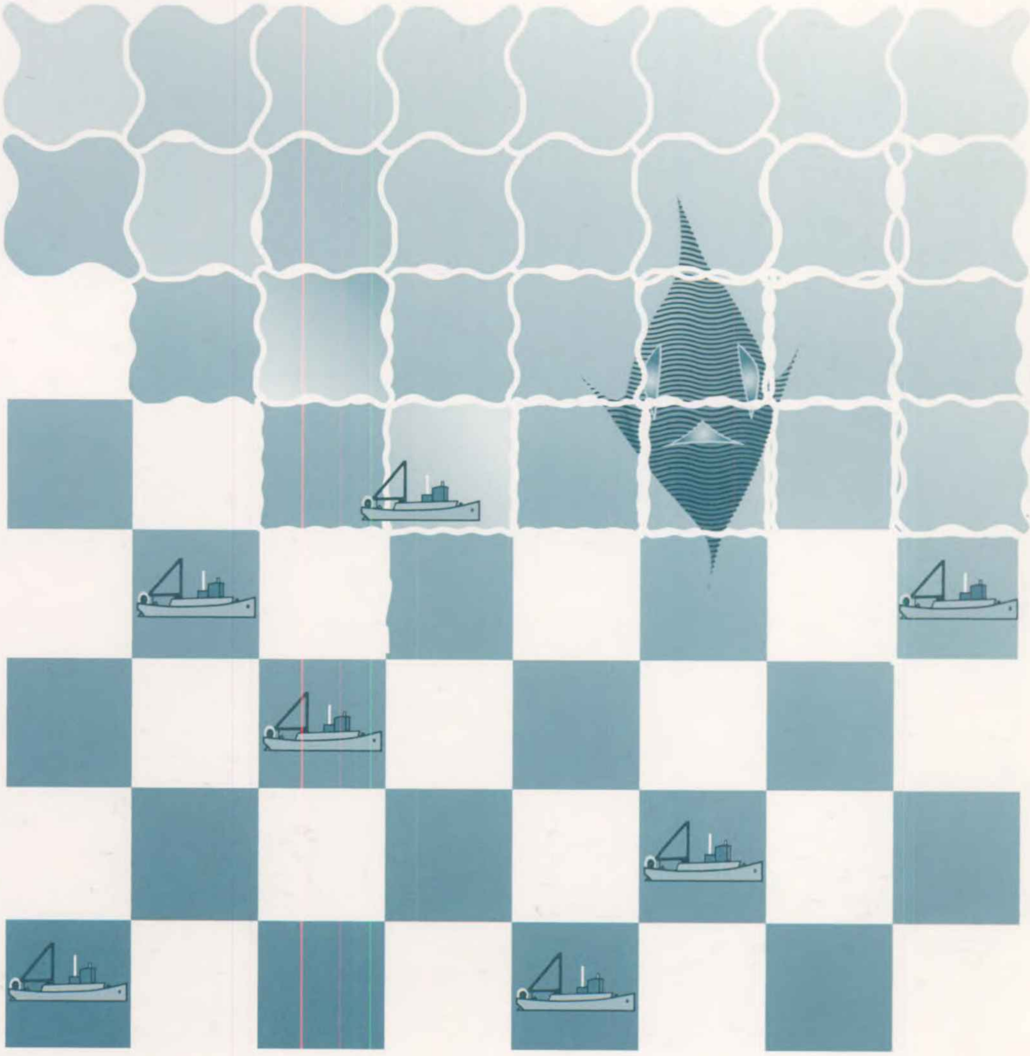

Net Losses

Untying the Gordian Knot of Fishing Overcapacity

Indrani Lutchman and Daniel D. Hoggarth

An IUCN Marine Conservation and Development Report

IUCN
The World Conservation Union

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Citation: Lutchman, I. and D. Hoggarth. (1999) Net Losses: Untying the Gordian Knot of Fishing Overcapacity. IUCN, Gland, Switzerland and Cambridge, UK. (iv + 32pp).

Published by:
IUCN Washington Office
1630 Connecticut Ave NW, 3rd Floor
Washington DC 20008-1053 USA
Tel +1 202 387 4826
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E-mail: postmaster@iucnus.org, http://www.iucnus.org

Produced by:
Kenneth R. Iseman for Iseman Creative, Inc.,
Alexandria, Virginia USA

Available from:
IUCN Publication Services Unit
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Cambridge, CB3 0DL UK
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E-mail: iucn-psu@wcmc.org.uk, http://iucn.org/

A catalogue of IUCN publications is also available.

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This document was made possible through the generous support of the David and Lucille Packard Foundation. IUCN and the authors wish to thank the reviewers, too numerous to name individually, from delegations to the FAO technical consultation on the management of fishing capacity in October 1998. We also wish to thank FAO staff who provided comments, including Serge Garcia, Dominique Greboval, and Rolf Willman, and IUCN staff, particularly Scott Hajost, Malcom Mercer and Rachel Kyte. Special thanks also to Kenneth Iseman and his colleagues for the production of a well-designed document at short notice on a modest budget.

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Executive Summary

The declining state of world fisheries has drawn attention recently to the problem of the expanding 'overcapacity' of the world's fishing fleets. With many stocks overfished, fishing fleets have supported themselves by moving to new or unregulated fisheries, often on the high seas. Following discussions on overcapacity at a number of recent intergovernmental fora, The Food and Agriculture Organization of the U.N. (FAO) has prepared an has prepared an International Plan of Action (IPOA), due for presentation at the February 1999 meeting of the Committee on Fisheries (COFI). The adoption of the IPOA will signal international commitment to address the problem of overcapacity. This primer is designed to assist governments with their development of national action plans on overcapacity, by giving a simple briefing on the issues and describing a range of alternative management options.

The physical capacity of a fishing fleet may be measured as some function of the numbers, sizes and power of fishing vessels and their gears. 'Overcapacity' exists wherever the full-time deployment of this physical capacity would result in fishing levels in excess of sustainable thresholds. Overcapacity may thus either be due to too many vessels, or to too much power in some or all of the vessels. Fishery managers have traditionally attempted to limit the amount of fishing (effort) to control the numbers of fish caught (fishing mortality) and ensure the sustainability of fish stocks. In open access situations, such management has done little to restrain the development of overcapacity in fleets. More consideration is now being given to the control of capacity, but managers must still remember that it is the level of fishing mortality which needs to be controlled. While reductions in physical capacity will usually be beneficial, simultaneous changes in the activities of the fleets may still keep fishing mortality at a high level. The simple relationships between fishing capacity, fishing effort and the resulting fishing mortality are described in Section I.

Section I also describes the historical trends in the world's fishing capacity and catches, and the forces which have led to this situation. Recent decades have seen the levelling off of total world fish catches, and major changes in their species composition, from high value demersal species such as cod to low value species pelagic species such as herring and anchovy. The technology or power of the world's fleets has increased four-fold over three decades. In combination with further increases in the numbers of vessels, the aggregate fishing capacity of the world's fleet may have increased around eight-fold in recent decades. Fifteen percent of recent additions belong to states which offer open registers, commonly referred to as Flags of Convenience vessels. As identified in the IPOA, ***there is an urgent need for improved monitoring of fishing capacity through the establishment of national and international registers.***

This rise in overcapacity is attributable to two main factors: (1) the relatively open access nature of many of the world's fisheries, and (2) the provision of government subsidies to build more and larger vessels. Fishery subsidies include construction and modernisation loans, income support, fuel subsidies and access subsidies. The total global value of subsidies is in the order of $54 billion annually. Such subsidies are now incompatible with the limited sustainability of marine fisheries. ***To harness overcapacity, management agencies should promote the redirection of subsidies for the development of fishing fleets towards those promoting fleet reductions, e.g. by decommissioning and buy-back schemes.***

Section II describes the attempts made by fishery managers to limit access and capacity at local, national and international levels. Locally, access has been traditionally restricted in some places by the use of 'territorial use rights in fisheries'. Such TURFS have been found to be effective under certain conditions, but, in modern times with increasing external pressures, they require strong support from governments for their continued success. At a national level, the declaration of EEZs facilitated access limitations on foreign fleets, but did not deter the build-up of national capacity within home waters. With dwindling stocks, it also resulted in the transfer of capacity to the unregulated high seas. The effectiveness of international attempts to limit access and capacity is under review. The activities of non-members to regional fisheries conventions and Flag of Convenience vessels continue to challenge the international community. The UN Fish Stocks Agreement and the FAO Compliance Agreement provide new impetus for controlling access and limiting capacity but these instruments are yet to enter into force. ***Ratification of these instruments should be encouraged.***

At each of the different geographical levels, a range of different fishery management tools may be used. Such tools vary in their potential effectiveness for controlling fishing capacity and fishing mortality, and also in the way in which they work. Some tools are designed for open access situations and require strong enforcement, while others are intended to allocate property rights to fishers and to provide indirect incentives for self-restraint. The tools fall into the following four categories:

- **output controls** on the size of catches which may be taken by the fishery (e.g. TACs or unallocated quotas, or ITQs);
- **input controls** on who may fish, and how much (e.g. restrictive licensing, limits on days at sea);
- **technical management measures** on where, when and how fish may be caught (closed areas, closed seasons, gear restrictions, fish size limits etc); and
- **economic controls**, such as taxes and decommissioning, affecting the profitability of fishing and the size of the fleet.

Section III describes the use and effectiveness of such tools at limiting overfishing, with examples in specific circumstances. It is shown that TACs play virtually no role in reducing fishing effort, and instead, usually increase fishing capacity by encouraging competitive 'racing' behaviour. As an alternative, the property-based ITQ system may make the greatest contribution to fishing effort and capacity limitation. Depending on their application, ITQs may directly control the numbers of fishing vessels. In addition, they indirectly provide the economic incentives for self-limitation of the other components of fishing effort. They also contribute to the limitation of physical capacity of the fleet within the local fishery, though they must force any unlicensed vessels out into the global fishing capacity pool.

Restrictive licensing (RL) may also limit the numbers of vessels in the fleet, but may not provide the same incentives as ITQs to limit the development of capacity. Since RL systems provide only temporary or permanent ***access*** rights to fishing rather than true ***property*** rights to the catches, vessels must still compete for their share of the catches. Though both systems can control fishing mortality effectively, fleet capacity must be more directly managed under RL than under ITQs.

A range of different technical management tools may also be used to contribute to the control of different components of fishing effort. Closed areas will not limit the actual fishing effort applied, as vessels will be simply forced into waters outside such reserves, though they may export biomass to the fisheries outside the area of protection. Closed seasons more directly limit the fishing effort of the fleet by controlling the time which vessels may spend fishing, but they may also cause socio-economic difficulties if fishermen are unemployed for much of the year. Technological and gear restrictions may be used to limit the power and size of vessels and gears within the locally managed fishery, but such vessels may still invest in technology for use in un-managed fisheries outside.

The actual numbers of fishing vessels may only be controlled by the property based ITQ systems, RL and by economic measures which either reduce the profitability of fishing or directly buy vessels out of the fleet. Only decommissioning (vessel destruction) physically reduces the ***global*** capacity of the fishing fleet. All the other tools have ***local*** effects, but may just displace vessels / effort / technology out into the global fishing pool.

The potential choice of alternative tools for fisheries with different ecological, cultural and economic circumstances is discussed in the final Section IV. ***The best choice of management tools will depend on a range of factors including the ecological, cultural and economic circumstances of the fishery, the capacity of the management agency, and the management objectives for the fishery, as chosen by all its various stakeholders.*** With wide variation in the nature of different fisheries around the world (or even within a region), **there is no single blueprint, 'one-size-fits-all' solution.**

With most major fish stocks around the world either over-exploited, or fully exploited, there is now an urgent need to control overcapacity and access at local, national and global levels. Reduction of fishing effort may either be achieved by applying property rights systems and limiting the access of fishers, or keeping open access regimes and applying stricter technical measures. The choice of solutions depends on the acceptability of restricted property rights and the ecological, cultural and technical circumstances of individual fisheries.

For inshore, artisanal fisheries, the use of TURFs and community participation in management may prove useful under certain conditions. For offshore, industrial fisheries, within national waters, ITQs, restrictive licensing or more traditional management tools may all contribute to the reduction of capacity within EEZs. On the high seas, fisheries may be effectively managed by regional conventions, given stronger international political support, e.g. by the ratification of the UN Fish Stocks Agreement and the FAO Compliance Agreement. In the end, global capacity reduction will only be achieved by reductions in both national capacity and the limitation of open access on the high seas.

Introduction

World fisheries have become the focus of much international attention in the last decade, due to the decline and collapse of major world fisheries, and the increasing number of conflicts between nations over who has the right to exploit the limited remaining fish stocks. The 'overcapacity' of the world's fleets has been highlighted as one of the major causes of these problems. This issue was discussed generally at the United Nations Conference on Environment and Development (UNCED), in Agenda 21 and more specifically during the Rome Consensus on World Fisheries[1], in Article 7 of the Code of Conduct on Responsible Fisheries[2], in the Kyoto Declaration[3], and in the Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea[4].

At the last session of the FAO's biennial Committee on Fisheries (COFI) in 1997, the FAO was requested to address the issue of fishing capacity. A Technical Working Group on the Management of Fishing Capacity met in the US from 15 -19 April 1998. A subsequent FAO consultation was held in Rome from 26-30 October 1998, at which a draft non-binding document on overcapacity, the International Guidelines/Plan of Action (IPOA) was approved by 81 countries and the EU. This document will be presented to the next session of COFI in February 1999 for final adoption. Although, the IPOA is voluntary, its adoption by COFI will signal a commitment by states to take concrete action on overcapacity at a national and an international level. The next phase will involve the development of national plans for the reduction of overcapacity.

The IPOA is based on the FAO Code of Conduct for Responsible Fisheries, and takes into account the relationship between the Code and other international instruments. The main objective of the IPOA is for "States and regional organisations to achieve worldwide, by a specified date, an efficient, equitable and transparent management of fishing capacity". A series of actions related to four main strategies are identified as means of achieving this objective. These are:

- the conduct of national, regional and global **assessments of capacity** and improvement of the monitoring of capacity which would involve the measurement of fishing capacity, diagnosis and identification of fisheries and fleets requiring urgent measures and the establishment of records of fishing vessels to support the FAO Compliance Agreement;
- the preparation and implementation of **national plans** to effectively manage fishing capacity and of immediate actions for those fisheries requiring urgent measures which would take into account the effect of different resources management systems on fishing capacity and socio-economic requirements; recommend specific action for overfished fisheries; address the issues of subsidies and incentives which result in overcapacity and take into account regional considerations;

[1]The Rome Consensus on World Fisheries adopted by the FAO Ministerial Meeting on Fisheries, Rome, 14-15 March 1995. The meeting urged governments and international organisations to "review the capacity of fishing fleets in relation to sustainable yields of fishery resources and where necessary reduce these fleets."

[2]The FAO Code of Conduct on Responsible Fisheries adopted by the Conference of FAO, Rome, October, 1995. Article 7 addresses issues related to fisheries management.

[3]The International Conference on the Sustainable Contribution of Fisheries and Food Security convened by the Government of Japan and the FAO adopted a Plan of Action to be implemented by governments, IGOs and regional fisheries management organisations which included the identification and exchange of information on mechanisms to reduce excess fishing capacity and on action to reduce excess capacity as soon as possible.

[4]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, New York, August 1995.

- the strengthening of **regional organisations** and related mechanisms for improved management of fishing capacity at regional and global level mindful of the provisions of the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks and the FAO Compliance Agreement; and
- **immediate action** for major transboundary, straddling, highly migratory and high seas fisheries requiring urgent measures.

These strategies may be implemented through complementary mechanisms to promote implementation of the IPOA such as awareness building and education, technical cooperation at the international level and coordination.

The management of fishing capacity should also take into consideration certain principles and approaches which include cooperation amongst states in the implementation of actions to address overcapacity; a holistic approach which entails that the management of capacity takes into consideration all factors affecting national and international capacity and the need to manage capacity with a view to achieving sustainable use of fish stocks consistent with the precautionary approach. (FAO, 1998a).

This primer is designed to assist governments, multilateral finance institutions and development assistance programmes in the development of policies on overcapacity and the preparation of national plans of action. In Sections I and II, the document examines the issues of capacity and access limitations, in terms of their causes and impacts. In Section III, the range of options for managing fishing capacity in terms of access limitations are presented. Case studies are included to highlight their applicability to specific fisheries. Finally in Section IV, the suitability of alternative measures for different types of fisheries is discussed, with reference to their specific cultural, economic and biological characteristics.

I. The Development of Fishing Overcapacity

Fisheries around the world initially began as 'open-access' resources, freely accessible to anybody wishing to fish. Such free access has usually led to the overexploitation of resources, and the overcapitalisation of the fishing industry, as fishers compete for dwindling fish stocks. Fishery managers have tried in various ways to control the spread of overcapacity, with variable levels of success.

This section introduces the subject of overcapacity, firstly by explaining its meaning and potential effect on fish stocks, via the mechanisms of fishing effort, catchability and fishing mortality. The historical trends in fishing capacity are then described, followed by some discussion of the forces responsible for the current excess levels. The section concludes with a description of the impacts on world fish catches and the biodiversity of fish stocks.

Controlling fishing capacity and fishing mortality

The physical capacity of a fishing fleet may be measured as some function of the numbers, sizes and power of fishing vessels and their gears. 'Overcapacity' exists wherever the ***full-time*** deployment of this physical capacity would result in fishing levels in excess of sustainable thresholds. Overcapacity may thus either be due to too many vessels, or to too much power in some or all of the vessels.

Fishery managers attempt to limit the amount of fishing to control the numbers of fish being caught, and ultimately to ensure the survival of enough fish to sustain the fish stocks. The relationship between the amount of fishing and the resulting rate of 'fishing mortality' is dependent on a wide range of different factors, only some of them related to the physical capacity of the fleet. When the amount of fishing is reduced by cuts in the numbers of vessels, for example, simultaneous increases in their power or their time spent fishing may still keep the actual fishing mortality at a high level. Fishery managers and policy makers must thus remember that it is ***fishing mortality*** which must be reduced to safe levels, and that capacity reductions are only a part of this process. To understand the potential contribution of different management tools and access controls to the reduction of fishing mortality, this section describes the different component parts of the fishing process. The potential impacts of different management tools on each of these different components are discussed in Section III.

As described in standard fisheries textbooks (e.g. Gulland, 1983; Hilborn and Walters, 1992), fishing mortality (the rate at which fish are caught) is dependent on the amount of 'fishing effort' applied and the 'catchability' of the stock to that effort. The components of each of these factors are first described in the following sub-sections.

FISHING EFFORT

The effort applied by a given fishing fleet depends on the number of vessels or gear units in use, their size or power, and the length of time for which they are used. As shown in Table 1, the relative importance of these different factors in determining a fleet's fishing effort will vary for different types of fishing. The total effort of a fleet will always depend to some extent on the numbers of vessels fishing and the time they spend fishing. The other components of fishing effort, however, will vary significantly between fisheries. The power of a trawler thus determines both the size of net it can tow and the speed it can tow at. The size of a purse seiner and its nets may both determine its ability to take advantage of the very large fish schools sometimes encountered. Both trawlers and purse seiners usually fish only one net at a time, so the numbers of gear units is less important for these fisheries. For fisheries using multiple small gears such as traps or long lines, however, the numbers of gear ***units*** used will usually be more important than the size or power of the

Table 1. Primary fishing effort components for different types of fishery.

Component of fishing effort		Trawl fishery	Purse seine fishery	Trap fishery	Gill net fishery	Long line fishery
Vessel capacity	Number of vessels	✔	✔	✔	✔	✔
	Vessel power	✔				
	Vessel size		✔			
Gear capacity	Number of gear units			✔	✔	✔
	Gear size	✔	✔		✔	
Time fished (activity)		✔	✔	✔	✔	✔

vessels used to set them. The size of such gear units is often standardised within a given fishery, though they may vary significantly for gears such as gill nets.

Whenever efforts are made to reduce ***one component*** of fishing effort, it is clear that this may not have the desired effect on the ***overall*** fishing effort. Fishermen around the world are well experienced in compensating for regulations on one factor with increases in another factor (e.g. by reacting to limits on the number of days spent at sea with increases in the size or power of their vessels). Total fishing effort may thus only be effectively limited when all of the necessary components of the fishing process are simultaneously controlled. The difficulty of achieving this control has been partly responsible for the increased use of property rights systems, which attempt to reduce the need of fishers to compete for their catches (see later).

CATCHABILITY

Fishing mortality is usually assumed to be proportional to fishing effort, with a constant 'catchability coefficient' determining the relationship between the two. The 'catchability' of a fishing gear is thus defined as the proportion of the total fish stock (the fishing mortality) taken by a single unit of fishing effort. If the fishing effort of a trawl fishery is measured in the number of hours spent trawling by a standard sized vessel, the catchability of that effort will be the proportion of the stock taken by one hour of trawling (usually a very small number!)

In reality, catchability is rarely constant. Like fishing effort, catchability depends on a number of different components, such as:

- **technology** (the introduction of new gear materials such as monofilament gill nets, or of electronic fish finding equipment may greatly increase catchability);
- **experience** (fishermen learn by experience where, when and how to set their nets, especially in the early days of a new fishery);
- **times fished** (fishing at night may be better than during the day; catch rates may be increased during spawning, migration or feeding seasons);
- **places fished** (catchability will be increased whenever fishing is done in areas of relatively high fish concentrations, such as spawning aggregations).

As a combination of the above factors, the catchability of an unregulated fishery will usually increase gradually over time as fishermen develop their skills and adopt new technology. Catchability may also increase dramatically in a short time, perhaps due to the introduction of an effective new gear component or technology, or the discovery of a new spawning aggregation.

FISHING MORTALITY

Fishing mortality is the product of fishing effort and catchability, and may also be measured directly as the proportion of the total stock caught annually by the fishery (fishing mortality = catch / biomass). Fishing mortality must be expected to vary over time according to both regulated and unanticipated changes in each of the above factors. Effective control of fishing mortality will only be achieved by making allowances for the full range of contributing factors. If fishing mortality is to be kept constant, for example, in the face of increasing technology, the implication is that the numbers of vessels or some other factor must be continuously reduced in compensation. If fishing mortality must be ***reduced*** (as is the case currently for most fisheries around the world), a vessel decommissioning scheme or other measures may solve the problem this year. Without strict controls, however, the increasing trend in mortality will then usually begin again. An ongoing approach must thus be taken, with continuous appraisals of the state of fish stocks, and of the relationships between fishing activity and fishing mortality. As shown in Section III, the different fisheries management tools such as quotas, closed seasons etc, each have specific potential effects on the different components of both fishing effort and catchability. A combination of such tools will often produce the most effective control mechanisms.

FISHING CAPACITY

The ***physical*** capacity of a fishing fleet depends on the numbers, sizes and power of vessels, the numbers and sizes of their fishing gears, and the supporting technological equipment associated with the fishing process. In some UK fisheries, managed under a restrictive licensing system, the physical capacity of fishing vessels is currently measured in 'vessel capacity units' (VCUs) as the following sum of a 'hull component' and an 'engine component':

VCU = LENGTH OVERALL (M) * BREADTH (M) + 0.45 * POWER (KW)

These capacity measurements are used to limit the development of the fleet, by restricting the entry of new vessels to the aggregate VCUs of other vessels whose licenses are inherited or purchased by the new owner. While this process may go some way towards limiting ***physical*** capacity, it should be clear by now that the simple measurement of vessel sizes and their power will not, in itself, necessarily limit the capacity of the fleet to over-exploit fish stocks. With continuous variations in the many other important factors, the current ***actual capacity*** of the fleet should be measured, not just as some physical sub-components, but as its actual ability to cause fishing mortality in the fish stocks. The overcapacity of the fleet, and the necessary reductions in capacity, may then be calculated from the ratios of ***current*** and ***target*** fishing mortalities. This implies that fishing mortalities should be calculated annually (e.g. by virtual population analysis - VPA - or other stock assessment tools), and adjustments made ongoingly to the physical fleet capacity on the basis of the latest figures. This is the process currently adopted under the EU's Multi-Annual Guidance Programme on fishing capacity (Lassen, 1996).

HISTORICAL TRENDS IN FISHING CAPACITY

In the period 1970-1992 , the world's fishing fleet increased in number from 580,980 to 1,178,160 vessels, and in gross registered tonnage (GRT) from 13.6 billion GRT to 26 billion GRT (FAO, 1995). Vessels 24m and over account for only 1.7% of the total number of all decked fishing vessels but almost 60% of their tonnage. Over the same period, the world's undecked fishing vessels increased in number from 1.5 million to 2.3 million. Reflecting the technology (catchability) of vessels, Fitzpatrick (1995, in Mace, 1996) estimated that actual fishing power has increased four-fold since 1965. Combining both vessel numbers and their fishing power, the actual fishing capacity of the world's fleets may be seen to have increased around eight-fold in recent decades (Mace, 1996).

Recently, after two decades of rapid growth, at 3.6 percent per year, the rate of increases in the number of decked fishing vessels slowed to 0.9 percent per year for the period 1990-95. There was a sharp decrease in the numbers of new vessels in 1995 and 1996 as well as a reduction in the tonnage of these vessels compared with earlier years. However, orders for new vessels in 1997 showed an increase in numbers of vessels and significant increases in tonnage.

A mere thirteen states accounted for eighty percent of the increases to the world's fleet between 1991-1995. Of those, four states accounted for 53 percent. Four states offering open registries, commonly referred to as Flags of Convenience states (FOCs), Honduras, Liberia, Panama and Cyprus, accounted for 15 percent of the total additions during this period (Fitzpatrick and Newton, 1998).

FAO's 1992 Report "Marine Fisheries and the Law of the Sea: a Decade of Change" (FAO 1992) estimated the replacement cost of the world's fishing fleet at $319,000 million for a global landed catch value of only $70,000 million.

Fishing fleets are grossly overcapitalised on a global basis with a few exceptions on a local basis. Despite recent attempts to reduce capacity, many fleets are now operating at a loss (FAO, 1993), propped up by government subsidies in the form of grants and loans. Additions to the world's fleet continue to exceed deletions: 1997 order books for new vessels show increased construction of large vessels. On a global scale, capacity is not being effectively reduced, and states with open registers are increasing their capacity (Fitzpatrick and Newton, 1998).

Forces responsible for increasing fishing capacity

Two main factors have contributed to the increase in fishing capacity: the open-access nature of many fisheries, and their resulting competitive exploitation; and the provision of government subsidies encouraging the development of national fleets.

OPEN ACCESS AND COMPETITION

Open access to fisheries has, in most cases, led to overexploitation, and the reduction of fish yields and economic profits. As exploitation of a fishery begins, increasing effort results in an increase in yields. Beyond a certain point, however, further increases in fishing effort will begin to reduce the reproductive capacity of the fish stocks, leading to reduced total yields, and possibly to eventual stock collapse. Fisheries have a finite productive capacity: Competition for fish under open access regimes will always encourage increases in inputs to levels which will, over time, cause total yield to fall.

There are also impacts on vessel catch rates. In open access fisheries, all participants effectively share the resource. The activities of any individual or group of participants in a fishery will have an indirect impact on the fortune of others. As more and more effort is applied to a fishery, its fish population will be reduced and its vessel catch rates will begin to decline. At this point, the entry of additional participants will result in further decline in catch rates, despite the increase in fishing effort by participating vessels.

In economic terms, open access means that the economic surplus or ***economic rent*** that the natural resource could have generated will be dissipated. The greater the increase in capacity or entry into the fishery, the faster the dissipation of this surplus. Since there are effectively no assigned owners, any resource rent that could be generated is seen by fishermen as a potential profit. As long as there is profit to be made, more participants will be attracted into the fishery. This scenario will continue until most of the profits are competed away. However, even when resource rent is partially dissipated, the participants may still make a profit (due to rising prices with falling supplies, for example), providing a misleading indicator of the level of overexploitation.

As a fishery slides into the decline phase and financial ruin becomes apparent, aid is usually sought from governments in the form of subsidies. The provision of subsidies by many governments has exacerbated the problem of overcapacity as it encourages overextended fishermen to remain in the fishery. The effect of an open access policy and subsidization has led to the decline of most fisheries worldwide.

FLEET DEVELOPMENT SUBSIDIES

With open access fisheries, and profits to be made by competing effectively in a global market, governments and international institutions have added to the problem of overcapacity by providing 'development' subsidies for fishing fleets. Such subsidies have been estimated to be as high as 20-25% of the industry's revenues of around US$70-80 billion per year (WWF, 1998).

During the recent decades, the capacity of the world fleet has increased many times, funded by subsidies to fleets totalling tens of billions of dollars each year. Fishery subsidies include:

- direct government payments for the **construction** of fishing vessels as well as loan guarantee programmes;
- **income support** programmes which have discouraged participants from leaving bloated fisheries;
- **fuel subsidies** which have lowered production costs; and
- **access subsidies**, paid as license fees for fisheries in foreign countries.

The total value of fishery subsidies (in terms of dollars spent or governmental revenues forgone) was estimated by FAO (1992) as $54 billion annually for the period 1988-89. More recently, it has been estimated that worldwide fishery subsidies total between $14.5 and $20.5 billion annually (Milazzo, 1998 in WWF, 1998). Although the amount of development subsidies appears to be decreasing, there is an urgent need for ***reductions*** in capacity, rather than continued investments. Effective disciplining of fisheries subsidies would promote progress towards improved management regimes. The use of positive subsidies (such as decommissioning and buyback schemes) will likely be required to assist in the transition to sustainability.

An important issue in terms of global fleet development is the subsidization of national fleets by licensing their access to fish in foreign waters. The EU fisheries agreements with West African countries provide a good example of this form of subsidization. These agreements have allowed the EU to redeploy large numbers of fishing vessels to the waters of African countries. Between 1970 and 1987, the tonnage of the EU fleet increased by roughly two thirds while the engine power of the fleet more than tripled. In response to the increase in capacity, the EU sought opportunities for its fleets in the waters of West Africa. EU fisheries agreements have since been negotiated with 19 African countries. As of 1996, the compensation paid to African countries under these agreements amounted to at least $229 million annually. This financial compensation takes the form of licence fees for access to the foreign fish resources, and represents a major subsidy for the EU fleets. The explicit subsidy provided by the EU to a 250 GRT shrimp vessel in Guinea Bissau, represents 46%of its profits (WWF, 1997a). Such a subsidy enables the vessel to stay in the fishery long after the point at which its true profitability is reduced to zero.

Effects on fish catches and biodiversity

The increase in global fleet capacity and the expansion of fleets into different ocean areas has inevitably impacted on major world fisheries. The following section examines the trends in catches in terms of their composition and value and highlights the related impacts on marine biodiversity.

FISH CATCHES

World catches of fish, crustaceans and molluscs in marine areas increased from 62 million tonnes in 1970 to a peak of 86.4 million tonnes in 1989. This substantial increase occurred after the introduction of the 200 mile Exclusive Economic Zones (EEZs) in the second half of the 1970s. Since 1989, total world fish catches have been relatively stable, e.g. with 84.7 million tonnes in 1995 (Fitzpatrick and Newton, 1998).

Although total catches are currently stable, the detailed picture of individual fisheries provides more concern. Thirty-five percent of the 200 major fishery resources are senescent (ie. showing declining yields), about 25 percent are mature (ie. levelling off at a high exploitation rate), 40 percent are still developing and 0 percent remain at low exploitation (undeveloped) level (FAO, 1997a). More than half of the world's major fisheries are thus either mature or senescent. Similarly, Garcia and Newton (1994), estimated that 44 percent of the world's scientifically assessed fish stocks were intensively to fully exploited, 16 percent were over-fished, 6 percent were depleted and 3 percent were slowly recovering. The 25 percent of over-exploited fish stocks clearly require urgent reductions in fishing mortality. While the other 44 percent of intensively to fully exploited stocks may currently be seen as healthy, they also require strong management to resist the trend towards overcapacity. With the world's highly mobile, modern fishing fleets, vessels from the overcapacity fleets can transfer to these vulnerable stocks extremely rapidly.

CATCH COMPOSITION (BIODIVERSITY)

With the most valuable fish stocks inevitably attracting the greatest attention, the composition of the world's fish catch is gradually changing towards less valuable, and usually smaller species. The proportion in weight of the total marine fish landings accounted for by pelagic fish has risen from about 50 percent in 1950 to over 60 percent in 1994. Such catches are mainly comprised of seven main species, all of them small in size (anchoveta, Atlantic herring, Japanese pilchard, South American pilchard, chub mackerel, capelin and Chilean jack mackerel). In contrast, the catches of the higher priced tunas and other large pelagics have declined, and the more valuable demersal fish production has levelled off since the 1970s.

In addition, the emphasis on single-species fisheries has resulted in uneconomic and non-target species, overquota and small fish being discarded and wasted. For example, in the North Sea, at least 40 percent of total biomass of commercial species is removed each year. This does not take into account the discards which are often far greater than the landed catch. For example, when using beam trawls in the North Sea for catching sole, for every kilogram of sole landed, as much as 10 kg of marine biomass is discarded and nearly 3 kg of bottom living organisms are killed by beam trawls (ITDG, 1996).

The overcapacity that has expanded in the North is also putting pressure on the fishery resources of the South. For example, 49 out of 55 trawlers of a Canadian company were sold to developing countries after the onset of the 1992 Atlantic cod crisis (Mathew, 1996 in ITDG, 1996). The sheer scale of these technologies which were developed for large schools of fish in the North can have a disastrous effect on fisheries in the tropics. In Kerala, south India, fishermen have documented that natural reefs have been destroyed by trawling, and that 150 once common species are no longer caught by artisanal fishermen due to the impact of trawling. During the 1970s, overall fish catches in Kerala declined and within this, the artisanal sector's catches fell to between 40 and 60 percent of pre-1970 levels (O'Riordan, 1992).

II. History of Attempts to Limit Access and Capacity

The declining state of the world's fisheries has not gone un-noticed by fishermen or governments. In response, varied attempts have been made to limit access and capacity at local, national and international levels. The history of these measures is briefly discussed in the following sections: details of the alternative management tools in use are provided in Section III.

Local access limitations

Access to small scale, traditional or 'artisanal' fisheries has been limited by a range of simple but often effective approaches in various places around the world. Such systems usually have a spatial basis to them, and are sometimes referred to as 'Territorial Use Rights in Fisheries' or TURFs for short. In these systems, rights of use and exclusion over fishery resources within specified areas and time periods are exercised by those communities that depend directly on them (Panayotou, 1989). Effective control is facilitated by the face-to-face interactions which occur between the fishers in these small communities, and the resulting power of community sanctions.

Such customary tenure is often embedded in highly complex systems of territoriality, associated with and usually adjacent to land-based estates or communities. Traditional TURFs are thus limited to certain coastal fisheries, and appear to work best for sedentary species, such as oysters and lobsters. For such species, fishing activities outside the TURF area have limited effects on local fish stocks, and the local community may thus benefit most from its own actions and sacrifices. Such systems have little potential for highly migratory species or offshore stocks. Examples of TURFs include coral reef fisheries in the Pacific (Ruddle et al, 1992), the lobster fiefs of Maine (Acheson, 1975), and the management of inshore waters by fishing cooperatives in Japan.

In the Maine lobster fishery, there are only a few formal restrictions: a government license, protection for breeding females, a minimum size limit and gear restrictions. Lobster fishermen have, however, formed their own 'harbour gangs', each defending a lobster territory of approximately 100km2. Such local groups control entry to their own territories by a range of social pressures, without formal laws or violence. Some of the gangs also introduced their own closed seasons and individual pot limits to further limit overexploitation. Local access limitations may thus serve to effectively control fishing effort, particularly in closely-knit societies with relatively low mobility (Pitcher, 1982).

Traditional TURFs appear most vulnerable to exposure to external values and technologies , and the decreasing authority of the community. When the fishery is no longer the only local employer, the overexploitation of the fishery may be seen by some as a valid way of attaining some new piece of technology. A new television may thus be given a higher priority than the sustainability of fishing as a livelihood. Where such trends weaken the effectiveness of TURFs, strong central government support and leadership may be required for their maintenance or introduction.

National access limitations

Attempts to limit access to national fishery resources began with U.S. President Truman's 1945 Proclamation on Fisheries. At this time, the United States asserted its rights, in certain circumstances, to 'establish explicitly bounded conservation zones in which fishing activities shall be subject to the regulation and control of the United States' (Burke, 1994 in Bailey, 1998). Soon after that, a number of Latin American states also made claims to their own territories, of varying sizes.

After inconclusive Law of the Sea Conferences in 1958 and 1960, many states imposed a fundamental change in the Law of the Sea regime around 1976, by claiming 200 nm Exclusive Economic Zones (EEZs) (Bailey, 1998). The EEZ was approved by the 1982 text of the Convention on the Law of the Sea (UNCLOS) which entered into force on 16 November 1994. Absolute freedom of the seas has slowly yielded to agreements among sovereign states regarding their conduct

Box 1. Iceland's attempts to limit national access

Icelandic cod were heavily over-fished before the declaration of Iceland's 200 mile EEZ in 1975. As cod stocks began to show serious signs of depletion during the 1970s, the Icelandic government attempted to establish its rights to sole exploitation of stocks in its local waters. Such rights were vigorously opposed by European countries, whose distant water fleets had been largely built on profits from the Icelandic fishery.

After the 200 mile EEZ was introduced, mesh restrictions and closed areas were introduced, and foreign fleets were allowed to take only a reduced quota for a transitional period. However even with national ownership of the resource, management was not as effective as had been hoped. In 1979 and 1980, quotas were still exceeded by 15% due to the overcapacity of the Icelandic fleet. Even though Iceland's EEZ reduced the problems caused by unrestrained fishing by other nations, it did not immediately solve the overcapacity of Iceland's own fishing industry. It did, however pave the way to improved national management, by legalising the eventual allocation of property rights as ITQs (see later).

in specific areas and with regard to specified activities. The extension of coastal state control to 200 miles represented the creation of state jurisdiction over national waters. Although still permitting navigational freedom, the establishment of EEZs removed vast areas of the seas from what was once seen as the 'global commons' (Box 1).

Though the declaration of fish stocks as national property did not immediately solve the problems of overcapacity, it gave coastal states the legal right and opportunity to manage their fish stocks in sustainable ways by controlling the race to fish.

A number of governments have already taken national initiatives to reduce fishing capacity (FAO, 1997b). Countries such as Malaysia, Argentina, Namibia, Australia, Iceland, USA and Canada have all introduced a number of measures to limit fisheries inputs and outputs in their national fisheries. Measures used include ITQs, and other modifications of access rights which aim to privatise the ownership of natural resources. Such privatisation provides incentives for reductions in capacity and for the economic and sustainable harvesting of resources (see details in Sections III and IV). Some states have used decommissioning and buy-back schemes to remove vessels from their fleets, or placed a moratorium on new vessels entering the fishery to prevent further development of capacity. Such actions have effectively halted the increase in capacity resulting from open access. On the negative side, they are sometimes seen to have benefited some members of the fishing industry more than others: their potential and actual socio-economic impacts on coastal communities clearly require detailed consideration.

International limitation

International waters remain mainly open-access. However, there are three legal instruments which provide the opportunity for restricting access and overcapacity on the high seas, as a means of conserving and managing marine living resources. Regional fisheries organisations play a vital role in the implementation of these instruments, as discussed in the following sub-sections.

THE UN CONVENTION ON THE LAW OF THE SEA

Though the 1982 United Nations Convention on the Law of the Sea (UNCLOS) went a long way towards allocating rights and responsibilities in EEZs, the high seas remained as legally problematic areas.

The term high seas refers to areas located beyond the EEZs of coastal states. These vast areas of oceans are mainly open access, and are exploited by distant water fishing fleets whose access to traditional fishing grounds has been restricted by EEZ regulations.

Few states have implemented legislation concerning the activities of their vessels harvesting fish on the high seas. Where they have, some of the fishing vessels affected have changed flags in order to evade the new measures: many of the vessels in high seas fleets are now under open register. The fact that UNCLOS did not provide for mechanisms allowing members of regional management bodies to deny the right to fish to vessels from non-member states played an important role in this process.

The development and support of a global system of regional institutions is one of the key features of the 1982 Convention (UN, 1996). There are now more than twenty regional and subregional fishery bodies such as the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Northwest Atlantic Fisheries Organisation (NAFO) whose mandates include the conservation and management of high seas fisheries. Some of these bodies have full regulatory powers while others have only an advisory role related to management issues. The role of fisheries management bodies has become more important since the entry into force of UNCLOS in 1994, and the adoption of the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks in 1995, as described in the following section.

THE UN 'FISH STOCKS AGREEMENT'

The UN 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 must be seen as a significant step in the implementation of UNCLOS.

Regional fisheries management organisations have a critical role to play in the implementation of the Agreement. The Agreement establishes a framework for such organisations and specific provisions highlight their opportunities for controlling the access and capacity of fishing fleets on the high seas.

Part II of the Agreement refers to the implementation of principles such as the precautionary approach as well as the need for states to cooperate in terms of achieving compatible conservation and management measures. Part III of the Agreement deals with the Mechanisms for International Cooperation Concerning Straddling and Highly Migratory Fish Stocks. This is a central part of the Agreement which defines in precise terms the nature of the obligation to cooperate under Article 64 of the 1982 Convention.

Article 8 specifies that States shall "cooperate by becoming a member of a subregional or regional fisheries management organisation or arrangement by agreeing to apply the conservation measures established by such an organisation or arrangement". To ensure that particular States cannot be excluded, the Agreement provides that organisations and arrangements must be open to participation by all States having a real interest in the fisheries concerned. Specifically Article 8, paragraph 4 creates a real incentive for States to cooperate by providing that only those states which become members of the organisation or arrangement, or which agree to apply the conservation and management measures established by it, will have access to the regulated fishery.

Article 10 sets out the functions of fisheries management organisations or arrangements in so far as they include the establishment of conservation and management measures as well as the allocation of participatory rights, compilation and dissemination of data and the establishment of cooperative mechanisms for monitoring, control and surveillance. Article 11 provides guidance on the matters to be taken into account in determining the rights of new members or new participants but does not confer any automatic rights of access to the fishery on new members or new participants. This will depend on a number of factors which include the status of the fishery, the respective contributions of members and their fishing patterns and practices, as well as the needs of coastal states whose economies are dependent on the exploitation of the fishery (WWF, 1997b).

The Agreement requires 30 ratifications or accessions to come into force. At the present time, 18 nations have ratified or acceded.

THE FAO 'COMPLIANCE AGREEMENT'

The conservation limits imposed on previously open access, high seas waters by regional conventions resulted in an increase in the re-flagging of vessels under 'flags of convenience' (FOCs). The adoption of such flags enables vessels to evade conservation measures for those regional conventions which the flag state has not yet become party to. Countries currently offering their flags include the Cayman Islands, Liberia, Cyprus, Barbados, Belize, and Belize, none of which reported catches of their fleets operating outside of their jurisdictional areas (Fitzpatrick and Newton, 1998).

In response to international concern over FOCs, the Agreement to Promote Compliance with International Conservation and Management of Fishing Vessels on the High Sea (the FAO 'Compliance Agreement') was approved in 1993. Originally the Agreement was intended to prevent the practice of re-flagging and to highlight the responsibility of States for vessels flying its flag. These aims were not fully achieved.

For new vessel construction and building, established international maritime practice is for FOC vessels to be flagged on delivery. For used vessels registered under a national flag, to change to a FOC requires permission from the national authority to remove the vessel from its register, although not all states or FOCs require such a deletion. States concerned with international conservation and management measures may be able to prevent their vessels from re-flagging by providing legislation that registered national fishing vessels cannot leave their jurisdiction. Requests for deletion from the registry could then be legally denied. Such a measure clearly has significant economic implications as it may prevent both the sale of used vessels to FOCs (intended to enable their evasion of regional restrictions), and also to other countries, intended for non-controversial use (Fitzpatrick & Newton, 1998).

It is clear that incentives still exist for the adoption of FOCs by fishing vessels intent on non-compliance. Such incentives may be further increased by heightened maritime safety and marine protection requirements in some regional and international conventions, encouraging more vessel owners to change to FOCs. Even though states with open registers are members of the International Maritime Organization and signatories to maritime conventions, better implementation of the requirements is clearly needed.

The main achievement of the FAO Compliance Agreement was as a means to monitor the areas used by fishing vessels operating on the high seas. The Agreement provides for FAO to maintain an international record of vessels authorized by flag States to operate on the high seas, which, through interaction with the Regional Fishery Bodies, would allow for determination of which vessels operated in the areas of jurisdiction of these bodies. There remains no clear obligation on states to supply the necessary information. Further pressure must thus still be brought to bear on all flag states to accept the agreement and control the activities of their vessels. Like the UN Fish Stocks Agreement, the FAO Compliance agreement has still yet to enter into force. As of January 1999, only 10 of the required 25 acceptance instruments had been received.

Conclusion

Action to limit fishing access and capacity has been applied at three main levels. At the local level, access limitation in traditional TURFs has been found to be effective under certain conditions. Local communities may control access to their resources when they have the recognised rights to do so, and perceive the long-term benefits of such actions. In modern times, such local mechanisms may need strong support from governments for their continued success.

At the national level, while it is true that the declaration of EEZs facilitated access limitations on foreign fleets, it was not sufficient to deter the build-up of capacity within national fleets. However, action not just authority is required to control capacity. Mechanisms are now being increasingly applied by nations to limit fishing fleets in their home waters, causing problems with the transfer of overcapacity on to the high seas and to other EEZs.

At an international level, there have been attempts to limit access and overcapacity on the high seas through the establishment of regional organisations and arrangements. However, the effectiveness of these is limited. Non-member and FOC vessels continue to fish on the high seas moving from region to region. The UN Fish Stocks Agreement and the FAO Compliance Agreement provide new impetus for controlling access, and to improve conservation and management, but these instruments have yet to enter into force.

III. Overview of Fisheries Management Tools and Their Effect on Fishing Capacity

A wide range of different tools has been used to regulate fisheries. Such tools vary in their potential effectiveness for controlling fishing capacity and fishing mortality, and also in the way in which they work. Some tools are designed for open access situations and require strong enforcement, while others are intended to allocate property rights to fishers and to provide indirect incentives for self-restraint. The tools fall into the following four categories:

- **output controls** on the size of catches which may be taken by the fishery;
- **input controls** on who may fish, and how much;
- **technical management measures** on where, when and how fish may be caught; and
- **economic controls**, such as taxes and payments for decommissioning, affecting the profitability of fishing and the size of the fleet.

This section describes the use and effectiveness of such tools, with examples in specific circumstances. The contribution of the different tools to fishing effort, catchability, fishing mortality and capacity are summarised in Section III. The potential choice of alternative tools for fisheries with different ecological, cultural and economic circumstances is discussed in the final Section IV.

Output controls

TACS AND UNALLOCATED QUOTAS

Total Allowable Catches (TACs), are set by fishery managers as an attempt to control the amount of fish that may be caught. They are usually calculated just before the start of the fishing season based on target exploitation rates and some knowledge of the current state of exploited fish stocks (e.g. from catch data), and of the abundance of young fish about to enter the fishery (e.g. from scientific surveys).

TACs have so far been set separately for each species. They may be subdivided as 'quotas' between defined areas and/or fishing gear types, perhaps as an agreed proportion of the TAC. In their simplest 'unallocated' form, however, quotas are set as the ***total*** catches allowed from the fishery sub-units, without any specification of ***who*** may take the catch.

In this form, TACs do not limit the fishing effort applied by fishing fleets. To the contrary, they generate a 'race for fish', forcing fishers to fish as hard as possible to a good share of the catch before the TAC or quota is exhausted. Such competition promotes non-compliance with regulations and makes fishing extremely difficult to enforce. Quotas based on TACs are also seen as inappropriate for mixed-species fisheries, as they encourage discarding of fish caught as by-catches in on fishery after the by-catch species quota is exhausted. In addition, they make enormous demands upon scientific resources in terms of data provision and analysis.

TACs and unallocated quotas are currently used for the management of most fish stocks in European waters. In these geographically complicated waters, the political difficulties of subdividing fishing rights between nations have so far proven a challenge for any mechanism other than a simple division of the TAC, based on historical proportions. The EU's Common Fisheries Policy (CFP), which provides the basis of the TAC system, has received many criticisms (Box 2), and is approaching a major review in 2002.

Box 2. Criticism of TACs for the management of European mixed-species fisheries (Holden, 1994)

- The application of TACs in the EU is abused by **political trade-offs**. Though the quality of the scientific advice on which the TACs are based is of a high quality, the process of making recommendations is too open to political influence. Once recommendations have been made to the European Council of Fisheries Ministers, there is a further process of negotiations and political 'horse trading' before TACs are finally agreed. Thus TACs are often set higher than recommended by the scientists due to political pressures.
- TACs are set separately for each major species, and cause by-catch problems in the **multi-species fisheries** in European waters. Fishing for secondary target species continues even after the TAC for the main target species is exhausted, leading to wasteful discarding. Under EU legislation, only landings not catches are formally recorded and used in assessments. Estimates of discard levels for North Sea haddock in 1993 were almost equivalent in weight to reported landings of the stock.
- Unallocated TACs are unsuccessful at limiting landings, and furthermore provide incentives for the 'race to fish', misreporting and illegal landings. Landings of over quota, 'black fish', have been estimated to be twice as high as for the total legal fish quota in Scotland (Reported in the Scotsman Newspaper, 16 Sept, 1992). The TAC system thus has played little or no role in the conservation of fish stocks.

Box 3. Case study: the South East Australian ITQ system (CEMARE, 1996)

The South East Australian fishery is the main supply of fresh fish to key Australian markets. Management in the form of entry limitation was introduced to the fishery in the mid 1980s in response to increasing levels of fishing effort and decreasing catches. Initially 150 licences were issued in the fishery. A boat replacement policy in the form of a unitisation scheme was also introduced in order to prevent licence holders from replacing the existing boats with larger boats. In order to introduce a new or larger boat to the fishery, units had to be acquired from other licence holders to meet the requirements of the new boat. Unit forfeiture was also introduced as a means to ratchet down the total capacity of the fleet as new boats were introduced to replace old ones.

However, while the management plan prevented the expansion of fleet capacity, the fishery was already overcapitalised by the time that the limitations became effective. The problem was compounded when it was realised that several key stocks could not sustain the existing levels of catch. A number of management tools were then implemented including buy-back schemes and ITQs.

After initial experiences, the preferred option was the ITQ. These were introduced for one species in 1989 and a further 15 species in 1992. Since then, the fleet size has decreased as fishermen, faced with lower catch levels, amalgamated their quotas and surplus quotas were removed from the fishery. This made a significant positive effect on the economic performance of the fishery as well as the long term sustainability of the catch.
For most sectors of the fleet, rates of return to capital were high or higher following the introduction of ITQs than in previous years.

INDIVIDUAL TRANSFERABLE QUOTAS (ITQS)

'Individual transferable quotas' have been introduced in several fisheries around the world to attempt to solve some of the problems associated with unallocated quotas. As ITQs, quotas are assigned directly to individual fishermen, or fishing companies, thereby eliminating the need to compete for catches. ITQs may either be allocated to fishers on the basis of their historical involvement in a fishery, or just sold to the highest bidders. ITQs do not obviate the need to set total catch levels, which may still vary between years, depending on the state of fish stocks.

ITQs are currently one of the most widely discussed management solutions to overcrowded fisheries. They have been strongly promoted as a successful system for the allocation of access rights in fisheries. Efforts to apply the concept in Iceland, New Zealand and elsewhere have been hailed as successes, and have resulted in a reduction of overcapacity (Box 3).

ITQs have four key advantages. Firstly, because they allocate ***exclusive*** rights to a share of the catch, ITQs provide an incentive to behave economically and efficiently and discourage competitive over-capitalisation. Secondly, where ITQs are allocated as a ***permanent*** share of the catch, participants in a fishery have an incentive to plan their fishing activities as a long-term sustainable strategy. ITQs expressed as percentages of the TAC give fishermen a clearer interest in maintaining the healthy state of the fish stocks, as this will maintain the actual weight of their percentage share of the TAC. Thirdly, the ***transferability*** of ITQs enables the most efficient operators and fishing gears to increase their shares via trading mechanisms, and allows the less efficient fishermen to leave the fishery with some compensation. Fourthly, ITQs assist with a certain level of ***self-enforcement*** and create incentives for participants in a fishery to behave cooperatively. This type of control cannot, however, completely replace centralised enforcement.

On the other hand, there are also disadvantages associated with ITQ systems. Since ITQs favour larger, more efficient and capital-intensive operations over small-scale fishers, they may result in the transformation of a fishery from one comprised of individual owner-operators to one with a (potentially smaller) number of wage earners. Without safeguards, they can facilitate concentrations of capital and accumulation of quotas in the hands of a few, and lead to the breakdown of traditional fishing societies. Since ITQs represent the allocation of private property rights (see Section IV), there may also be resistance from fishermen who had traditionally obtained benefits from the previously open-access fisheries and resent this restrictive measure. Alternative variations on the strict market-based ITQs are continuously being developed, including the community-allocation of quotas, where non-market mechanisms may be employed in the allocation of rights (Symes, 1998).

Some developed states have implemented Individual Transferable Quotas (ITQs) to fishing vessels as a means to reduce the size of their national fleets, and avoid the financial implications associated with fleet reduction programs. In most cases ITQs reduce the size of the fleet, but the practice of leasing quotas by quota holders will, in turn, increase the capital requirement for active fishing vessels. ITQs therefore reduce the number of fishing vessels but do not necessarily reduce the overall capital demand from the resource. In addition, the benefits of ITQ's to conservation and management have at this time, not been sufficiently demonstrated to allow for unqualified endorsement for implementation.

The discarding of by-catch in multi-species fisheries also remains one of the most difficult problems to overcome in ITQ schemes (as in unallocated TACs and other management mechanisms). The process of 'high grading' is particularly associated with single-species ITQs, especially where different sized fish fetch very different prices. In this, fishers discard smaller, low value fish, and only land larger, high value ones to maximise the value of their slice of the quota.

Input Controls

Input controls attempt to limit the actual fishing effort applied in fisheries, as compared to output controls such as quotas which attempt to control the resulting catches. In principle, input controls may be the most effective management tools for controlling fishing effort wherever enforcement can be effective. This section considers the application of restrictive licensing of the numbers of vessels, and the use of days at sea regulations to control fishing time.

RESTRICTIVE LICENSING

The simplest means of controlling fishing effort is by using a licensing scheme that limits the number of vessels or fishers allowed to participate in a fishery. Such ***restrictive*** licensing must be distinguished from the registration schemes that exist in many fisheries, where licenses are required to fish, but are freely available to all.

Licensing programs are best undertaken when a fishery is still developing. This reduces the political problems associated with forcing existing participants to leave a fishery. They also work best in management regimes where the resources are seen as the property of a single country, i.e. within EEZs. When licensing an already overcapitalised fishery, difficulties will often arise when considering the criteria for issuing licenses, e.g. to vessels according to their track records of catches.

Due to increases in fishing power due to technological developments, licensing schemes that limit entry to a ***constant*** number of vessels or fishermen may not in themselves prevent the reappearance of overcapacity. In order for licensing programmes to achieve the desired exploitation levels they may need to be continually readjusted depending on the state of the stocks and the fishing mortality being applied. Reductions in the numbers of licenses will be easier to apply where licenses are issued to operators who do not have a permanent stake in the fishery (see Box 4). Licenses may also contain other stipulations, such as the size of vessel, types of gear and mesh size that can be used. The phenomenon of 'technology creep', where other technological factors are used to circumvent restrictions, must be taken into account.

Box 4. Restrictive Licensing of the Falkland Islands Squid Fishery (des Clers, 1998)

Commercial fisheries in the Falklands began in the 1960s. Fishing activities were uncontrolled until the extension of the 150nm Falkland Islands Interim Conservation and Management Zone (FICZ) was declared in October 1986 (FIG, 1989 in des Clers 1998). Soon after this declaration, the Falkland Islands government began to limit the number of vessels through a vessel licensing scheme. Since that time, restrictive licensing has remained the main tool used to manage fishing effort within the zone.

The licensing scheme is very closely linked to the stock assessment program. It is mandatory that vessels report catch, effort and location on a daily basis to the Fisheries Department. Since 1987, it has been based on a system of points which favors European and locally registered vessels through locally based companies. License fees per season increase with vessel GRT. Although the number of vessels fishing dropped when the EEZ was declared, the demand for access has largely exceeded the number of licences offered. Vessels without licenses have resorted to fishing outside the FICZ.

By 1991, the squid fishing fleet in the Falkland EEZ were mainly European distant water vessels who had been given the incentive through EU financial instruments to reflag and re-register. The re-registration of EU fleets for distant water fishing had the potential threat of permanent overcapacity in the FICZ but the restrictive licensing program implemented by the FIG has managed to avert this.

Restrictive licensing reduces localised fishing capacity, protects fish stocks and minimises the rent dissipation resulting from overcapacity. By minimising the amount of restrictions on a fishery, and by allowing participants in a fishery to land all of their catch within defined seasons (as compared to the more limited ITQs), the incentives for cheating are greatly reduced. This type of licensing has worked well for species where TACs cannot be estimated in advance. In such fisheries, the number of licenses may be set to achieve a target escapement level for the following year (Box 4). Good monitoring and assessment is still required, however, to determine when target escapement levels are reached, and to ensure the fishery is not overexploited.

LIMITS ON DAYS AT SEA

Days at sea regulations are used to limit the total numbers of days that vessels may spend in a fishery. They are usually set as a monthly limit, and applied in conjunction with restrictive licensing, in order to control the fleet's total level of fishing effort. Days at sea limits are currently used in this way in many EU fisheries, where restrictive licensing alone has been unable to limit the fishing fleets, due to the high demand for access and political pressures. Days at sea limits spread the burden of capacity cuts across licensees, but may eventually push the fleet to economic crisis if the resulting catches decline too far due to the short fishing time available.

Days at sea limits may also be useful in small scale fisheries where part-time fishing activity may be acceptable, or in seasonal fisheries where fishermen and communities have alternative income-earning activities. They may cause problems, however, where most of the participants in a fishery are heavily dependent on fishing with few alternative prospects of other jobs. It may also be important to recognize the rights of seasonal fishermen, as well as the economic significance of seasonal fisheries, in planning for the management of fishing capacity.

Technical Management Measures

CLOSED AREAS

Closed areas are one of the most traditional measures used to control fishing exploitation in order to maintain yields. They are most appropriate for sedentary and local stocks but are generally not considered to be appropriate for highly migratory species. They are most often used to protect the grounds of juvenile and breeding fish. For these purposes, their effectiveness depends on a clear understanding of the population dynamics of the species. The benefits of closed areas can be enhanced by the establishment of other controls on fishing effort, outside the closed area. The actual benefits of closed areas depend on the scale of migration of adult fish (affecting their vulnerability to fishing outside the zone) and the rate of increase of production of new recruits from the increased stocks inside the area.

In some cases, partially closed areas are also used as a means of allocating user rights amongst different groups of fishermen. For example, some developing countries have established closed coastal belts to protect their small-scale fishers from competition with the large-scale industrial fishers. In both of these cases, effective enforcement and surveillance systems will be required to ensure the benefits of closed areas. In inshore waters, such systems may be best achieved under locally-supported community based management of resources (see Section IV).

MARINE PROTECTED AREAS

Marine protected areas (MPAs) are sites established for the protection of wildlife and essential habitats in particularly vulnerable or valuable locations. Areas closed to fishing activity should not be confused with MPAs, though the two may share some features, objectives and benefits. In Agenda 21, section 17, on the protection of oceans, places a specific requirement on coastal states to undertake measures which will maintain biological diversity and the productivity of marine species and habitats under national jurisdiction. This includes amongst other things, the establishment of MPAs. A number of other international agreements – not least the Convention on Biological Diversity – implicitly or explicitly promote the adoption of protected areas for a range of conservation purposes. A global representative system of MPAs is also now being promoted by IUCN, the World Bank, and the Great Barrier Reef Marine Park Authority.

Though MPAs are thus designed for nature conservation purposes, calls have also been made for their use in the fight against global excesses of fishing activity. MPAs may provide significant conservation and productivity benefits, but it is important to recognize that they will not contribute to the reduction of fishing overcapacity. While an MPA may reduce the catchability of some portions of a fish stock, it may also result in the transfer of fishing capacity to other areas. The use of MPAs must therefore be orchestrated with broader regional attempts to control fishing activity.

CLOSED SEASONS

Closed seasons are conceptually similar to closed areas, and designed to protect vulnerable stocks or those fish in critical periods of their life cycles. They may need to be flexible to allow for environmental variability in the timing of key life history events (which the closed season is designed to protect).

Although closed seasons can be beneficial to conservation, one of their major drawbacks is that they can actually encourage overcapacity, in the same way as unallocated quotas. Participants in a fishery may thus increase their investment in fishing vessels and technology so as to ensure good catches during the more limited open season, thus leading to increased fishing pressure (Box 5). The effectiveness of this measure must be ensured by a combination of other measures such as limiting access and capacity. As is the case with closed areas, closed seasons are only useful when used with other strategies for reducing overcapacity.

Box 5. Closed Seasons and the Pacific Halibut Fishery (OECD, 1993)

The Pacific halibut fishery is one of the oldest commercial fisheries on the west coast of North America dating back to the 1890s. In 1979, the Canadian Department of Fisheries and Oceans (DFO) moved to limit the halibut fishery. Limited entry was aimed at stopping the growth of redundant harvesting capacity, but was applied far too late. Although the total number of vessels was capped, nothing was done to control the other components of fishing effort and catchability, or to curb the 'race for fish'. Vessel owners then used whatever means they could to increase their fishing power, such as investing in larger boats, employing larger crews, or even fishing for up to 24 hours a day.

The side effects of the race inevitably became dangerous for the halibut industry. Fishermen fished in dangerous weather, with excessive gear to try and catch more and more fish. Gear was being lost as vessels set too much gear in bad weather. The quality of the fish diminished as more time was spent hauling and setting and less time processing fish.

With greater fleet limitation, the Pacific halibut fishery could operate safely and productively all year round. With an overcapitalised fleet, the Pacific Halibut Commission has been repeatedly forced to shorten the season. By the late 1970s, the bloated fleet was restricted to fishing only a few weeks a year. By 1990, the season was a mere 6 days. Closed seasons may thus be effective in controlling fishing effort, but may prove disastrous when they are not in conjunction with other measures to control fishing capacity.

GEAR AND TECHNOLOGICAL RESTRICTIONS

Restrictions on fishing gear are popular with fishery managers because they are relatively easy to implement and enforce. Mechanisms such as square meshes in trawls may be used to increase the escape of undersized fish, while certain designs may prevent by-catches of undesirable species. Biodegradable gaps in traps may prevent 'ghost-fishing' by lost gear. In single gear fisheries, gear restrictions also they have no distributional impacts.

Fishermen, may dislike technological restrictions because of the limits they impose on their activities and the expenses incurred with changing gears. In over-exploited fisheries where participants are under pressure to catch more, these additional restrictions are usually greeted with opposition due to their short-term impacts. However, there are also instances where participants in a fishery support gear and technology restrictions in the belief that these measures will maximise the quality and value of their catches in the long term, and where there is confidence that compliance will be universal. Gear and technological restrictions have some potential to control capacity, if implemented and enforced, by limiting the catchability of the fishing process.

MESH / FISH SIZE LIMITS

Mesh and fish size limits are used, often jointly, to prevent the capture of small fish. Size limits are applied either to ensure that some fish are able to reach maturity and spawn before capture, or simply to increase the average size of fish landed in the fishery. Size limits may be effective at limiting the catchability of fishing gears towards small fish, but may be difficult to enforce in highly dispersed fisheries.

Box 6. Subsidies and the Northwest Atlantic Groundfish Fishery (Schrank, 1995).

In 1990, catch from the Northwest Atlantic made up 35 percent of the total Canadian finfish catch. In 1990-93, Canadian catches of Atlantic cod fell by over 90 percent. As early as 1960, the problem of overcapacity in the Northwest Atlantic was evident but fishing by foreign vessels, mainly Spanish and Portuguese was still blamed for the collapse. With the declaration of the 200 mile EEZ in the mid-1970s, the Canadian government focussed on ensuring the competiveness of national fleets. Government supported the growth of the industry in the form of subsidy programs to both fishermen and processors, with the intention of maintaining regional stability within the fisheries sector. The level of subsidisation grew until the early 1980's when the total subsidies was equivalent to the value of production of landings in some regions. In 1991, total subsidies exceed $1 billion, while the total value of catch was estimated to be about $0.9 billion.

In 1992, the cod fishery was closed indefinitely based on the recognition that the levels of exploitation and subsidisation were unsustainable. Policies were introduced to reduce the harvesting capacity of the fleet by some 50 percent and fishermen and processing plant workers have been retrained. In the absence of subsidies it is likely that both the environmental and social impacts resulting from overcapitalisation would have been significantly lower.

Economic Controls

DEVELOPMENT SUBSIDIES

As described in Section I, governments, multilateral finance institutions and development agencies have used a range of different subsidies as a means of improving the economic condition of the fishing industry. Subsidies may, however, cause more harm than good. A whole array of direct subsidies have been applied by various governments and management authorities: the subsidisation of fuel costs, the provision of low-cost loans, for gear acquisition and vessel reconstruction, and the support of fish prices, generally by restricting fish imports. Other forms of subsidisation are used for research and to provide alternative livelihoods for fishermen and communities.

In both developed and developing countries, direct subsidies have provided the incentive to buy bigger boats and invest in advanced technology and gear without any thought for the future of the fish resources. This has facilitated the build-up of overcapacity and resource depletion, as their costs were not totally supported by fishermen. Once this process has begun, more subsidies are given to compensate for the resulting losses and this usually exacerbates the problem. However, many countries have reduced the level of subsidization to the fishing industry in recent times. There has been a re-direction in most cases of subsidies towards capacity reduction (see Box 6).

TAXES AND FEES

Taxes are levied as a means of achieving broad policy objectives but are not generally used for the reduction of fishing effort. Two types of taxation can be used: direct and indirect. License fees can be charged directly on vessels or gear, either with or without restrictions on license numbers, or taxes can be levied indirectly on the weights of fish landed. Such taxes may provide for cost-recovery of the often substantial requirements of the management, monitoring and enforcement process.

Taxes are generally unpopular with participants in a fishery unless they are used to supply some direct benefit, such as increased numbers of fish through stocking programmes. Taxes may nevertheless be useful in reducing fishing effort as they increase the overheads of fishing and may force some of the less efficient operators out of the fishery. The desirability of this selection mechanism will depend on the objectives – social or economic – of the fishery.

DECOMMISSIONING

Directly reducing physical fishing capacity by decommissioning and buy-back schemes potentially has the greatest impact on reducing local overfishing. True decommissioning involves the scrapping of vessels to remove their capacity permanently. Where vessels are only bought out of one fishery to be immediately sold into another, global capacity clearly is not reduced. The effect of such exports of capacity in the receiving fisheries depends on local situations and the state of fish stocks, and must be considered on a case by case basis. For some under-exploited fisheries in developing countries, the transfer of fishing capacity at second-hand prices may be beneficial to local fishing industries

In Europe, the decommissioning of vessels under the Multi-Annual Guidance Programmes (MAGPs) is the main mechanism of streamlining the industry in line with available fish resources (Lassen, 1996).

Summary of the effects of different management tools on the limitation of fishing mortality and capacity

As explained in Section I and demonstrated in this section, the management tools described vary in their abilities to contribute to the limitation of fishing mortality (effort times catchability) and capacity. As shown in Table 2, no single tool will simultaneously constrain all of the different components of fishing effort and catchability.

As catchability must always be expected to increase gradually in line with both the experience of skippers and the technology of fishing, it must be expected that both fishing effort and capacity will need to decrease gradually over time. If such factors are not controlled, fishing mortality will continue to increase, and more and more stocks will eventually collapse due to overfishing.

Reductions in fishing effort may either be achieved by applying property rights systems and limiting the numbers of fishers, or by keeping open access conditions, applying increasingly strict technical and economic measures and slicing the pie ever more thinly between fishermen. As discussed in Section IV, the choice of solutions depends on the acceptability of property rights systems, and the ecological, cultural and technical circumstances of individual fisheries. Before moving on to this discussion, this section provides some summary points on the potential effects of the different management tools on fishing mortality and capacity.

Firstly, it is now clear that the unallocated TAC system has little to recommend it due to the competitive 'racing' behaviour it promotes. A TAC system plays virtually no role in the control of fishing effort, apart from limiting the time available for fishing after the quota is all caught and the fishery is closed. In the open-access days of the Pacific halibut fishery, overcapacity was so excessive that the fishing season was reduced to only a few days in length.

As alternatives, property-based systems such as ITQs may make the greatest contributions to fishing effort and capacity limitation (Table 2). Depending on their application, ITQs may directly control the numbers of fishing vessels. In addition, they indirectly provide the economic incentives for self-limitation of the other components of fishing effort. They also contribute to the limitation of physical capacity of the fleet within the local fishery. On the negative side, ITQs still require catch limits to be set, may result in social problems in certain circumstances, and must force any unlicensed vessels out into the global 'fishing capacity pool'.

Restrictive licensing (RL) limits the numbers of vessels in the fleet, but may not provide the same incentives as ITQs to limit the development of capacity. Since RL systems provide only temporary or permanent ***access*** rights to fishing rather than true ***property*** rights to the catches, vessels must still compete for their share of the catches. Though both systems can control fishing mortality effectively, fleet capacity may need to be cut back more regularly under RL than under ITQs. With ITQs, and constant catch shares, operators may either choose to trade off increasing technology against reducing effort (perhaps freeing them to go fishing elsewhere for part of the season), or to stick to existing methods and maintain full-time activities within the one fishery.

Some countries have both input and output controls, designed to support each other. In the EU, days at sea limits, are currently being used in conjunction with RL systems and TACs in an attempt to coordinate the allowable catch quotas and the effort required to take it. Depending on their specifications, days at sea regulations may also limit the catchability of fishing activities if they prevent the concentration of allowed fishing days in the best fishing seasons, by spreading effort out over the year. However, with continuous changes in the design of vessels and their catchability, it is easy for such input and output mechanisms to get out of step with each other. For these reasons among others, many countries are now moving towards ITQ-based output controls, in various forms, where possible (Cunningham, 1993, in CEMARE, 1996).

The actual numbers of fishing vessels may only be controlled by the property based systems, restrictive licensing and by economic measures which either reduce the profitability of fishing or directly buy vessels out of the fleet. Only decommissioning (vessel destruction) physically reduces the ***global*** capacity of the fishing fleet. All the other tools have l***ocal*** effects, but may just displace vessels / effort / technology out into the global fishing pool.
The direct and indirect contributions of restrictive licensing and taxes will depend on what exactly is licensed or taxed, (e.g. engine capacity or vessel size). It must also be remembered that the global benefits of decommissioning may easily be compensated by development subsidies for the creation of new vessels, or by vessels built without subsidies.

A range of different technical management tools may also be used to contribute to the control of different components of fishing effort. Closed areas will not limit the actual fishing effort applied, as vessels will be simply forced into waters outside such reserves. They may contribute to reducing the catchability of fishing effort, but only if the reserve covers an area of high fish densities such as a spawning ground or if fish migrations are sufficiently low to keep fish in the reserve away from the fished waters. Such protected stocks may export biomass to the fisheries outside the area of protection, either as larvae or adult fish. Closed seasons more directly limit the fishing effort of the fleet by controlling the time which vessels may spend fishing, but they may also cause socio-economic difficulties if fishermen are unemployed for much of the year. Technological and gear restrictions may be used to limit the power and size of vessels and gears, and both their catchability and capacity (Table 2). Again, however, such measures only control the physical capacity of the fleet within the locally managed fishery, as vessels may still invest in technology for use in un-managed fisheries outside.

Table 2. Contribution of different fisheries management tools to the limitation of fishing effort and catchability within a managed local fishery, and the physical capacity of the fishing fleet at both a local and a global level (empty cells = no contribution; it is assumed that the regulations are enforced).

Management tool		Contributes to limitation of fishing effort within local fishery?						Contributes to limitation of catchability within local fishery?				Contributes to limitation of physical capacity?	
		No. of vessels	Vessel power	Vessel size	Gear units	Gear size	Fishing time	Tech-nology	Exper-ience	Times fished	Places fished	Locally	Globally
Output Controls	Unallocated Quota						Indirect						
	IQ/ITQ (Allocated Quota)	Yes	Indirect	Indirect	Indirect	Indirect	Indirect	Indirect				Indirect	
Input Controls	Restrictive licensing	Yes	Maybe	Maybe	Maybe	Maybe						Yes	
	Days at sea limits						Yes			Maybe			
Technical Measures	Closed area / reserve										Yes		
	Closed seasons						Yes			Yes			
	Technological / gear restrictions		Yes	Yes		Yes		Yes				Yes	
	Mesh / Fish size limits							Yes					
Economic measures	Taxes and fees (or removal of subsidy)	Indirect	Indirect	Indirect	Indirect							Yes	
	Decommissioning (vessel destroyed)	Yes										Yes	Yes
	Buyback schemes	Yes										Yes	

IV. The Choice of Access Controls in Different Contexts

The development of locally appropriate solutions

The previous sections have described the development of the world's overcapacity and overexploitation of fish stocks, and outlined the potential contribution of different management tools for their limitation. This final section provides some guidance on which access controls and management tools may be most useful in different contexts.

The best choice of management tools will depend on a range of factors including the ecological, cultural and economic circumstances of the fishery, the capacity of the management agency, and the management objectives for the fishery, as chosen by all the various stakeholders. With wide variation in the nature of different fisheries around the world (or even within a region), there is no single blueprint, 'one-size-fits-all' solution. Guidelines are given in the following sub-sections for alternative management approaches for different types of fishery (artisanal, industrial and high seas). In the end though, the appropriate solution for each local situation must be determined by its own local stakeholders based on its own individual circumstances.

Improvements to management arrangements will often require new ***partnerships*** to be formed between government and the various stakeholders in the fishery. Where such new institutions are created against a background of limited experience of shared responsibilities (or even outright conflicts), there will be a need to adopt these new management practices gradually, and perhaps in only a few fisheries or locations in the first instance. It will often be difficult to predict the exact outcome of using a given management tool, due to local variations in habitat characteristics, social factors, external influences, and so on. The outcome of bringing together different stakeholder groups may also vary locally depending on their strengths and weaknesses, and the combination of groups involved in each place.

Given that there are no perfect solutions, it is recommended that a 'process approach' be adopted for the uptake of new management tools, instead of attempting to stick rigidly to solutions seen to work elsewhere (Mosse et al, 1998). In the process approach, the development of a new management solution may best be seen as an ongoing activity, in which solutions to problems will arise through experimentation and practice rather than through design. This contrasts to the more conventional view of development 'projects' as linear, controlled systems, where there is a fixed and predictable relationship between project inputs and project outputs. A flexible approach may always find a solution as long as sufficient commitment to shared goals can be developed and maintained. The key to such commitment will often lie in the ***joint selection*** of fishery management objectives by all of the key stakeholders of a fishery.

In searching for shared goals, it must be clearly understood that it will usually not be possible to satisfy all of the objectives of all of the different stakeholders at the same time. Stakeholders promoting economic efficiency and supporting the introduction of ITQs, for example, may often find themselves in conflict with social scientists and artisanal, family based operators who give higher priorities to social and community goals. In the end, a spirit of compromise, the recognition of alternative perspectives and a commitment to overall social welfare and long-term sustainability may still provide workable local solutions.

The question of property rights

The allocation of 'rights' to exploit natural resources is an emotive issue much discussed in fisheries circles in recent years. Fishing around the world must have been open access for many centuries. In the 'good old days', with few fishermen and lots of fish, the open access situation posed few problems, as there must always have seemed to be enough fish to go around. Nowadays, with many more fishermen, there are clearly not enough fish to keep up with the capacity of the fleets. With economists pointing to the advantages of exclusive rights, fishers are naturally wondering just ***who*** will have the right to fish, and ***who*** will lose out? This section considers the possibility of applying limited use rights in fisheries; the following sections show where different types of property rights systems may best be used.

Property rights to common pool resources may be held in one or more of the following ways (Symes, 1998a):

- **open access**, where fishing is freely available to all, though perhaps within defined technical regulations;
- **private property**, where an individual or corporation has the right to exclude others from using the resource;
- **communal property**, held by an identifiable community of users with rights to exclude others, and
- **state property**, where the state holds the rights to the resource in trust, on behalf of the country's citizens.

Private property rights are allocated under ITQ systems where a defined slice of the quota is seen as 'property' even though its size may vary between years. Where communal property rights are allocated, subsidiary individual rights may either be allocated to a limited subset of community members or kept as the right of all. State jurisdiction was initially confirmed by UNCLOS, and the declaration of the 200 mile EEZs.

Where property rights are legally and culturally assignable, it is now generally accepted that they will lead to economic, management and sustainability benefits. As both private property and communal property, rights based management can reduce the proliferation of statutory controls that threaten to suffocate the fishing industry (Symes, 1998b). Whoever is allocated the rights to fish, such benefits will only be achieved if the allocation is be clearly made, and recognised and respected by those fishers excluded from the fishery.

In some cultures, privatised rights to natural resources may not be compatible with traditional or legal systems. In France, for example, fisheries are still seen as a cultural heritage and fishing rights are prevented from becoming marketable goods (Prat, 1998). In such cultures, open access systems may need to be retained, and fishing effort and mortality constrained only by tools such as non-allocated quotas, technical and economic measures.

Even where property rights are legally acceptable, the restricted allocation of use rights may still raise opposition, whenever they are seen as giving unfair advantage to a few fishers. Such arguments may be countered if the users ***pay*** for their use rights, and the revenues generated are taken into state coffers for the wider benefit of all citizens (Clark et al, 1989). Even private property rights may then be seen as being 'rented' from the state, rather than simply handed over to a select few, to the permanent loss of the rest of the the population. Where such an allocation provides long-term sustainability benefits either to a local community or to the nation via use right rentals, then the benefits from the fishery may still be seen to be gained by all. In comparison to the alternative open-access situation with universal rights to fish, but extremely limited profitability, the renting of use rights may be seen as both fair and beneficial to society as a whole. Finding acceptable solutions of this kind may require the creation of fully transparent mechanisms demonstrating the profits and revenues being generated by a fishery, and their distribution between different stakeholders.

Both restricted property fisheries and open access fisheries may in principle be managed sustainably. A property based system allocates more responsibility to the stakeholders and gives them the incentive to operate more efficiently and sustainably. On the negative side, they may also lead to the exclusion of the less capitalised, marginal operators, unless these are protected somehow. Open access systems, in contrast, may spread fishing opportunities more widely between those desiring to fish, but will usually lead to high levels of fishing capacity restrained by increasingly complicated management measures.

Inshore, artisanal fisheries

Artisanal fisheries are usually labour intensive, with many small boats from dispersed, coastal communities exploiting traditional, local fisheries. Such fisheries usually operate within the inshore waters, often within the 12-mile territorial waters. Artisanal fisheries in temperate waters usually target sedentary species, particularly shellfish, while those in tropical waters are more often associated with multi-species stocks, e.g. on coral reefs. Such fisheries are often spatially discrete, operating within site of local landmarks, and around specific aquatic features, such as banks, islands, estuaries or channels.

For such inshore artisanal fisheries, the provision of employment opportunities and food security and the sustainability of the lifestyles and cultures of coastal communities may be higher priorities than the generation of the maximum economic revenues. With these objectives, and with their usually small size and social and geographic features, such fisheries are well suited to community-based property rights systems. The ownership of 'TURFs' for local fisheries (Section II) may thus promote voluntary restraint and give fishing communities the incentives to ensuring the long term survival of their fisheries and the viability of the local community. When given the appropriate incentives, local management of inshore, artisanal fisheries may benefit from the empirical knowledge and practical experience of local fishermen, and also from their abilities to enforce their own local management regulations.

Though attractive, community based fisheries management (CBFM) in spatial 'TURFs' may be more practical in some places than in others. A wide range of preconditions have been identified which increase the chances of successful CBFM (see e.g. Ostrom, 1990; Pinkerton, 1989; and Pomeroy and Williams, 1994). These include clear boundaries and a manageable size for the management unit, and a relatively homogenous community with shared interests and a common approach to problem solving. CBFM may be best encouraged especially where it already exists, or can be strengthened, and in societies with a tradition of ownership and area-based allocation of rights (e.g. in agricultural systems).

Though CBFM has operated successfully in some societies for centuries, traditional mechanisms are now increasingly threatened by the invasion of new systems of values and economic pressures from outside the local community. CBFM will often nowadays require the legal support of governments in a co-management role, and the participation of a range of different stakeholders, such as environmental groups, development NGOs, and fish processing and marketing industries. The devolution of fisheries management to local partnerships is thus far from being a simple option.

For effective CBFM, the management partnerships must be legally recognised and given the right to exclude others from the resource. Management rules must be well adapted to local conditions and to the preferences of the community members and other stakeholders. Local fishery managers must not be simply expected to enforce regulations imposed on them 'top-down' by national fisheries departments. They must instead be allocated the right to make their own regulations, possibly on condition of their compatibility with the principles of sustainable use. Local partnerships must also be given time to gradually take on full responsibility for managing the fishery. In the early days, they will require legal, technical, financial, social and administrative support. Intermediary organisations such as environmental and development NGOs and projects may provide invaluable support to both government and community partners at this time. Ironically, CBFM also requires a strong central government, committed to the principle of decentralisation.

Where a number of different CBFM areas are being developed simultaneously, they should be integrated by government planning agencies into wider systems of coastal zone management. The different CBFM areas may also be coordinated regionally, depending on their size and numbers, with government partners communicating both positive and negative experiences between different areas to encourage the learning process.

Local CBFM may use a range of different management tools. In traditional systems, technical management measures have been commonly employed, such as area and season closures, and restrictions on the most dangerous types of gear. Access may also be limited to members of the community either by formal licensing, or by informal methods, as used by the harbour gangs of the Maine 'lobster fiefs' (Acheson, 1975). Such tools may be relatively easy for local communities to administer and enforce, compared to the technical complexities inherent with quota based management (not least the annual estimation of the TAC and the monitoring of catches from so many dispersed fishers). The may also be most appropriate for multi-species resources, where single species quotas cause difficulties with bycatches and discarding.

Offshore, industrial fisheries

In direct contrast to the artisanal fisheries, industrial fisheries are characterised by relatively few vessels, high capital investments and profits, and the ability to fish far from the home port. Most such fisheries operate within the 200 mile EEZs of coastal nations.

With fewer direct associations with particular ports, it has been proposed that these types of fisheries should be managed with the primary objectives of sustaining fish stocks and maximising economic efficiency (Munk, 1997, in Symes, 1998b).

As for the artisanal fisheries, the choice of management system depends on stakeholder preferences and practical circumstances. Either open access, communal or individual access rights may all be appropriate in different cases (Symes, 1998b). Where the allocation of individual property rights is acceptable and practical, sustainability and economic objectives may be most easily achieved by ITQ systems with transparent and open markets for quota rights. The relatively small number of large vessels involved in these fisheries eases the burden of monitoring and controlling the ITQ system, that may prevent its use in artisanal fisheries. Quota setting will usually be the responsibility of governments, while quota administration and market planning may either be conducted by government, or be devolved to industrial or 'community' partners.

ITQ systems are particularly appropriate for long-lived, usually demersal species, where TACs can be estimated in advance from catch monitoring and pre-recruit surveys. For short-lived species, and for squid which only live for a single year before reproducing and dying, catches usually can not be estimated in advance due to the uncertain relationship between the numbers of spawners and subsequent recruits. The alternative restrictive licensing may then be more effectively employed, where the number of vessels is limited to achieve a given target fishing mortality, instead of a specified total catch. Such approaches have been used in the Falklands squid fishery (see Box 4), where the fleet is mostly comprised of foreign vessels, and priority objectives are thus the sustainability of the fishery and the generation of license revenues. Limited entry systems may also be valuable elsewhere, preferably in the context of real partnership agreement with the industry and on the basis of more rigorous financial incentives.

For stocks which straddle the waters of many different nations, agreements over the allocation of property rights may be especially hard to achieve. Until political agreements can be reached, non-property-based management tools may remain the only practical way of reducing capacity and fishing effort in these fisheries. In the North Sea, for example, TACs for stocks shared amongst adjacent nations are set regionally by the European Commission, and subdivided into national quotas for allocation purposes. Capacity and fishing effort are controlled by supporting national licensing systems, and days at sea limitations within each country. The regional control of fishing capacity is harmonized by the Multi-Annual Guidance Programmes (MAGPs), which are updated every five years to accommodate the latest estimates of fishing mortality caused by the fleets. Closed areas and seasons may also serve to limit fishing mortality.

Highly migratory species and high seas fisheries

As access to fisheries in national waters becomes increasingly limited around the world, more and more vessels will find themselves competing for the few fish remaining in high seas waters. Fish stocks in these waters include highly migratory species, such as tuna, swimming freely through the world's oceans, and other less migratory species, which nevertheless straddle the waters of one or more coastal nations and the high seas.

Fisheries for these species are usually industrial, though some stocks may also be exploited by artisanal fleets, either as juveniles in inshore waters, as adult salmon returning to their native rivers, or as tuna passing briefly through artisanal fishing grounds. Such wide ranging fisheries are the most difficult to manage due to the absence of clear property rights in international waters, and the challenge of enforcement over such vast areas.

High seas fisheries are at present either open access, or managed by regional fisheries organisations, such as NAFO and ICCAT. As mentioned earlier, such organisations may apply management constraints on vessels of those nations which become party to their associated conventions, but traditionally have had no legal power over vessels of other non-party nations. However, ICCAT has recently adopted control measures to extend their influence over such nations, e.g. by the use of disincentives such as sanctions.

In principle, property rights systems may still be used, for example as a TAC split between cooperating exploiting nations. At present, however, such allocations may always be disrupted by the activities of non-collaborating vessels. The use of protected areas or reserves has also been proposed, but these may need to be prohibitively large for highly migratory species, especially where fishing continues unabated outside. Enforcement of regulations on the high seas is also problematic.

There is thus little that can be done at present to force the reduction of global overcapacity on the high seas. Some useful contributions may nevertheless be made. First and foremost, governments may work on limiting capacity within their own regions, and resist subsidising the creation of excess vessel capacity, which may overflow on to the high seas or other EEZs. International fora may also (1) continue to work towards regulating as many as possible of the different geographic areas and migratory species under regional conventions, and (2) encourage all nations to become contracting parties to those convention areas in which their vessels fish. The ratification of the UN Fish Stocks Agreement and the FAO Compliance agreement will alleviate some of the major problems with FOC vessels and non-party contraventions. National governments should be encouraged to sign and ratify these instruments in order to make their provisions effective.

Conclusion

As this overview demonstrates, there is no single model for the development of national plans to manage fishing capacity. Nations will develop models based upon their own national experience and character, legal and social traditions, and economic and environmental conditions. Approaches to property rights, to inputs on fisheries, and outputs from fisheries, will vary from state to state.

What must not vary is the resolve to take decisive action to address the problem of unsustainable use of marine resources. IUCN looks forward to the opportunity to collaborate in building the capacity and understanding to address this critical issue. We hope that this document will be useful in national and regional planning workshops and as a public awareness tool.

References

Acheson, J.M., 1975. The lobster fiefs: economic and ecological effects of territoriality in the Maine lobster industry. Human Ecology, 3: 183-207.

Bailey, J.L. 1998. Inside/ Outside EEZs: the High Seas, EEZs, and Property Regimes Reconsidered. pp129-142 *in* Symes, D. Property rights and regulatory systems in fisheries. Fishing News Books. 268pp.

CEMARE, 1996. Current economic policies and their impacts on fisheries exploitation. Report to World Wide Fund for Nature. UK pp26.

Clark, I.N., P.J. Major and N. Mollett, 1989. The development and implementation of New Zealand's ITQ management system. pp 117-145 *in* Neher, P.A., R. Arnason & N. Mollet, 1989. Rights based fishing. NATO ASI Series E. Vol. 169. Kluwer Academic Publishers.

des Clers, S. 1998. Structural Adjustments of the Distant Water Fleet of European Factory Trawlers Fishing for Loligo Squid in Falkland Island Waters. pp143-152 *in* Symes, D. Property rights and regulatory systems in fisheries. Fishing News Books. 268pp.

FAO, 1992. Special Chapter, pp.32, 50-53. (The figures cited refer to the period ca. 1988-89).

FAO, 1995. The State of World Fisheries and Aquaculture. FAO.Rome 57pp.

FAO, 1997a. Review of the State of World Fisheries Resources: Marine Fisheries. FAO Fisheries Circular, No. 920. 173pp.

FAO, 1997b. State of World Fisheries and Aquaculture. FAO. Rome. 15-20pp.

FAO, 1998a. FAO calls for strict management of fishing capacity - International Agreement proposes concrete actions. Press Release 98/62. Rome.

FAO, 1998b. Draft International [Guidelines] [Plan of Action] for the Management of Fishing Capacity. Rome.

Fitzpatrick, J. 1995. Technology and fisheries legislation. Paper presented at the International Technical Consultation on the Precautionary Approach to Capture Fisheries. Lysekil, Sweden, 6 - 13 June 1995.

Fitzpatrick, J. and Newton, C,. 1998. Assessment of the World's Fishing Fleet 1991-1997. Submitted to Greenpeace International.

Garcia S.M. and C. Newton (1994) Current situation, trends and prospect in world capture fisheries. A paper presented to the Conference on Fisheries Management. Global trends. Seattle. Washington, USA, 14-16 June 1994.

Gulland, J.A., 1983. Fish Stock Assessment - A Manual of Basic Methods. FAO/Wiley series on food and agriculture; v1. 223pp.

Hilborn, R. & C.J. Walters, 1992. Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Chapman and Hall. 570pp.

Holden, M. 1994. The Common Fisheries Policy: Origin, Evaluation and Future. Fishing News Books.

Hyvarinen J. Wall, E and I Lutchman. 1998. The United Nations and Fisheries in 1998. Ocean Development and International Law 29:323-338.

ITDG, 1996. Fisherfolk safeguarding aquatic biodiversity through their fishing techniques. Rugby. UK. pp6-7.

Lassen, H. 1996. Report of the Group of Independent Experts to advise the European Commission on the Fourth Generation of Multi-Annual Guidance Programmes. CEC XIV/298/96-EN., 16 April 1996, 216 pp.

Mace, P.M. 1996. Developing and sustaining world fisheries resources: The State of the Science and Management. 2nd World Fisheries Congress Proceeding. Brisbane, Qld.

Mosse, D., J. Farrington and A. Rew (Eds.), 1998. Development as Process: Concepts and methods for working with complexity. 1st ed. Routledge, London. 202pp.

OECD, 1993. The Use of Individual Quotas in Fisheries Management. Paris. pp 149.

O'Riordan, B.J. 1992. Fishing out the gene pool, Appropriate Technology Journal, Vol 18, No. 4, pp 6-9, IT Publications, London.

Ostrom, E. (1990). Governing the Commons. The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge, 280pp.

Panayotou, T., 1989. Comments on K. Ruddle's " The organisation of traditional inshore fishery management systems in the Pacific". Pp. 8694 *in* Neher *et al*, 1989.

Pinkerton, E. (Ed) (1989). Cooperative management of local fisheries. New directions for Improved Management and community Development. University of British Columbia Press. Vancouver, 299pp.

Pitcher, T. J. and Hart, P. Fisheries Ecology. Croom Helm. London & Sydney.

Pomeroy and Williams (1994). Fisheries Co-management and small-scale fisheries: a policy brief. International Centre for Living Aquatic resources Management, Manila 15pp.

Prat, J.L., 1998. The status of fisheries property rights in French law. pp48-56 *in* Symes, D. Property rights and regulatory systems in fisheries. Fishing News Books. 268pp.

Ruddle, K., Hviding, E. and Johannes, R.E., 1992. Marine resources management in the context of customary tenure. Marine Resource Economics, 7: 249-73.

Schrank, W.E. 1995 Extended fisheries jurisdiction. Marine Policy 19 (4), pp 285-299.

Symes, D. 1998a. Property rights, regulatory measures and the strategic response of fishermen. pp3-16 *in* Symes, D. Property rights and regulatory systems in fisheries. Fishing News Books. 268pp.

Symes, D. 1998b. Towards a property rights framework for the management of Europe's fisheries. pp257-264 *in* Symes, D. Property rights and regulatory systems in fisheries. Fishing News Books. 268pp.

UN, 1996. Report of the Secretary General of the United Nations on the Law of the Sea, 1 November, 1996, A/51/645. New York.

WWF. 1997a . Subsidies and depletion of World Fisheries. Case Studies. Washington. pp 19.

WWF, 1997b. 1995 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. Implications for Regional Fisheries Management Organisations and Arrangements. A report commissioned and funded by WWF UK. Prepared by Michael Lodge. pp 15.

WWF, 1998. Towards Rational Disciplines on Subsidies to the Fisheries Sector: A call for New International Rules and Mechanisms. A WWF Discussion Paper by David Schorr.

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