



WHAT DO WE KNOW ABOUT FISHERIES MANAGEMENT?

SUCCESSSES, FAILURES, AND PROMISING APPROACHES

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In 2002, nations attending the World Summit on Sustainable Development (WSSD) promised to make substantial progress toward recovering depleted fish stocks by 2015. But how will they make good on this promise? Over the years, national governments and regional fisheries organizations have used a variety of regulations and other measures to try to curb overfishing and manage fish stocks more sustainably. Some of these measures have been effective in achieving specific goals. Others have simply substituted one set of problems for another rather than solving the overfishing issue. This chapter describes some successes, failures, and promising approaches to sustainable fisheries management.

Fisheries management options generally fall into three broad categories: those that manage fishing effort by limiting the number of fishers or the gear they can use (so-called “input controls”); those that manage the level or size of the permissible catch

(so-called “output controls”); and technical measures, such as the designation of limited fishing seasons, restricted zones, or limits on fish size. All these measures restrict when, where, and how fishing takes place or how many fish can be harvested in order to protect fish stocks and maximize economic output. Some of these approaches also restrict who can participate in a fishery.

As mentioned in earlier chapters, most fisheries are managed as open access resources, that is, there is no restriction on who can use the fishery. However, as these regimes show their weaknesses, managers turn to approaches that are more restrictive. These include limiting entry to the fishery through the sale of licenses, limiting particular uses in certain areas (zoning), or limiting the amount of fish that one can harvest (quotas). Some systems have even granted “property rights” or exclusive access to a portion of the harvest in hopes of giving fishers a stake in the

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health of the fishery (see the section on *Individual Fishing Quotas* below).

This chapter also considers the merits of using an ecosystem-based approach to recovering fish stocks, and includes a brief overview of integrated river basin management approaches for freshwater fisheries, and the establishment of marine reserves as part of the wider range of management tools.

Over the years, national governments and regional fisheries organizations have used a variety of regulations and other measures to try to curb overfishing and manage fish stocks more sustainably. Some of these measures have been effective in achieving specific goals. Others have simply substituted one set of problems for another rather than solving the overfishing issue.

MANAGING FISHING EFFORT

Limited Licensing

Licensing—the allocation of licenses to fishers or fishing vessels, entitling them to harvest from one or more stocks—is the most widely used system for controlling the fleet capacity (Cunningham and Gréboval 2001). The theory is that by limiting the number of licenses issued, fisheries managers can limit the effort focused on a particular stock and so prevent overfishing. However, licensing programs are insufficient on their own to control a fleet's overcapacity. They do not prevent fishers from expanding the capacity of their vessels or adding new technology to increase their catch. And, as fish become scarcer because of overfishing, that is exactly what many licensed fishers do to remain profitable—they increase their capacity by investing in larger, more powerful boats or improved technology to target fish more accurately. The net effect is, usually, an increase in the fleet's ability to overfish even when the number of licenses remains constant (Cunningham and Gréboval 2001).

Licensing schemes also suffer from other problems, particularly when they are being set up. The initial allocation of licenses, for example, can be difficult (OECD 1997). Fishers with a history of harvesting a given stock are usually given preference, but it is often difficult to establish who was fishing before and who was not, and therefore who should be given preference. Also, if a bidding process is involved, many of the licenses may end up in the hands of a few large, well-financed fishing companies, at the expense of smaller and poorer operators.

Once licenses are issued, managers may try to reduce the pressure on a stock by slowly reducing the number of licenses issued. This can happen through buy-back programs or by retiring licenses as fishers die or move on.

Gear and Vessel Restrictions

Gear and vessel restrictions aim to reduce the fishing power of vessels by limiting boat dimensions, crew size, or the type and number of gears used. These measures can be quite successful in reducing fishing pressure in the short run. In the long run, however, they tend to lose their effectiveness because they are often easy to circumvent with new technology (Jennings et al. 2001). Fishers adapt by developing new gear or switching to other unrestricted gear, and fishing regulations generally cannot keep up with the fast pace of adaptation.

Buy-Back Programs

Buy-back programs offer governments a quick and direct means to reduce pressure on fish stocks by purchasing licenses or vessels from active fishers and retiring them. By lowering the total number of boats, governments can reduce the industry's overcapacity problem. The idea behind these programs is to provide a financial incentive so fishers move to other occupations, while increasing the profitability of the remaining fishers by reducing competition.

Buy-back programs have been carried out in many countries, including Australia, Canada, Japan, the Netherlands, Norway, Taiwan, and the United States (Holland et al. 1999). Results have been mixed. Some programs have been successful in reducing fleet size and capacity, but these reductions are often offset by the increased capacity of the remaining fishers, who continue to invest in new technology, modernizing their vessels. In the United States, for example, the National Marine Fisheries Service reported that the ability of remaining fishers to increase their rate of harvest was so large that the impact of the buy-back program was muted (NMFS 1999).

Buy-back programs can be very expensive and can go awry in other ways as well. The cost of the program in the Australian northern prawn fishery in the late 1980s, for example, was \$43 million (Holland et al. 1999). Sometimes fishers who have been "bought out"—and in theory have quit fishing—use their government buy-out payment to purchase a new vessel, often a larger or more modern one and return to fishing. Sometimes, they even return to fish the same stock they had been paid to retire from. A survey of 240 fishers who participated in the buy-back program in the British



Unloading a 16,000 pound catch of pollock in Alaska. Only fish brought into port are counted against the established catch quotas.

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Columbia salmon fishery found that 47 percent of them purchased another vessel and license and re-entered the fishery (Kurt and Muse 1984, cited by Holland et al. 1999). In the Washington State salmon fishery, nearly 40 percent of the participants in the buy-back program sold an unwanted license or vessel, only to then upgrade their vessels and gear and re-enter the industry soon after (Kurt and Muse 1984, as cited by Holland et al. 1999).

Another common practice is that retired vessels from one country may be sold to fishers in another country and find a second life, sometimes re-entering the very same fishery under a new flag. In the first round of tuna fleet reduction efforts in Japan (1981-1982), many of the retired vessels instead of being scrapped were sold to the Taiwanese who began to fish the same tuna stocks using the “retired” vessels. Hence, the overall pressure on tuna stocks remained high (Komatsu 2000). A comprehensive analysis of buy-back programs published in 1999 concluded that they had generally been

ineffective in addressing the overcapacity problem due to the lack of restrictions on re-use of retired vessels (Holland et al. 1999).

In order for buy-back programs to be truly effective, they must include rules that limit the ability of remaining licensees to expand their fishing capacity, and prohibit vessels that have been retired from being reactivated. For example, current buy-back programs in the United Kingdom and Japan require participating vessels to be scrapped. This increases the cost of the program but ensures that the vessels are truly eliminated from the fleet (Cunningham and Gréboval 2001).

MANAGING THE LEVEL OF CATCH

Total Allowable Catch

Catch controls limit the amount of a given species, by weight that fishers can catch and keep. The most common application of this type of control is the Total Allowable Catch (TAC). The TAC sets the maximum tonnage that can be extracted from a given fishery within a specific period—usually a year (FAO Fisheries Glossary 2003). If set at the right level, TACs can effectively reduce the direct pressure on a fish stock. The “right level” should be no higher than the fishery’s maximum sustainable yield—the maximum harvest that still allows the fish stock to remain biologically healthy and able to replenish itself indefinitely. However, TAC systems have many flaws. Perhaps the worst is that they give fishers a big incentive to fish as quickly and intensively as possible to maximize their share of the allowable catch. This competition for the limited pool of fish has many negative consequences. Fishers tend to invest in larger and more powerful vessels and gears, leading to overcapacity. It also leads to higher bycatch rates, and encourages fishers to operate in inclement weather, which leads to more accidents and increased gear loss. Shorter fishing seasons also result as fishers race to catch as much fish as possible before the TAC is reached. A shorter fishing season can also reduce profits by flooding the market with fish over a short time thus lowering fish prices—a bad outcome for both fish and fishers (OECD 1997; NRC 1999).

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Finally, setting the TAC at the proper level is a major challenge. Sometimes TACs are based on recent catch records, rather than on a scientifically estimated maximum sustainable yield. Even when managers do their best to refine their estimates, the calculation is complex and full of uncertainty because it is based on catch statistics and information on population dynamics, both of which may be flawed or not fully understood (see *Annex A* and *B* for further discussion on stock assessments and data limitations). In developing countries, the considerable data and analyses necessary to establish a maximum sustainable yield are often limited or not available at all so setting a legitimate TAC is even more difficult.

Further, some fisheries experts question the whole concept of “maximum sustainable yield” and its use in fisheries management (Caddy and Mahon 1995). Instead, they encourage the precautionary approach, which implies that when managers are uncertain about the accuracy of stock assessments or the intricacies of particular fish dynamics they should set the TAC at a lower level than the maximum yield, leaving a substantial margin for error.

Individual Fishing Quotas

One variation on the TAC that has become increasingly common is the individual fishing quota, where a specific proportion of the TAC may be allocated to individual fishers to harvest at their own pace. In many instances, fishers are allowed to treat these individual transferable quotas (ITQs) as personal assets, with the legal right to buy or sell them. Since the late 1970s, many countries have implemented ITQ programs, including Australia, Canada, Iceland, New Zealand, and the United States. Although they represent a significant innovation in managing stocks, such quota systems are still only used in a small fraction of the world’s fisheries.

The theory behind ITQs is that fishers are more likely to use sustainable practices if they hold a long-term interest in the fishery in the form of a guaranteed percentage of the harvest. Their incentive to overfish is less because that diminishes the value of their asset—their quota—while conservative fishing increases its value. And because they do not directly compete with other fishers, they can adopt a more reasonable schedule.

The introduction of ITQs has indeed brought benefits in some fisheries. In Alaska these programs have eliminated the traditional “race for fish,” improved safety, and considerably reduced ghost fishing—the accidental entanglement of fish by abandoned or lost gear (NRC 1999). (See *Box 7.1* on ghost fishing.) Iceland and New Zealand both have comprehensive ITQ programs that are generally considered successful in reducing overall fishing effort and improving the efficiency of the industry as a whole (Hannesson 2002).

But ITQs have disadvantages too. For one, they still rely on setting a TAC, and suffer from the same scientific difficulties in determining a reliable estimate of sustainable yield. For instance, the TAC for New Zealand’s orange roughy fishery was set too high because of pressure from the industry, resulting in high immediate profits for the quota holders but serious depletion of the stock (Copes 2000). Another problem is that ITQs give fishers an incentive to “high-grade,” or substitute larger (and more valuable) fish caught later in the day for smaller fish caught earlier. The smaller fish are usually discarded overboard—dead or dying. Only fish brought into port are counted against the quota, so high-grading maximizes the value of the catch even as it depletes the fish stock. A related practice is when fishers dump their catch at sea when prices are too low—again, so that the fish they have caught will not count against their quota.

From a management standpoint, quota systems are also rather inflexible, making it difficult for fisheries managers to follow the precautionary approach to protect fish stocks. The stability of the quota system is built on setting the TAC in advance of the fishing season, and not altering it as the season progresses (Copes 2000), therefore, managers have little flexibility to change if they realize mid-season that the TAC is too high, and overfishing can result.

In addition to the ecological issues associated with ITQ systems, they have also engendered some social and equity problems. A primary goal of most fishing quota programs is to reduce the overall amount of fishing by apportioning the resource among a limited number of people. That means that some fishers ultimately lose their jobs, and communities dependent on fishing can become vulnerable. In Australia’s southern bluefin tuna fishery, the number of quota holders was consolidated from 143 to 63 in the first four years of ITQ management (Muse and Schelle 1989, cited in Grafton 1996). This consolidation also represents another difficulty with ITQ programs: the danger that over time, quota prices will increase and will be monopolized by a small number of

efficient, well-capitalized, and usually larger fishing companies, putting small-scale operators and smaller fishing communities at a disadvantage. In Iceland, for instance, since 1990, when the ITQ system was extended indefinitely, there has been a shift in the composition of the fleet toward fewer, but larger vessels, thus increasing the overall fleet capacity (NRC 1999). During the consolidation of fishing quotas, Icelandic communities of less than 500 people lost a much larger share of their quota than larger communities, leaving them with unemployment problems and an eroding tax base (Eythórsson 2000). In order to avoid this, New Zealand, for example, caps the maximum percentage ownership of the total quota by any one company or individual (Grafton 1996).

RESTRICTIONS ON SIZE, SEASON, AND FISHING ZONES

Size and Sex Selectivity

In order to keep a fish stock biologically viable, it must retain its ability to reproduce. Fisheries managers sometimes try to help by forbidding the catch of mature or egg-bearing females. They may also designate the minimum mesh size of nets and the minimum size or maturity of fish caught, so that immature fish are not harvested before they can reproduce.

These measures can be particularly useful where the target species can be returned to the sea alive, as with lobsters or scallops. But with many other species, they have not proven to be effective conservation measures (OECD 1997). A review of 50 fisheries which employed size and sex-selective measures found that they are particularly ineffective in cases where the stock has been in poor condition for some time, or where more than one

type of fish is targeted at the same time. Enforcement of these measures has also proven costly and difficult, because they depend mostly on observer programs requiring many qualified staff (OECD 1997).

On the other hand, managers can sometimes provide incentives to fishers to increase the effectiveness of gear selectivity requirements. When Norway introduced a ban on discards in 1983 (FAO 1997a), it created an economic incentive for fishers to modify their gear and methods to improve catch selectivity and minimize bycatch, leaving more room in their holds for the targeted species. The policy is generally considered a success; however, the effectiveness of such bans relies heavily on enforcement (Nordic Council of Ministers 2002; Megapesca 1999). (See *Chapter 7* for more detailed discussion on discard ban policies.)

Time and Area Closures

Time and area closures, in which fishing is barred during certain periods or in certain fishing grounds, are standard management approaches that have been



OCEANUM-DAKAR

Harvesting juvenile fish is harmful to the health of the fish stock.

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used in both small-scale and industrial fisheries for decades, if not centuries (Ward et al 2001). They can be effective management tools, but are usually combined with other regulations because, on their own, neither will reduce the overall pressure.

Closed seasons are used to protect stocks at critical times in their lifecycle—such as when they are spawning—or as a way of lowering the total catch. A major disadvantage of establishing a closed season is that fishers will have an incentive to race for fish during the open season. In the Northern Pacific halibut fishery, fishing is restricted to several 24-hour periods per year, resulting in a hectic competition. This causes high processing and storage costs, frequent injury or death to fishers, and large amounts of wasted fish (Anderson 1995).

Closed areas are used to help depleted stocks recover, or to protect biologically critical areas such as spawning grounds or juvenile nurseries. The problem with this approach is that it does not necessarily decrease the overall fishing pressure. Boats that usually operate in the closed area often simply move to an adjacent open space, increasing fishing pressure there.

“Certified” Sustainable Fishing

A relatively recent approach to better managed fishing is the “ecolabeling” of seafood that has been certified as “sustainably harvested”. (See *Box 11.2 Seafood Certification: Incentive for Sustainability*.) Fish that are caught within the given criteria of “sustainability” can be labeled and marketed as being

Box 11-1: Seafood Certification: Incentive for Sustainability

Government regulations on where and when to fish and what gear to use are not the only factors affecting the behavior of fishers, and thus the pressure on fish stocks. Fishers also respond to the marketplace, taking note of the preferences that consumers show for one product over another. This is the idea behind “certifying” some seafood and marine products as “sustainable.” The intent is to capitalize on some consumers’ desire to buy marine products that do not contribute to overfishing or other destructive practices, providing an economic incentive for sound fisheries management.

Generally speaking, a certification is an officially sanctioned label or designation guaranteeing—through inspections or other verification methods—that a given product has met certain standards in its growth, harvest, or handling. The most common environmental certifications—or ecolabels as they are often called—are those applied to organic foods. The “certified organic” label has demonstrated its market value over many years. Certification of marine products is a more recent phenomenon, driven by growing concern over the status of fish stocks worldwide and the commitment of some companies to sustainable fish supplies. In the last decade, both public and private organizations have started to develop standards that can be used in the marine industry, and to design programs to apply these standards in a credible manner (Wessells et al 2001; Pickering et al. 2002).

Organizations that are actively involved in certifying marine products today include the Marine Aquarium Council, the Global Aquaculture Alliance, and the Marine Stewardship Council. The Marine Aquarium Council (MAC) is a nonprofit organization formally established in 1999 that certifies the collection, husbandry, and handling of ornamental aquarium marine organisms including fish, corals, and other invertebrates. The MAC standards are intended to assure that populations of aquarium fish and their habitats are maintained in optimal health, and harvested fish are

well treated. Since developing the standards in 2001, MAC has certified the practices of two fishermen associations and four fish exporters in the Philippines (MAC 2003a; MAC 2003b).

The Global Aquaculture Alliance (GAA), a nonprofit aquaculture industry organization, has developed the

Responsible Aquaculture Program, which certifies products that are farmed in an environmentally and socially responsible manner (GAA 2003). The program currently focuses on shrimp aquaculture and has certified four shrimp farms in Central America (Aquaculture Certification Council 2003). GAA’s *Code*

Table A Marine Stewardship Council: Selected Principles and Criteria for Sustainable Fishing

Principles	Criteria
<p>Protection of Target Fish Stock: Fishing operations must be conducted in a manner that does not lead to over-fishing, or in a manner that demonstrably leads to the recovery of depleted populations</p>	<ul style="list-style-type: none"> • Catch levels are set to maintain high productivity of target populations • Where the exploited populations are depleted, stock recovery is allowed to occur based on the “precautionary approach” • Fishing operations do not alter the age, sex, or genetic structure of the exploited stocks
<p>Protection of Surrounding Habitat and Ecosystems: Fishing operations must maintain the productivity, functioning, diversity, and community structure of the ecosystem on which the fishery depends</p>	<ul style="list-style-type: none"> • Fishing operations do not alter the biological structure of the ecosystem of which the target stock is a part • Fishing operations do not threaten marine biodiversity and avoid, or minimize damage to, endangered species
<p>Presence of Institutional and Operational Framework to Implement the Principles: The fishery must be subject to an effective management system that incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable</p>	<ul style="list-style-type: none"> • Fishing operations comply with local, national, and international laws and standards • Fishing operations respect the cultural context and the long-term interest of fishing-dependent communities • Appropriate procedures are in place for effective compliance, monitoring, control, and surveillance of fishing operations • Periodic assessments are undertaken of the status of the target stock and the impact of fishing operations on the stock and the ecosystem • A mechanism for settlement of disputes is in place

Source: MSC 2002.

more ecologically responsible. The theory behind this approach is that obtaining the certification—which is usually granted after inspection by an independent, nonprofit organization—would add value to the product by either allowing it to be sold at a higher price or to attract consumers who demand products with minimal environmental impacts. If the business case is proven, this can act as a powerful economic incentive for fishers to harvest in ways that minimize their impacts on ecosystems and species.

APPLYING THE ECOSYSTEM APPROACH

The fishery management measures evaluated in this chapter are typically administered by national government agencies and supported by multilateral

and bilateral agreements between nations. But alternative institutional arrangements that actively involve resource users also play an important role in improving compliance rates with norms and regulations, especially in small-scale fisheries. (See *Chapter 5* for discussion on co-management approaches to small-scale fisheries.)

The ecosystem approach framework is based on the central concept of managing fisheries as integral parts of the ecosystem, rather than just as a collection of fish stocks to be exploited without regard to the system that nurtures them. But applying an ecosystem approach may require different legal and institutional frameworks that include not only governments, but also a multitude of other stakeholders. Under this approach, fisheries management must do more

of Practice in Shrimp Aquaculture is intended to assure that GAA-certified shrimp are not contaminated by pathogens, chemicals, and drugs that pose human health concerns. It also ensures that certified shrimp farms do not destroy mangroves and wetlands, and that they minimize the waste load they release to the environment. In addition, the code provides some general guidelines for harmonious relations with aquaculture laborers and the local community (GAA 2003).

The Marine Stewardship Council (MSC) is the most widely known example of an independent organization certifying capture fisheries based on standards for sustainable management. Since 1997, MSC has elaborated standards for sustainable fishing practices in seven fisheries, and certified fishers using these practices. Table A lists some of the key principles and criteria used by the council. There are 219 MSC labeled products in the market (as of August 2004), mostly sold in Europe (MSC 2004). Fish stocks for which certification has been completed include Alaska salmon, cockles from the Burry inlet in Wales, hand-line caught English Southwest mackerel, Loch Torridon Nephrops (a Norwegian lobster fishery in Scotland), New Zealand hoki, Red Rock lobster in Baja California, South African Hake Trawl Fishery, South Georgia Patagonian toothfish longline fishery, Thames herring, and Western Australia rock lobster. In addition, as of August 2004, 16 more fish stocks were under review for certification (MSC 2004).

A major challenge for MSC is the time-consuming nature of the certification processes partly because they involve broad multi-stakeholder negotiations. Since only a tiny proportion of the world's fisheries has been certified so far, MSC-labeled products are not yet available in sufficient quantities to influence consumer preference in a major way. As a result, certification hasn't yet achieved its potential as an economic incentive for better fisheries management. However,

the council is currently assessing several large fisheries for possible certification. These include Alaska Pollock—the world's largest whitefish fishery—and North Sea herring (MSC 2004). If certified, these widely circulated products could make the MSC certification scheme much more visible and economically relevant worldwide.

One benefit that is already emerging from MSC's program is that it can help small-scale fishers carve out a market niche and give them a comparative advantage against large industrial fishing operations. Until now, the products from small-scale fishers tended to be out-competed by lower-priced products provided by larger companies. Certification is starting to shift this dynamic in some places. The majority of the MSC-certified fisheries so far are dominated by small-scale fishers: The Thames herring fishery, for example, only produces 120 metric tons per year and the Burry Inlet cockles fishery has just 55 license holders. With the MSC certification to distinguish them, these smaller operations are able to reach a more sophisticated and better-priced market through a new set of seafood retailers across the world who have signed on to purchase the certified products (MSC 2004).

The success of some environmentally friendly consumer products and organic foods in general suggests a great potential for seafood certification schemes (Pickering et al. 2002). However, a detailed study of consumer preference in the United States shows that the preference for ecolabeled seafood will likely differ by species, geographic region, consumer education, and certifying agency (Wessells et al. 1999). The survey also revealed a lack of awareness about the declining status of many of the world's fisheries. For example, two thirds of the survey respondents were unsure of the state of Pacific salmon and Atlantic cod stocks, indicating that building consumer awareness of the need for better fishing practices will be a crucial step in making certification programs more effective.

One example of a successful seafood certification effort is the “dolphin-safe tuna” label that identifies tuna caught using methods that minimize dolphin mortality. Evidence from the United States shows that these labels have been effective in altering consumer behavior (Teisl et al. 2002), and have consequently promoted the adoption of “dolphin-safe” fishing methods. (See *Chapter 7* for further discussion on dolphin bycatch and dolphin-safe tuna labeling).

However, there are a few potential problems associated with these seafood certification schemes. Establishing and maintaining the credibility of such a program is a significant and costly effort, in part because there are no internationally recognized standards for certifying sustainable seafood. Adding to the challenge is the fact that several different schemes may arise independently and compete or be in conflict with each other, leading to possible confusion among consumers. In addition, fishers in some developing countries are resistant to the idea of certification. They worry that such schemes could be misused as trade barriers, effectively shutting them out of lucrative markets because they cannot afford to fund or participate in the certification process. In the case of MSC, financial resources are now available to encourage such small-scale fisheries to go through with the process (MSC 2004).

Aside from ecolabeling, other general labeling requirements can be important tools to encourage more sustainable fishing practices. For example, simply requiring that seafood labels show the origin of the fish can help deter illegal, unreported, and unregulated (IUU) fishing (see *Chapter 9*). Several regional fisheries bodies, such as CCAMLR and ICCAT, now require fishers to supply certain catch or trade documentation in order to help prevent illegally caught fish from entering the market (Wessells et al. 2001; FAO 2002f).

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than just satisfy the commercial fishing industry, it must accommodate the wide array of economic and social benefits that people derive from aquatic environments, such as recreation and tourism, transportation, local livelihoods, cultural identity, and so on. The practical effect of this is that it widens the group of users that have a legitimate say in how the fishing environment is managed (FAO 2003b).

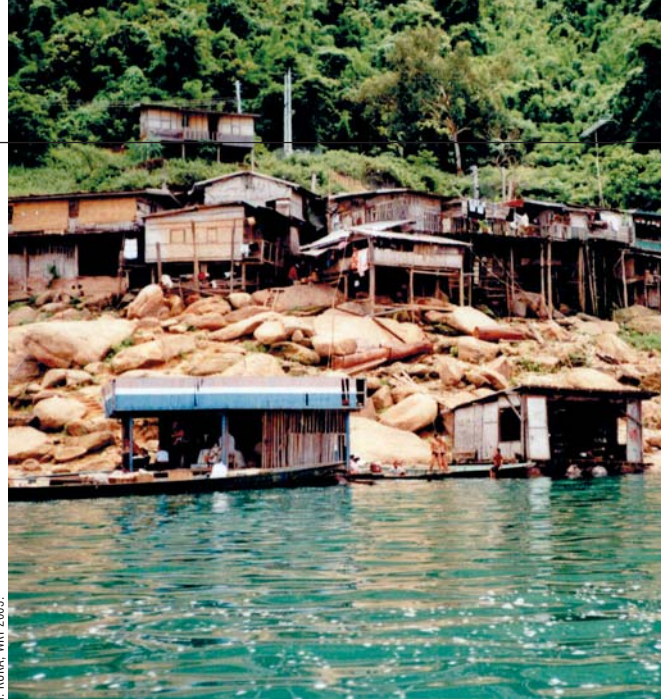
A perfect example is the increasing shift toward, and acceptance of, the integrated river basin management (IRBM) approach—an approach that advocates managing a river and its entire catchment as a single system, and coordinating all the user group activities that take place within this geographic unit. Another example is the establishment and integration of marine reserves into traditional fisheries management approaches.

The following section provides a brief overview of the role that IRBM has played in sustaining inland fish and water resources and a more detailed discussion on the role of marine reserves in rebuilding fish stocks and conserving marine biodiversity.

INTEGRATED RIVER BASIN MANAGEMENT: AN ECOSYSTEM APPROACH TO FRESHWATER RESOURCES AND THEIR FISHERIES

Inland fisheries, water for irrigation, flood control, and hydropower are among the goods and services that people derive from freshwater ecosystems. Current approaches to managing water continue to be mostly fragmented, favoring single uses, such as water withdrawal for irrigation, at the expense of the wider array of goods and services, including fisheries. As population grows, human society will become more dependent on irrigation for food supply and hydropower for electricity, placing extraordinary stress on already altered freshwater ecosystems, particularly in arid and semi-arid regions of the world.

Inland fishery resources are often overlooked when assessing river basin development plans—usually taking a back seat to dam and irrigation development schemes. The price that farmers pay for irrigation water, for instance, does not account for impacts associated with excessive water withdrawn for crops, such as lower water flows to sustain fish populations. As the previous chapters have shown, local communities, especially the poor, depend heavily on inland fishery resources for their livelihoods. Assessing



Y. KUBA, WRI 2003.

Rural fishing communities displaced by dam construction often live under precarious conditions, Laos.

development plans at the basin scale and their impacts on inland fisheries, therefore needs to come to the forefront of policy agendas in many nations. Applying the ecosystem approach to managing water would ensure, at least in theory, that all goods and services derived from ecosystems, including inherent ecological functions, are taken into account when assessing development plans for a given river or lake—the integrated river basin management (IRBM) approach.

But despite the commitment by many countries to implement IRBM approaches, such plans are still in their infancy. In most river basins around the world, allocation of water for irrigation and hydropower continues to take precedence over other water uses, as countries prioritize food and electricity production. Many times, these products—food and electricity—are not made available to local or national populations, but exported to neighboring countries as a source of foreign currency. The ecosystem is, for the most part, routinely ignored in water allocation priorities, with negative consequences for inland fishery resources.

In order to implement an IRBM approach, new institutions are required, such as river basin organizations (RBOs), which link adjacent states along the river corridor in a legal framework allowing them to cooperatively manage water resources within a single basin. RBOs can provide a forum for dialogue where the wide array of stakeholders can participate. As a result, development plans and water-use strategies can become more balanced, minimizing environmental and social impacts. For RBOs to be effective, however, they need to be given the authority, funding, and legal mandate to implement long-term



policies. They must also have the wide participation of riparian states.

Effective RBOs are still the exception around the world, but some countries such as South Africa and Australia are making considerable progress in changing the way water is managed and allocated. South Africa is one of the best examples of a concerted national effort to monitor, assess, and conserve the country's

inland native fisheries. One of its most prominent and innovative pieces of legislation is the National Water Act of 1998. The fundamental guiding principles of the Act are sustainability and equity in the “protection, use, development, conservation, management and control of water resources.” The Act also establishes that the national government, acting through the Minister, is responsible for the achievement of these fundamental principles in accordance with the Constitutional mandate for water reform (National Water Act 1998).

One of the most progressive aspects of South Africa's National Water Act is the establishment of the *Reserve*, which consists of two parts: the basic human needs reserve, and the ecological reserve. The basic human needs reserve provides for “the essential needs of individuals served by the water resource in question and includes water for drinking, for food preparation and for personal hygiene” (National Water Act 1998). The ecological reserve relates to both the quantity and quality of the water required to protect the aquatic ecosystems; that is the minimum amount of water necessary for the environment to function naturally. To establish this reserve, river basin authorities have to calculate the flow required for all the natural cycles to be sustained. This would include, for example, the water flows required for the spawning of sensitive fish species such as largemouth yellowfish (de Villiers, pers. comm. 2004).

The Snowy River in SE Australia provides a striking example of what can be achieved if there is a real commitment to sustaining river flows. The river, a tributary of the Murray, has two large dams to provide both irrigation water and electricity to much of southeastern Australia. The dams have had devastat-

ing effects on the fisheries of the Snowy River for over half a century. Stream flow in parts of the river was reduced to only 1 percent of its original flow at critical periods of the year (Rose and Bevitt 2003). In 2000, the state governments of New South Wales and Victoria signed an agreement to restore the Snowy to 15 percent of its original flow in 7 years, 21 percent in 10 years, and to an eventual target of 28 percent (Commonwealth of Australia 2000).

These examples show that, although not easy, implementing IRBM approaches that allocate water to the ecosystems can be done, and can go a long way in ensuring the sustainable management of water resources and their fisheries. However, the success of such approaches depends heavily on cooperative governance and political commitment (de Villiers, pers. comm. 2004).

CAN MARINE RESERVES HELP MARINE FISH STOCKS RECOVER?

Within the last decade or so, marine scientists and conservation groups have begun to suggest that establishing marine reserves—sanctuaries where fishing and other human activities are restricted—is one way to help battle the long-term depletion of fish stocks. These reserves are just one type of the broader “marine protected area” concept—that is, marine areas that have some level of protection from exploitation. While some marine protected areas may allow limited fishing and other extractive uses, marine reserves generally do not; they are often known as “no-take zones” or “marine sanctuaries” where fishing is barred.

Research on marine reserves leaves little doubt about the conservation benefits they offer. A recent review of 73 reserves around the world showed that the density, size, diversity, and overall biomass of fish inside these sites was significantly higher than at control sites outside the reserves (Halpern 2003).

Given the proven ability of marine reserves to nurture stocks within their boundaries, there is a growing expectation that they will also enhance commercial stocks in surrounding waters and beyond. The theory is that reduced mortality within a new reserve will first allow depleted fish populations to recover within the reserve. With time, these populations will grow in size and density, allowing adult and juvenile fish to migrate from the reserve into adjacent waters—a “spillover effect” that will help

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replenish nearby fishing grounds. In addition, as the fish populations within the reserve continue to grow, so does their reproductive capacity. This allows a net export of eggs and larvae from the reserve, some of which may even drift to more distant waters, where they can replenish fish stocks there as well. So, in theory, reserves can have both a local and long-range beneficial effect.

Evidence of Fisheries Benefits

The biological benefits of marine reserves for organisms and ecosystems within the reserves are well documented. But their benefits to commercial fisheries outside the reserves are poorly known so far and are still the subject of debate (Ward et al. 2001). Part of the problem is that few marine reserves have been strictly protected and monitored for long enough to determine the effect of potential benefits in surrounding waters. Even fewer reserves have been set up specifically to enhance a commercial fishery. In addition, monitoring and demonstrating the spillover effect is no easy matter, and documenting benefits to distant waters is even more difficult.

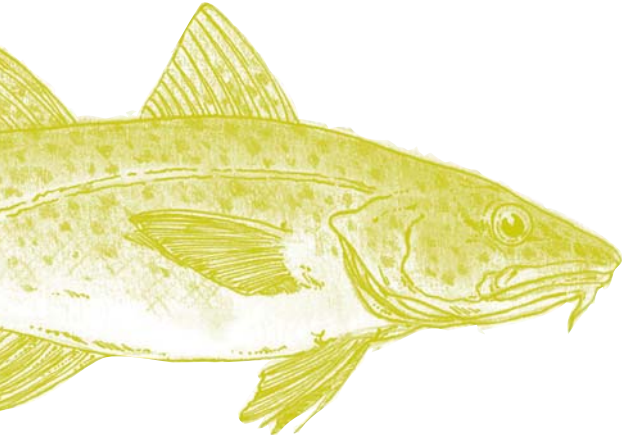
Lack of proof that marine reserves can enhance commercial fisheries feeds into fishers' resistance to the creation of new reserves. Designating a reserve involves relinquishing rights to access fishing grounds currently in use to achieve a benefit sometime in the future. The more uncertain and nebulous the future benefit appears the less likely fishers are to give up their present benefits—however meager—to support the planned reserve. When a marine reserve is proposed, fishers want to know up front, when, and to what extent the surrounding fish stocks will be enhanced.

That kind of predictive ability will probably not be available for some time. Nonetheless, there is some evidence to support the idea that reserves can benefit fish stocks outside their borders. For example, a study of the oldest fully protected marine reserve in the United States, the Merritt Island National Wildlife Refuge in Florida, shows that large trophy fish have spilled over into nearby waters where they are taken by recreational fishers (Roberts et al. 2001). Case studies and research in localized reef systems also show that the recovery that comes from establishment of a reserve can affect areas immediately adjacent to the reserves (Ward et al. 2001; Polunin 2003).



Additional support comes from the recuperation of fishing grounds that have been closed for extended periods. The complete closure of fishing areas in the North Sea during the two World Wars, for instance, led to a substantial increase in groundfish, which translated into higher catch rates and greater production immediately after the wars, when commercial operation resumed (Polunin 2003). A more recent example is the closure in 1994 of a large portion (17,000 km² or about 25 percent) of the Georges Bank—once the most productive area for harvesting groundfish in the eastern coastal waters of North America. After a 5-year closure, stocks of several species have increased, including scallop, haddock, and flounder (Murawski et al. 2000). These improvements are now beginning to spill over into waters outside the closed areas (P. Howard, New England Fishery Management Council, pers. comm., cited in Gell and Roberts 2003).

These results seem to indicate that in order for any substantial spillover to develop, the reserve must be strictly protected from fishing for several years at a minimum (Ward et al. 2001). Even then, results are not assured. Cod stocks within the Georges Bank closure, for example, have been much slower to recover than other species. Some experts suggest the reason for this is that cod are more mobile than haddock and flounder, and may migrate out of the protected area where they are then harvested, rather than gradually building up their numbers within the reserve (Gell and Roberts 2003). Others suggest that prior overfishing of cod in the Georges Bank has radically shifted the structure of the fish community, with that niche now filled by other species, making it harder for cod stocks to regain their former dominance in the ecosystem (Chamut 2003). In any case, it is clear that the rate and nature of recovery of fish species within reserves may vary considerably.



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Making Marine Reserves Successful

According to current research, the effectiveness of marine reserves in helping fish stocks recover is influenced by a number of conditions, including the design and the location of the reserve, the life history and behavioral pattern of target fish species, how depleted the fish stock is when restoration begins, how much fishing has contributed to the decline of the fish stock, and how long the reserve remains closed to fishing (Ward et al. 2001). The size of the reserve is also clearly a large factor in its success. Modeling studies indicate that as much as 20-50 percent of the range of a target fish population might have to be protected from all exploitation in order to sustain the stock over the long term. This implies that reserves will probably have to cover large areas of former fishing grounds in order to produce significant recovery results (Ward et al. 2001).

Unfortunately, there is still much we do not know about marine reserves or how to maximize their benefit. We do not yet know if it is feasible to establish a network of reserves sufficient to recharge stocks and sustain the modern fishing industry at the same time. With this level of uncertainty, it will undoubtedly be very difficult for many politicians and fishers to support the kind of large and long-lasting closures in heavily fished waters that fish recovery via a marine reserve system would call for. On the other hand, conventional fishery management approaches, such as quota systems and seasonal closures, also do not guarantee fish recovery and require concessions from fishers too. Moreover, the commitment to restore stocks that nations made at the Johannesburg Summit is too ambitious to rely on these traditional approaches alone, adding pressure to further explore the marine reserve option.

An understated strength of marine reserves is that they provide a clear example of one type of ecosystem-based approach to fisheries management, since they protect both fish and the ecosystem where they live. In marine reserves, all species—regardless of their commercial value, sex, or size—are protected. That means reserves can retain older and larger individuals with high reproductive rates that otherwise would be fished out by commercial fishers (Berkeley et al. 2004; Hixon, pers. comm. 2004). Reserves can also maintain the structure of marine communities intact, allowing important interactions among species to function unimpeded. This can provide a good complement to typical fishery management approaches that focus on maintaining a single species and may be especially useful in the tropics, where many species may be commercially exploited in one fishery. In this case, a marine reserve approach is probably easier to implement and enforce than trying to regulate the fishing effort or catch quota of each species separately (Ward et al. 2001; Roberts and Hawkins 2000).

Recognizing the wide ranging benefits of an ecosystem approach to managing fisheries, some countries have started testing the concept of a marine reserve with a commercial fisheries goal in mind. The first no-take zone in the United Kingdom was established in 2003 at Lundy Island Marine Nature Reserve at the joint request of local fishermen and English Nature, a government agency responsible for wildlife conservation (English Nature 2003).

One problem that hinders the effectiveness of marine reserves is non-compliance. The enforcement of closures and no-take regulations is fraught with

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difficulty. For example, repeated incidents of shrimp poaching have been reported in the Dry Tortugas Marine Reserve in the United States (Florida Keys National Marine Sanctuary 2002a, 2002b, 2003). Effective management of fishing in the waters just outside reserves is also a key to success (Ward et al. 2001). Close stakeholder involvement throughout the process of establishing and managing reserves can increase fishers' understanding of the problems and benefits of these sites, and hence strengthen enforcement and compliance (Roberts and Hawkins 2000; Berkes et al. 2001).

SOME MANAGEMENT CONCLUSIONS

With the exception of marine reserves and IRBM plans, the measures described in this chapter illustrate the basic approaches that countries have used for decades to manage their fisheries. Each has met with moderate success in some situations, but all have weaknesses that limit their overall effectiveness. Even in combination they frequently fail to adequately protect stocks. In addition, their performance varies greatly from one fishery to the next, depending on the configuration of fleets, technologies, and underlying regulations. Past experience shows that there is no perfect combination of these measures that will guarantee sustainability in every fishery—no “one-size-fits-all” approach that nations can rely on.

In addition, as useful as these conventional measures are, many of them still operate under *de facto* open access regimes, where the rights and obligations of individual resource users are not clearly defined or allocated. And therefore the driving force behind overfishing persists: the economic incentive to catch more and higher-valued fish before others do. This incentive, combined with the inherent difficulty of limiting access to the oceans, drives growth in the number of fishers and the sophistication of their gear. The bottom line is that there are too many fishers for the available supply of fish, and they are too efficient at their jobs. Reducing fishing capacity globally by 30 percent, for example, would have a huge systemic effect on today's overfishing problem.

Alternative employment opportunities and food security for fishers—especially in developing countries—are desperately needed in order to reduce the overall fishing pressure.

Other problems plague the effective management of fish stocks as well. Even where the allocation of rights are well defined, enforcing compliance with any of these conventional measures is a major challenge. In most cases, national budgets for enforcement are small compared to the scale of the task, with thousands of fishing vessels dispersed over large areas. In addition, stock assessments and models are often inadequate to allow management measures to be accurately calibrated to individual fish stocks (see *Annexes A and B*). Nor are most management measures well-suited for the multispecies fisheries common in many tropical waters.

Another difficulty is that, historically, fishery management actions have been primarily aimed at industrial fleets in coastal or open oceans, where commercial interests were focused. Comparatively little attention has been paid to the special needs of small-scale fishers, especially in developing countries, or the special challenges of managing freshwater fishing. By and large, policy-makers and regulators have ignored these sectors, resulting in management that is inadequate and underfunded. (See *Chapter 5* for discussion on co-management of small-scale fisheries.)

Although more work is required to refine the ecosystem-based method of managing fisheries, new institutional frameworks that take an integrated approach to resource management, such as IRBM, can provide a platform for balancing competing interests and supporting the fair allocation of rights. And while the establishment of marine reserves is not a panacea for recovering fish stocks—at least in a systemic manner—they offer the potential to augment traditional fisheries management approaches at the local level and help meet the urgent need to restore stocks. Marine reserves and Integrated River Basin Management plans are examples of an ecosystem approach to resource management—conveying potential benefits to both small-scale and industrial fishers, and offering recognized conservation benefits.