policies and in developing a framework within which to achieve maximum overall economic efficiency, they cannot be taken beyond a general framework for thinking about fisheries management.

A difficulty with these two concepts is that they rest on the simplistic assumption that, for a particular fish stock, there is a level of fishing effort that can be sustained year after year, with surplus growth neatly compensating for overall catch. Most marine stocks, however, live in a complex and variable environment which produces what sometimes seems to be chaotic or random fluctuations in their populations with causes that are often, at best, poorly understood (Gleick, 1987). For practical purposes there is little chance, with the current state of scientific knowledge of marine ecosystems, of even knowing whether a maximum economic or biological yield has been achieved because, among other factors, the lack of precision in stock assessment is generally accepted as potentially being 30–50%. If, however, these concepts are regarded as broad ranges rather than precise targets they do

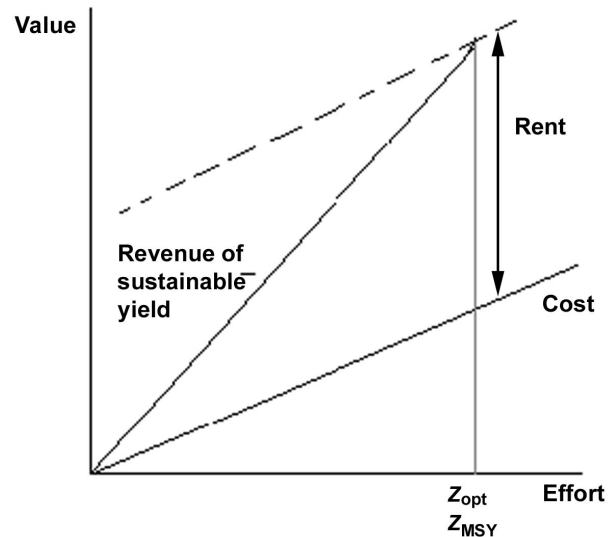


Figure B-4: Constant CPUE: Z_{opt} will be the same as Z_{MSY} . (Adapted from Hannesson (1993, p. 23).)

offer a conceptual framework within which an analysis of a fishery can take place and offer a better basis for decision making than nothing at all.

The above analysis emphasises in general terms the potential rent available in fisheries and the ease with which it can be completely dissipated. Any notion of efficient use of the resource must address the question of what happens to the resource rents.

B.2. Optimal Capacity: Maximising the Benefit

If the fleet and/or processing capacity is greater than the optimum to harvest and process the catch, then resource rent is going to be wasted on excess capacity. The difficulty is in determining the optimum fleet size. An optimum capacity for one year could be greater or less than the optimum capacity for the next year. The extent that this is so will depend on the variability of the size the target stock biomass.

The biomass of most fish stocks, to a greater or lesser degree, varies in size over a time scale of several years. This may have profound implications for the optimal size of the fleet that may be required to harvest the catch and the processing capacity that may be required.

To illustrate, let us take an example of a hypothetical fishery targeting a stock whose biomass varies in size on roughly a decadal time scale. When the environmental conditions are most favourable and the biomass is at its largest, 12 vessels just manage to harvest the catch. This is clearly the optimal fleet capacity for that year. At the point when the environmental conditions are most hostile to this stock, the biomass plummets so that only five vessels are needed to take what is considered the optimal catch for that year. Vessels, however, have a life of two to three decades. Thus, if you

Table B-1: Illustration of optimal fleet capacity in conditions of variable resource productivity with different cost and price scenarios. (Manning, 1999).

No. of vessels in fleet:		12		11		10		9		8		7		6		5	
Year	Optimal capacity for the year	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught	Excess number of vessels	Units of fish not caught
1	7	5		4		3		2		1					1		2
2	9	3		2		1					1		2		3		4
3	12	0			1		2		3		4		5		6		7
4	10	2		1					1		2		3		4		5
5	9	3		2		1					1		2		3		4
6	7	5		4		3		2		1					1		2
7	5	7		6		5		4		3		2		1			
8	7	5		4		3		2		1					1		2
9	8	4		3		2		1				1			2		3
10	9	3		2		1					1		2		3		4
Vessel/year over-capacity; units of catch not caught		37		28	1	19	2	11	4	5	9	2	15	1	24		33
Loss if vessel opportunity cost = \$2m each; value of catch not caught = \$1m per unit		\$74m		56+1 = \$57m		38+2 = \$40m		22+4 = \$26m		10+9 = \$19m		4+15 = \$19m		2+24 = \$26m		\$33m	
Loss if vessel opportunity cost = \$2m each; value of catch not caught = \$2m per unit		\$74m		56+2 = \$58m		38+4 = \$42m		22+8 = \$30m		10+18 = \$28m		4+30 = \$34m		2+48 = \$50m		\$66m	
Loss if vessel opportunity cost = \$2m each; value of catch not caught = \$4m per unit		\$74m		56+4 = \$60m		38+8 = \$46m		22+16 = \$38m		10+36 = \$46m		4+60 = \$64m		2+96 = \$98m		\$132m	
Loss if vessel opportunity cost = \$0.5m each; value of catch not caught = \$6m per unit		\$18.5m		14+6 = \$20m		9.5+12 = \$21.5		5.5+24 = \$29.5m		2.5+54 = \$56.5m		1+90 = \$91m		.5+144 = \$144.5m		\$198m	

allow capacity to build up so that you are able to harvest the whole catch in the best years, then you will need to carry the overcapacity for the remainder of the time when environmental conditions cannot support such a large biomass. It would also not make sense to reduce the fleet capacity so that all vessels are always fully employed. In most instances it would be more economically optimal to have some of the vessels idle for part of the time.

The optimal capacity for the whole period will be determined by the opportunity costs of having vessels lying idle for part of the time and the net value of lost harvest due to capacity being less in some years than what is needed to harvest the catch. In Table B-1 the number of vessels in excess of those needed to harvest the catch for each year and the units of

catch uncaught for the year because of undercapacity for that year are set out for each size of fleet between 12 and 5 vessels. For illustrative purposes different arbitrary values are used for the opportunity cost of overcapacity and for the net value of uncaught catch. The optimum fleet size for the decade is highlighted for each cost scenario. In the last instance, the optimal capacity is that needed to take the full catch in the best year because the value of the catch is very high in relation to the opportunity cost of excess capacity.

It becomes clear from this example that the optimal fleet capacity for the longer term is likely to be below the optimal in good years but that this is dependent on the net value of the catch in relation to the opportunity cost of excess capacity.

Appendix C: The GATT and WTO Rules on Subsidies

C.1. The GATT Rules

The original rules on subsidies of the GATT are found in Article XVI of the GATT (Zamora *et al.*, 1990). Paragraph (1) of this article, which is the original article, creates a reporting obligation of all subsidies that have the effect of increasing exports or decreasing imports. The remaining four paragraphs were added as a result of the 1954–5 GATT review session.

Paragraph (4) requires that ‘contracting parties shall cease to grant either directly or indirectly any form of subsidy on the export of any product other than a primary product which subsidy results in the sale of such product for export at a price lower than the comparable price charged for the like product to buyers in the domestic market’. This involves a prohibition on subsidies for nonprimary exports but not for primary exports.

Paragraph (3) urges contracting parties to avoid the use of subsidies on the export of primary products but does not prohibit it. It then goes on to create the obligation not to use an export subsidy on a primary product which results in obtaining more than ‘an equitable share of world export trade in that product’.

Developing countries did not accept any of the four additions to Article XVI and so were not bound by them; only a small group of industrialised countries accepted these provisions.

Article 14 of the GATT Subsidies Code is on developing countries and recognises ‘that subsidies are an integral part of economic development programmes of developing countries’ (Para.1). The remaining nine paragraphs of this article set out rules generally protective of developing country interests.

C.2. The 1994 WTO Agreement on Subsidies and Countervailing Measures

The 1994 WTO Agreement on Agriculture exempted fisheries from its scope and so it is necessary to look to the 1994 WTO Agreement on Subsidies and Countervailing Measures (WTO, 1994) for the WTO rules on subsidies applicable to the fisheries sector. Here the rules relating to subsidies are

significantly more developed than in earlier agreements and they govern the use of subsidies in the fisheries sector.

The agreement applies a series of tests to establish whether a subsidy exists. For a measure to meet the definition of a subsidy it must confer an economic benefit, pass the ‘specificity’ test, be ‘prohibited’ or ‘actionable’, or cause an adverse effect. In the case of ‘serious prejudice’ it must pass a two-step test. These are expanded on below.

Article 1.1(a)1 defines a subsidy as ‘financial contribution by a government or any public body within a territory’ where

- there is a direct transfer of funds (e.g., grants, loans, equity infusion),
- there is a potential transfers of funds (e.g., loan guarantees),
- government revenue is forgone or not collected (e.g., tax preferences),
- government provides free services other than general infrastructure, or purchases goods,
- there are payments to a funding mechanism or to a private body to perform any of the above, or
- there is any type of price or income support programme in the sense of Article XVI discussed above (Art. 1.1(a)2).

The subsidy must also confer an economic benefit on the recipient (Article 1.1(b)). Article 1.2 requires that subsidies, as defined in Article 1.1, must then be made subject to the ‘specificity test’ described in Article 2 and must be found to be specific. All subsidies are divided into two broad categories:

- Specific subsidies are targeted at certain industries, enterprises or groups of industries and enterprises in a given geographic region;
- Nonspecific subsidies are made generally available and so are more broadly distributed in a country.

Subsidies are of three types. *Prohibited subsidies* are trade contingent and include those that directly promote exports (export subsidies) or restrain imports through, for example, the required use of domestically produced goods (Art. 3). A procedure is established (Art. 4) leading ultimately to countermeasures as a remedy. *Nonactionable subsidies*

(Article 8) include two categories: all nonspecific subsidies and three subcategories of specific subsidies of which two apply to fisheries sector assistance programmes. Specific subsidies are not actionable if they assist disadvantaged regions or ‘promote adaptation of existing facilities to new environmental requirements’ (Art. 8.2(c)). This opens up the possibility of environmental subsidies in a trade agreement on subsidies. Finally, *actionable subsidies* must be ‘specific’ and cause one of three ‘adverse effects’ (Art. 5):

- injury to the importing country’s domestic industry,
- nullification or impairment of a trade benefit or
- ‘serious prejudice’ to another signatory.

The two-step test applied to determine ‘serious prejudice’ is developed and defined in Article 6. Firstly, *ad valorem* subsidisation must exceed 5% (Art. 6.1(a)). The subsidies cover an industry’s operating losses, individual enterprise operating losses on a regular basis, debt that is forgiven or grants that are provided to pay debts. There must also be proof of one of the following: trade displacement, price undercutting or changes in market shares.

Subsidies that are prohibited or actionable are not permitted in terms of the WTO rules.

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Glossary

aggregation

concentration of fish in a particular space for whatever reason

anadromous species

species such as salmon that spend their adult life in the sea but go up rivers from the sea to spawn

artisanal fisheries

traditional fisheries involving fishing households (as opposed to commercial companies) using relatively small amounts of capital and energy, relatively small fishing vessels (if any) and making short fishing trips relatively close to shore, mainly for local consumption; artisanal fisheries can be subsistence or commercial fisheries, providing for local consumption or export; sometimes referred to as small-scale fisheries

benthos

organisms living on or in the sea bed

biomass

the total weight of a fish stock or stocks, or a component of a stock: for example, the biomass of the cod stock, the spawning biomass (i.e. the weight of mature females)

bycatch

catch taken in a fishery that is not the intended target of the fishery

capital stuffing

investing excessively in productive inputs, often as part of the race for fish

catadromous species

species that live in fresh water but go into the sea to spawn

catch per unit of effort (CPUE)

the quantity of fish caught (in number or in weight) with one standard unit of fishing effort: for example, the number of fish taken per 1000 hooks per day or weight of fish in tonnes taken per hour of trawling; CPUE is often considered an index of fish biomass (or abundance); sometimes referred to as catch rate

cod end

the end of the trawl-net where fish collect during trawling

co-management

an arrangement where responsibility for resource management is shared between the government and user groups

continental margin

consists of the continental shelf, slope and rise

continental shelf

the relatively shallow coastal prolongation of the continent under the sea with moderate inclination, extending from the shore to the edge of the continental slope where the inclination increases rapidly

continental slope

outer edge of a continent between the continental shelf and the deep-ocean floor marked by an increased inclination

demersal species

those living close to the sea bed and depending on it

depleted stock

a stock driven by fishing to a very low level of abundance compared with historical levels, with a dramatically reduced spawning biomass and reproductive capacity

developed fishery

a fishery which, following a period of steady increase of fishing pressure and catches, has reached its level of maximum average yearly production; such a fishery is yielding close to its maximum sustainable yield

discarding

the practice of dumping unwanted catch at sea; most fish will not survive the process although some species (e.g., clams) are likely to do so

economic rent

the economic or resource rent in a fishery is the difference between the total revenues obtained from the fishery resource and the total costs where these include a return to capital, entrepreneurship, risk etc: that is, profit over and above what would be considered a normal profit in the economy; the decision as to who gets the rent (e.g., the society, the management authority or the fishers) is a key policy issue

excess fishing capacity

in the short term, fishing capacity that exceeds the capacity required to capture and handle the allowable catch; in the long term, fishing capacity that exceeds the level required to ensure the sustainability of the stock and the fishery at the optimal level

exclusive economic zone (EEZ)

‘an area beyond and adjacent to the territorial sea’ (LOSC Art. 55) under national jurisdiction which ‘shall not extend beyond 200 nautical miles from the baseline from which the breadth of the territorial sea is measured’ (Art. 57), declared in accordance with the provisions of 1982 UN LOSC; within the EEZ the coastal state has the right to explore and exploit, and the responsibility to conserve and manage, the living and nonliving resources of the zone (Art. 56)

fish stock

usually refers to a particular population that is more or less isolated from other stocks of the same species and hence self-sustaining

fishing effort

the combination of fishing gear, boats, electronic equipment and people deployed over a given unit of time to catch fish; often a proxy, such as boat days on the fishing grounds, is used to measure effort

flag state

the state in which a vessel is registered; the vessel flies the national flag and comes under the jurisdiction of that state

ghost fishing

the accidental capture of aquatic organisms by fishing gear that has been lost or discarded at sea and which continues to entangle or trap aquatic animals.

high-grading

The discarding of fish that could have been sold in order to replace them with more valuable fish

highly migratory species

marine species whose life cycle includes lengthy migrations, usually through the EEZ of two or more states as well as into international waters

individual quota

a right granted to an individual or company to catch a certain quantity of fish within a certain time frame

individual transferable quota

an individual quota that is divisible, transferable and tradable

input controls

limits on the type and/or amount of fishing inputs deployed in a fishery with the aim of limiting yields and fishing mortality

maximum economic yield

the yield at which the value is greatest of the positive difference between total revenues and total costs of fishing, with all inputs valued at their opportunity costs; it is the yield at which the maximum rent is obtained from the fishery

maximum sustainable yield

the highest theoretical equilibrium yield that can be taken on average from a stock under existing average environmental conditions without affecting significantly the reproduction process

mesopelagic species

pelagic species found at intermediate depth in the water column

nautical mile

unit of distance equivalent to 1 minute latitude at the equator (=1852 metres or 1.15 miles)

opportunity cost

the value of that which must be forfeited in order to achieve something

output controls

direct limitation of the fish catch through total allowable catch and quotas

overfishing

exerting fishing pressure beyond the optimum level

pelagic fish

fish that spend most of their life in the upper waters of the open sea

phytoplankton

small, usually microscopic, plants drifting in the upper layers of the ocean, consuming nutrients and light energy to produce biomass

pristine stock

a stock in its natural condition before anyone has fished it; sometimes referred to as a virgin stock

property right

an enforceable, specific claim to a particular stream of benefits; in fisheries they may be vested with a state or a group of states as public property, as the common property of a group of individuals or with a community, or they may be held by individuals or companies as private property rights

race for fish

refers to a pattern of fishing that occurs in an open-access fishery where demand exceeds the capacity of the fish stock to supply; it is characterised by an increase of fishing effort deployed to harvest available fish before others do so

stock collapse

the reduction of a stock's abundance by fishing and/or other causes to levels at which production is negligible

straddling stocks

stocks of fish that migrate between the waters of one or more states and the high seas

territorial waters

the area of sea, up to a maximum of 12 nautical miles beyond the coastal base line (LOSC Art.3), over which a coastal state exercises sovereignty, except for the right of innocent passage for foreign vessels (LOSC, Arts. 17–32)

total allowable catch

the total catch, set by the management authority, to be taken from a fish stock in a specified period

transboundary stocks

stocks of fish that migrate between the waters of two or more states

trawl net

towed net consisting of a cone-shaped body, closed by a bag or cod end and extended at the opening by wings. It can be towed by one or two boats and, according to the type, is used on the bottom or in midwater.

trophic levels

classification of natural communities or organisms according to their place in the food chain

zooplankton

microscopic animal species which feed on the phytoplankton

In compiling this glossary use was made of the glossary being developed by the FAO—see www.fao.org/fi

ACRONYMS AND ABBREVIATIONS

CPUE	catch per unit of effort
EEZ	exclusive economic zone
EFZ	exclusive fishing zone
FAO	United Nations Food and Agricultural Organisation
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Seas
IQ	individual quota
ITQ	individual transferable quota
LIFDCs	low-income food-deficit countries
LOSC	Law of the Sea Convention (refers to the UN Convention of 1982)
MSY	maximum sustainable yield
NAFO	Northwest Atlantic Fisheries Organisation
RFMO	regional fisheries management organisation
TAC	total allowable catch
TURFs	territorial use rights in fishing
WTO	World Trade Organisation

