6 Exploiting a living resource: Fisheries

> For decades, the catch from the world's fisheries steadily increased – with the result that many fish stocks are now classified as overexploited or depleted. Failed fisheries policies and poor fisheries management are to blame for this situation. Short-term profits appear to take priority over the development of a low-impact, sustainable fisheries sector that will remain economically viable in the long term.

Marine fisheries – the state of affairs

> Fish is an important source of food for people. It also represents an important sector of the economy: the estimated annual landed value of fish globally is around USD 90 billion. However, in many of the world's maritime regions, perpetual overfishing is putting stocks at risk.

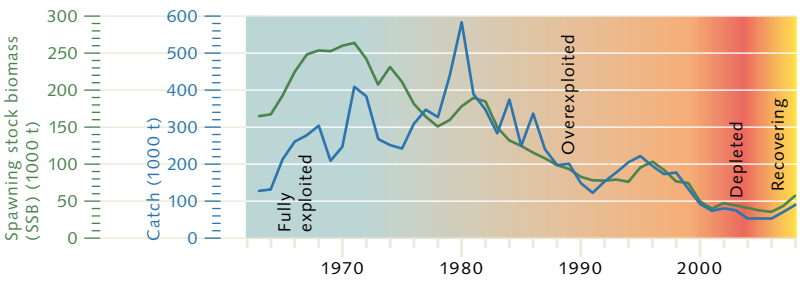
Exploitation on a massive scale

Total global production of fish and fishery products from capture fisheries and aquaculture currently stands at around 140 million tonnes per annum. Until the early 1990s, the harvest from marine fishing followed an almost constant upward trajectory, with landings worldwide increasing fourfold from an annual figure below 20 million tonnes in 1950 to around 80 million tonnes in 1990. Since the 1990s, the total amount of fish, shellfish and crab caught in the sea has remained more or less constant.

Due to the great demand for fishery products, fish farming is also steadily expanding, especially in Asian countries. With an annual growth of around 7 per cent, aquaculture is one of the most rapidly expanding food industry sectors. Aquaculture already provides more than 40 per cent of the global consumption of fish and shellfish. However, many fish species raised in the aquaculture sector are predatory fish, which rely on a supply of other fish for food. Wild-caught fish are therefore used as feed. Although the amounts vary considerably according to species, it takes an average of around 5 kilograms of fish meal and fish oil to produce 1 kilogram of farmed fish. Wild-caught fish are also used as breeding stock. Switching to consumption of farmed fish alone, therefore, does not necessarily protect wild fish stocks.

The expansion of marine fishing has contributed significantly to the decline and in some cases the depletion of global fish stocks. Overexploitation particularly affects long-lived fish species such as redfish *(Sebastes marinus)* which take several years to reach maturity and begin spawning. In extreme cases, it may even lead to the depletion of the stock. For example, stocks of cod in the Northwest Atlantic off the United States coast have collapsed after years of overfishing.

6.1 > The example of North Sea cod shows how a fish stock collapses (i.e. becomes depleted) if there are no longer enough mature fish (spawning stock, green) available to produce offspring.



Decline of spawning stock

North Sea cod stocks, too, have been greatly reduced by intensive fishing. This species is a particularly good example of the effects of the exploitation of the seas. Experts define a stock as a self-sustaining population of a fishspecies within a geographically defined area. The spawning stock – i.e. the mature individuals that are capable of reproduction – are particularly important in scientific terms. The Food and Agriculture Organization of the United Nations (FAO) does not provide any precise definitions of the various status categories of stocks. For example, the boundary between "fully exploited" and "overexploited" status is somewhat fuzzy. According to the FAO, the term "fully exploited" means that a fishery is operating at or close to an optimal yield level, with no expected room for further expansion. A stock is termed "overexploited" if it is being exploited above a level that is believed to be sustainable in the long term, evident

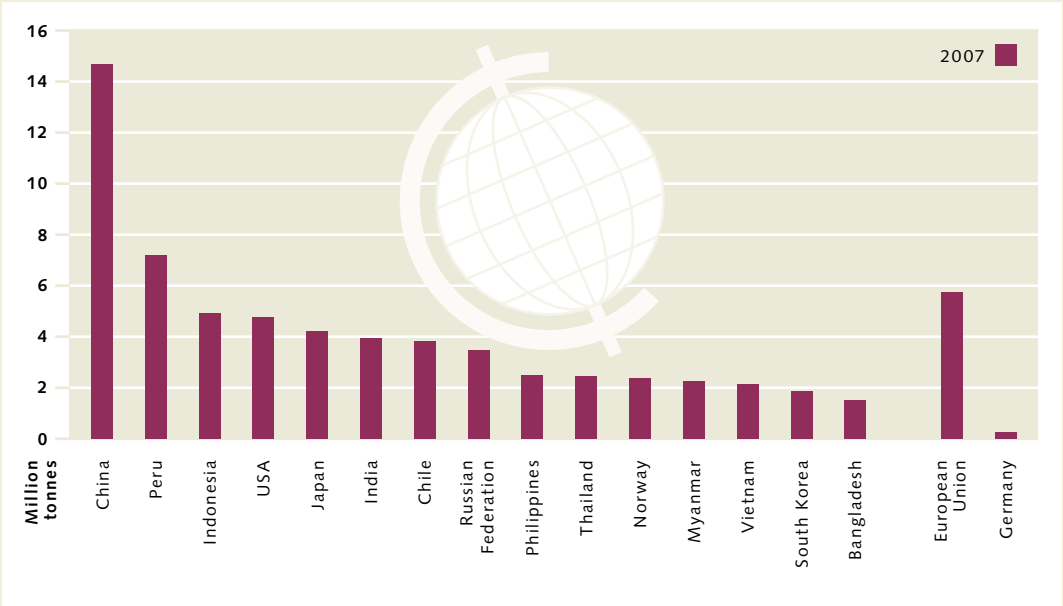
6.2 > Aquaculture is a booming industry today and fish are being farmed on a large scale, as seen here on the Chinese island of Hainan. However, fish farms do not necessarily help to conserve wild fish stocks as they require large quantities of fish meal or wild-caught forage fish for feed.

from the steady decline of the stock. A stock is said to be depleted if catches are well below historical levels, irrespective of the amount of fishing effort exerted. A stock is said to be recovering if catches are again increasing after having been depleted.

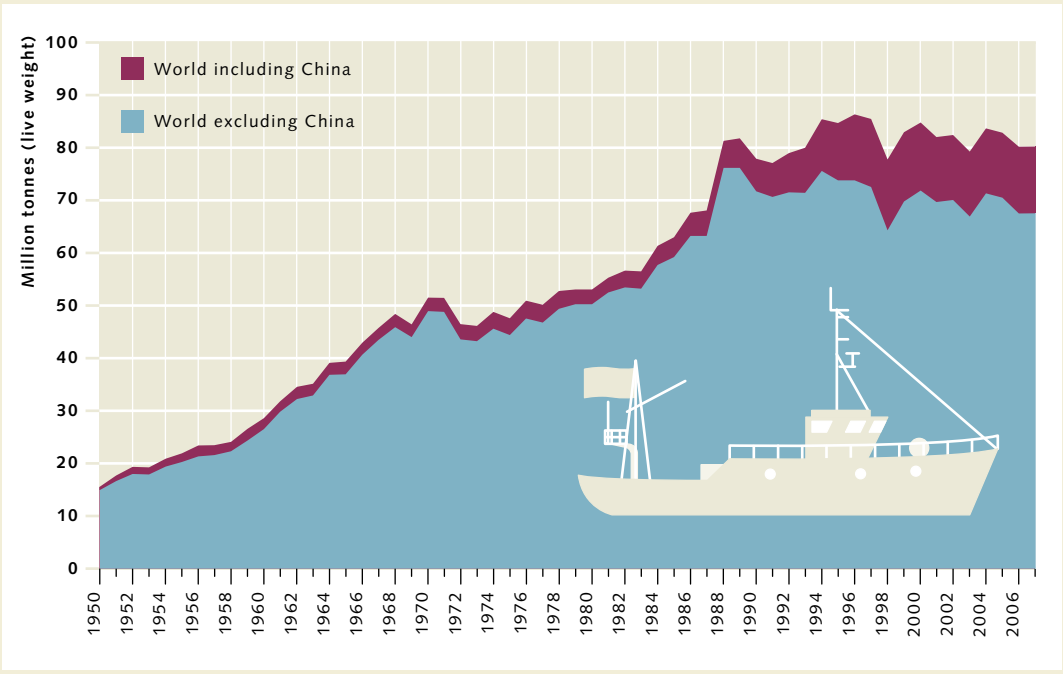
According to FAO estimates, there has been a steady increase in the proportion of overexploited and depleted stocks since the 1970s. By contrast, there has been a decrease of around 50 per cent in the proportion of underexploited stocks, which stood at an estimated 20 per cent in 2006. This trend may be due to the development of increasingly efficient fishing technology, including technically improved means to locate shoals of fish and ever more powerful fishing vessels. The construction of enormous factory ships means that large catches can be frozen while the vessel is still at sea, enabling ships to exploit fishing grounds at great distances from the port of landing. Continuing advances in fishing technology also allow fish to be caught at ever greater depths. Furthermore, due to a lack of alternatives, commercial fishing is increasingly turning to species that were previously regarded as unprofitable, of poor quality, or unfit for consumption.

Stock assessment – a difficult task

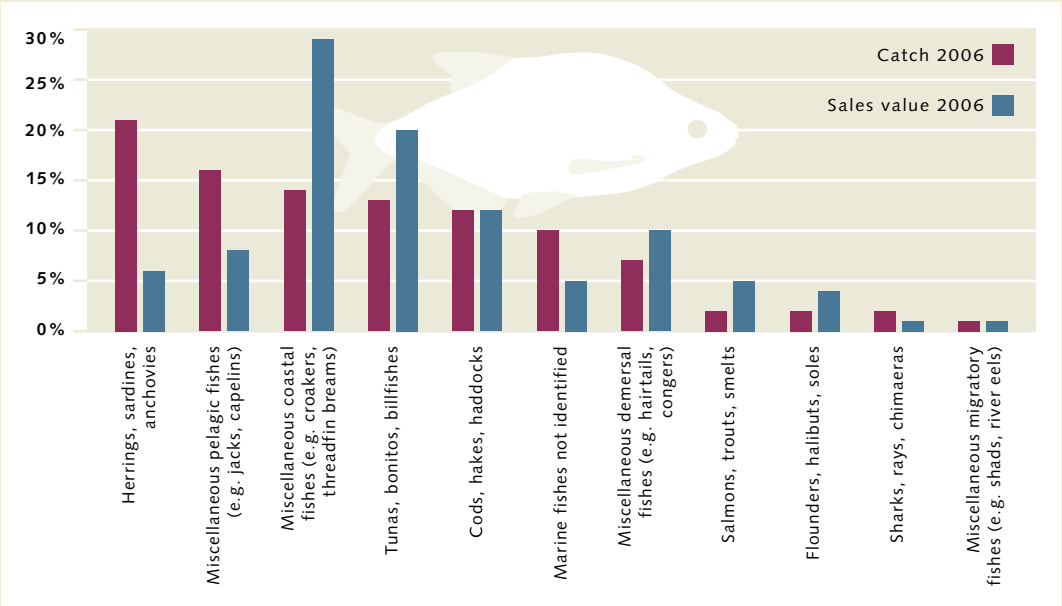
Correctly assessing fish stocks is a difficult task. As it is not possible to count fish individually, stock sizes are now estimated using mathematical models. Current catch figures from the fishing industry are an important source of data in this endeavor. The models also take account of the effort that must be employed in order to catch this quantity of fish, based, for example, on the number of fishing days or the fleet size – for the fewer the fish there are in the sea, the greater the effort needed to achieve a specific catch volume. However, even today not all catches are reported, so the available data may be incomplete. The mathematical models therefore also include information from scientific test catches, which are regularly carried out by fisheries biologists and include data



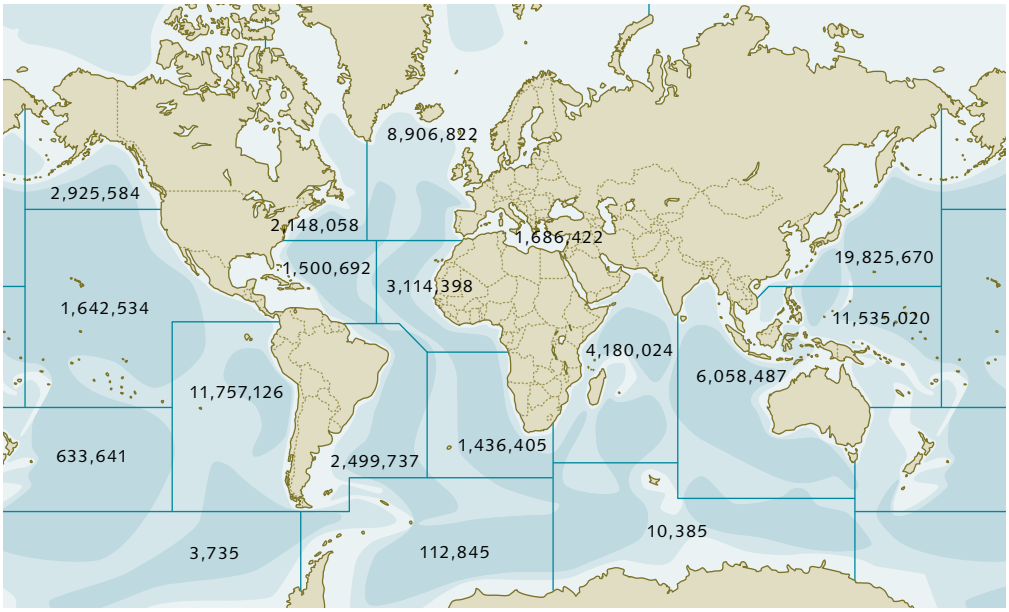
6.3 > Top producer countries, based on catch



6.4 > World marine capture fisheries production since 1950



6.5 > Catches and landing values by groups of species



6.6 > Catches by region in tonnes (live weight) (2007)

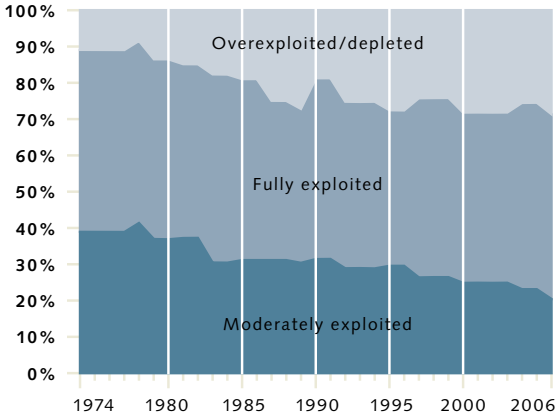
The fate of the cod

Atlantic cod *(Gadus morhua)* – commonly known simply as cod and also found in other maritime regions, including the Baltic Sea – was a popular staple food across much of northern Europe and the islands of the North Atlantic for a very long time. Cod stocks were abundant and the species was easy to catch. It was one of the main ingredients in Britain's national dish, fish and chips, while in Norway, air-dried cod (stockfish) was a popular traditional food. Cod – which can reach up to 1.5 metres in length – is a demersal fish, which means that it lives on or near the bottom of the sea. Its habitats are located in the coastal regions of the Atlantic Ocean. Cod can be found near the coast as well as at depths of up to 600 metres. Cod is a difficult species to farm, however.

The great dependence of the fishing nations on their cod stocks was demonstrated in the "Cod Wars" from 1958 until 1975. During this period, a series of political confrontations erupted after Iceland – concerned about the future of its traditional fishing grounds and more intensive competition from foreign deep-sea trawlers – progressively expanded its Exclusive Economic Zone (EEZ) (Chapter 10) from 3 to 200 nautical miles. In so doing, Iceland succeeded in protecting cod stocks in the Northeast Atlantic from overexploitation by other fishing nations. This is evident from the fact that around 1 million tonnes of cod are still being harvested annually in the Northeast Atlantic, whereas cod stocks in the Northwest Atlantic range off the east coast of North America are an outstanding example of failed fisheries management. Here, the once abundant cod stocks off Newfoundland, which in the past yielded some 600,000 tonnes of catch weight annually, have now collapsed after years of overfishing.

How could this have happened? After centuries of mainly coastal fishing using smaller fishing vessels, in 1950 the fishing industry switched to industrial bottom fishing using trawl nets and also began fishing in deeper waters. Catches increased considerably in the short term, leading to a decrease in population size. Attempts to regulate catches with international fishing quotas and Canada's efforts to tackle the problem by expanding its Exclusive Economic Zone could not curb the dramatic drop in yield. After the population had completely collapsed at the end of the 1980s, there was no option but to close the commercial cod fishery in 1992, followed by a ban on artisanal fishery in the coastal communities of Newfoundland in 2003. The social and economic consequences of this move have been severe. Biologists now believe that due to the massive disruption of the marine ecosystem, it has passed a tipping point and that even with a total ban on fishing, cod stocks will not recover.

6.7 > Fighting over fish: the economic significance of the fishing industry for some nations became apparent during the "Cod Wars" in the Northeast Atlantic. The United Kingdom and Iceland even deployed warships in the conflict over control of the fishing grounds. On 7 January 1976, the Icelandic patrol boat *Thor* (above left, background) collided with the British frigate *Andromeda* (foreground) some 35 nautical miles off the Icelandic coast. According to the British version of events, the collision occurred after *Thor* attempted to cut the nets of the British trawler *Portia* (above right, centre). During the manoeuvre, *Thor* abruptly changed course and rammed the frigate. The dispute between the two countries was so intense that Iceland even broke off diplomatic relations with the UK for a time.



6.8 > The use intensity of commercially relevant fish stocks has increased significantly worldwide.

on the age structure of the fish stocks and stock density. Measured in terms of total catch weight, the People's Republic of China tops the list of the world's leading fishing nations by a clear margin; China claims to land an estimated 14 million tonnes of fish or more annually. In second place is Peru, with an annual catch weight of around 7 million tonnes. In regional terms, the Northwest Pacific (19.8 million tonnes) and the Southeast Pacific (11.8 million tonnes) are the fishing areas yielding the largest catches.

With annual production of 7 to 10 million tonnes, the Peruvian anchoveta is the most productive marine species. It is a mainstay of the Peruvian fishing industry and is also caught by other countries. Second in the ranking is Alaska pollock *(Theragra chalcogramma)* (2.9 million tonnes), followed by Atlantic herring *(Clupea harengus)* (2.4 million tonnes).

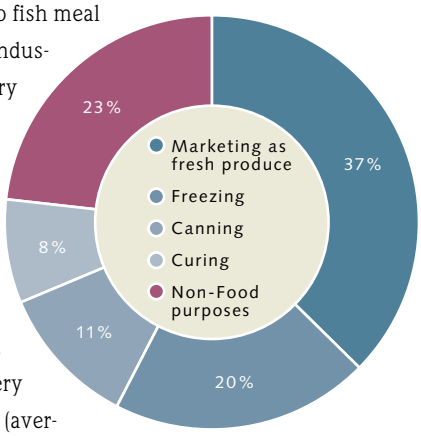
Generating billions in revenue – with fish meal and gourmet fillets

The estimated landed value of fish globally is around USD 90 billion. Even more added value is generated in the processing industry, which turns the fresh catch into a variety of fishery products. The commercial value of different fish species varies considerably, firstly due to the different amounts available on the world markets and, secondly, because various fish species enjoy different levels of popularity among consumers. Rare species of tuna can command prices in excess of 100 euros per kilogram on the Asian market, whereas fishermen are paid as little as 10 to 20 cent for a kilo of sprats.

The prices of fishery products also depend on how the catches are processed. Broken down by quantity, the various forms of utilization of world fisheries production have remained more or less constant over recent years. Around three-quarters of the catch is destined for direct human consumption, with approximately half of this reaching the final consumer in the form of fresh fish, a quarter being processed into frozen food products, and a further quarter being preserved by curing, pickling or canning before being brought to market. The remaining 23 per cent of the catch is processed into fish meal and fish oil, mainly for the feedstuffs industry, and is used in aquaculture and poultry farming, for example. The significance of fish in terms of its contribution to the human diet also varies from region to region. Consumption of fishery products is heavily dependent on the availability of other food sources and proximity to the sea. Worldwide, approximately 16.4 kilograms of fishery products (live weight) per capita per year (average for 2003 to 2005) are used for consumption. This figure includes products from inland fisheries and aquaculture. However, per capita consumption in the European Union countries (EU-15) is 25.7 kilograms – well above this average. Compared with countries such as Spain (42.6 kilograms) and Portugal (55.4 kilograms), where fish has traditionally formed a major part of the diet, per capita consumption of fishery products in Germany is 14.3 kilograms, and hence broadly in line with the global average.

Fishing and aquaculture provide employment for an estimated 43.5 million people worldwide, mostly in Asian and African countries. The People's Republic of China accounts for the major share, with more than 12 million people employed in fishing and aquaculture.

6.9 > Utilization of fisheries production (breakdown by quantity), 2006. "Non-food purposes" largely consists of the production of fish meal and fish oil for use in fish or livestock farming.



The causes of overfishing

> It is now generally understood when and why fish stocks become depleted. Global demand for fish and the intensity of fishing activity are known to be key factors in this context, but ecological aspects also play an important role. The influencing variables need to be studied in more detail, however, in order to provide a conclusive explanation of the causes of overfishing.

Dwindling fish stocks – too complex for simple explanations

Whether a fish stock survives over the long term or is fished to the point of depletion depends on how much of the fish is caught. This is determined primarily by the fishing effort deployed. The term "fishing effort" comprises the combination of the structure of the fleet within a given fishery, the fishing gear and fishing technology used, and the amount of time spent fishing. Another factor influencing catch volumes is consumer demand, e.g. for certain species of fish or for products that have been processed in a particular way. Ultimately, it is consumer demand that determines to what extent the fishing effort pays off for fishermen.

Fishing opportunities are also influenced by a variety of ecological factors. The marine ecosystem comprises not only the various fish stocks, each characterized by their individual stock density and age structure, but also the biotic (living) and abiotic (non-living) environment. The biotic environment includes predators such as marine mammals, birds and predatory fish, as well as prey such as plankton and other species of fish. It also includes species of flora and fauna that interact with the fish stocks in other ways – corals are one example, as they form habitats for fish. Key parameters of the abiotic environment include temperature, salinity and oxygen concentration, as well as water quality.

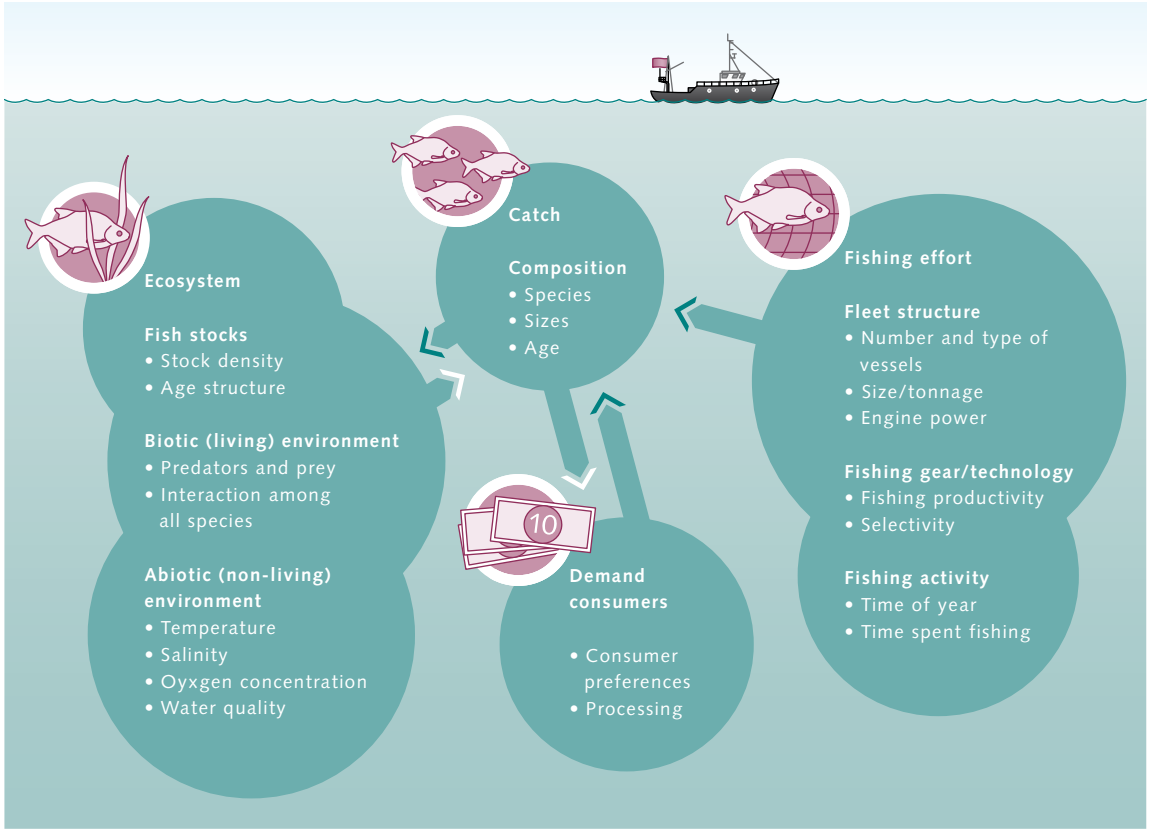
The interactions between the various influencing factors occurring throughout the ecosystem are highly complex and therefore difficult to determine. They may also change over time, for example, as a consequence of global warming (Chapters 1, 2 and 5). Consumer demand and fishing effort indirectly affect the marine ecosystem as well. Depending on the volume and composition of the catch, the age structure and density of the fish stocks may change, and this can affect the coexistence of the various species of marine flora and fauna.

Ecological and economic objectives of fisheries policy

The implementation plan adopted at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg established the maximum quantity of fish that

Sustainable management – the Alaska pollock fishery

There are many stocks of Alaska pollock *(Theragra chalcogramma)* in the Pacific, five of which are managed in accordance with the US Groundfish Fishery Management Plans (FMPs). These plans contain expert groups' recommendations on the precise catch volumes that are sustainable for specific species, and are intended to ensure that fishing activity takes place in accordance with the maximum sustainable yield (MSY) principle. On the average, stocks have now already reached almost 80 per cent of the level required for harvesting at MSY. A moderate level of fishing activity takes place, which means that the quantities of fish being withdrawn from the sea are relatively small, and this level may even be less than is strictly necessary. Nonetheless, fishermen are currently still able to harvest approximately 1.1 million tonnes annually, mainly in the Bering Sea and around the Aleutian Islands. The fishermen use nets that are trawled through the water, not dragged along the sea floor. This does much to conserve bottom-dwelling species. Careful selection of nets with appropriate mesh sizes and other technical measures will also help to substantially reduce bycatch.



6.10 > Schematic overview of a marine fishery. The white arrows show the route taken by the fish from the sea to the consumer. The dark-green arrows show the impacts of consumer demand and fishing effort on catch volumes and the marine ecosystem.

can be harvested annually with a view to protecting the world's stocks. This is known as the maximum sustainable yield (MSY). The MSY is the maximum annual catch that can be taken from a species' stock over an indefinite period without jeopardizing that stock. The volume of the catch that can be sustained over an indefinite period depends on the size of the stock. For many stocks, the size of the stock that would permit MSY is equivalent to around half the natural equilibrium stock without fishing activity.

As fish species vary in terms of their commercial value, the economically relevant variable is not the weight of the catch in tonnes but the value of the fishing yield. Fishing costs are the second major economic variable in a given fishery. An increase in fishing effort leads to higher operating costs due to the costs of increasing inputs such as wages, fuel and fishing gear. As a consequence, fishing is particularly profitable if the difference between the fishing yield and the total costs is sufficiently large. Analogous to the MSY, the value of the largest positive difference between total revenues and total costs of fishing is known as the maximum economic yield (MEY).

Economic incentives for overfishing

From an economic perspective, the problem of overfishing arises because marine fish stocks are a "common" resource: a fish, once caught, belongs to the fisherman, whereas a fish that is still in the sea does not. Viewed in economic terms, a fish in the sea has value by virtue of the fact that it reproduces and continues to gain in weight, which means that the fishing yield will increase in the future if the fish stays in the sea. So there is a price asso-

6.11 > Even today, deep-sea fishing is back-breaking work. However, vessels are now equipped with state-of-the-art fishing technology, including aids to locate shoals of fish.

ciated with catching the fish because this value is lost. In the case of overexploited stocks, which are in particular need of recovery, this price may even exceed the market price obtained for the landed fish. As fish stocks are a common resource, however, in an open and completely unregulated open-access fishery no one ever pays the true economic price. For that reason, the economic costs of fishing are underestimated and far more fish are caught than is economically sensible.

If a fish stock is of a size that permits the maximum economic yield (MEY) to be achieved, there is a strong incentive for individual fishermen to deploy additional vessels or work additional shifts in order to increase their personal earnings. This means that in an open fishery, the fishing effort will be scaled up until it is virtually impossible for any fisherman to generate any profits at all.

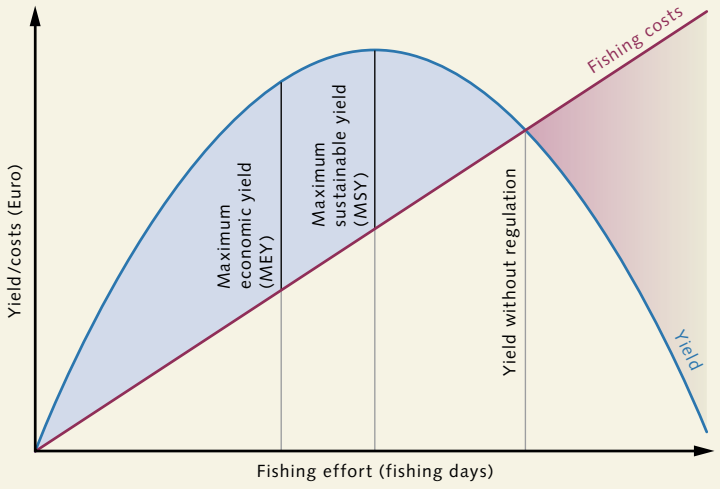
Furthermore, state subsidies allow the fishery to be maintained even when the direct costs of the fishing effort have already exceeded the value of the fishing yield. Fishermen's individual operating costs are reduced in many cases by direct or indirect subsidies. Every year worldwide, more than USD 10 billion is paid to fishermen in the form of fuel subsidies or through modernization programmes, with 80 per cent of this in the industrialized countries.

According to calculations by the World Bank, the global fishing effort should be reduced by 44 to 54 per cent in order to maximize total economic benefits from global fishery, i.e. in order to achieve maximum economic yield. The World Bank currently estimates the loss of future net benefits due to overfishing to be in the order of USD 50 billion annually – a substantial figure compared with the total annual landed value of fish globally, i.e. around USD 90 billion.

A further major difficulty for successful regulation of fishing, in terms of the maximum economic yield (MEY), is ongoing enforcement and monitoring. If a particular fishery is highly profitable, fishermen may be tempted to drive up their earnings by making illegal landings. Around one-third of all fishery products reaching the market are estimated to come from illegal fishing, or fishing activities that circumvent international agreements. Illegal, unreported and unregulated (IUU) fishing obstructs efforts to conserve and maintain fish stocks. IUU fishing is not just carried out by a few private entrepreneurs who deliberately violate the law and others' fishing rights. It also involves vessels registered in countries whose own standards do not meet those adopted by the international community or who lack the capacities to establish control mechanisms. Illegal, unreported and unregulated fishing therefore mainly harms artisanal fisheries in the coastal regions of developing countries. The annual global economic cost of IUU fishing is estimated to be at least USD 10 billion.

The profits of fishing

To what extend fishing is economically profitable in the long term by considering the yield, the operating costs and the fishing effort. A specific constant effort will result in the maximum sustainable yield (MSY) being achieved. This is the maximum annual catch that can be taken from a species' stock over an indefinite period without jeopardizing that stock. The maximum economic yield (MEY), by contrast, is a monetary variable. It is equivalent to the maximum annual earnings from fishing, and represents the largest difference between total revenues and total costs. The MEY is attained at a lower level of effort than the MSY. Without regulation, the fishing effort would increase for as long as fishing remained commercially viable, i.e. as long as the earnings obtained from fishing remain positive. In an unregulated fishery, the effort is therefore the point at which revenue and costs are equally high.



Classic approaches to fisheries management

> For many years, authorities have been attempting to control fishing with a variety of regulatory instruments in order to conserve stocks. These instruments include fishing quotas, limits on the number of fishing days, and restrictions on the engine power of fishing vessels. However, many of these measures fail because the quotas and restrictions introduced are not stringent enough, are not properly monitored, or because fishing practice simply ignores the regulations.

How can overfishing be avoided?

Overfishing means that the annual catch volumes are ecologically and economically unsustainable. Ultimately, excessively high catches are the result of too much fishing effort. As fish stocks decline, the effort required to catch a given quantity of fish continually increases. Fisheries policy or centralized fisheries management has responded to this situation by adopting direct measures that aim to limit catch volumes or indirect measures focussing on fishing effort.

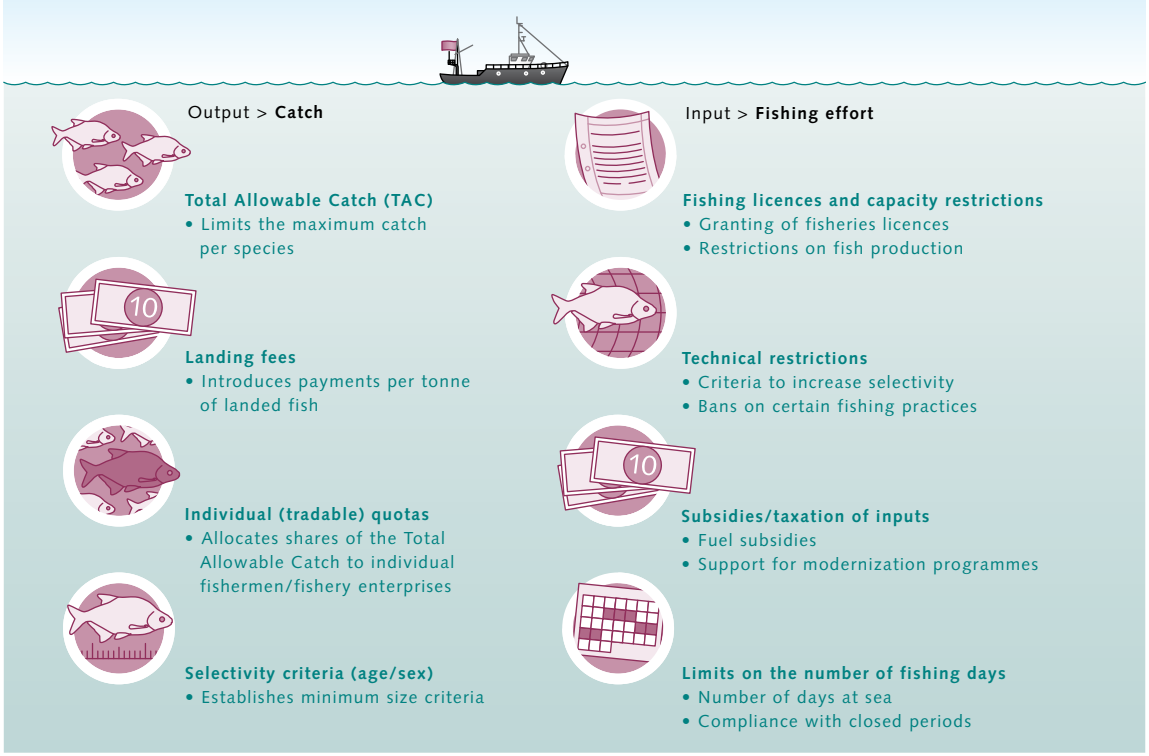
Reducing catches

In order to reduce total catch to a biologically and economically sustainable level, authorities frequently introduce Total Allowable Catches (TACs). Ideally, the TACs should be set at a level that allows the maximum economic yield (MEY) to be achieved in the long term. However, TACs alone are not enough to safeguard economic efficiency, for at the start of every new fishing season with a limited TAC, each fisherman would attempt to secure the largest possible share of the quota for himself by engaging in a very high fishing effort for a short period (also known as the "race to fish"). If the quota is thus exhausted within a relatively short time, fishing capacity then remains unused until the next fishing season. In order to give the individual fishermen a modicum of planning security throughout the entire fishing season, the TACs are therefore allocated to individual vessels, fishermen or cooperatives.

Fisheries policy strategies that grant fishermen the right, in one way or another, to determine the quantity of fish they will harvest over the long term are known as "rights-based management of fisheries". Individual transferable quotas (ITQs) are the prime example. Here, fishermen are allocated individual quotas, which they can trade freely with other fishermen. Fishermen who operate relatively uneconomically are likely to sell some of their quotas, while more economically efficient companies can purchase additional ITQs. In the long term, the effect of this is to concentrate the quotas among a small number of fishery enterprises, thereby ensuring that the Total Allowable Catch is landed at lower total cost.

These concentration processes can be observed in practice. In New Zealand, for example, where a system of ITQs has been in place since 1986, the number of ITQ holders was around one-third lower in 2000 than in 1990. Obviously, not all social objectives can be achieved solely by means of the individual transferable

6.12 > Deep-frozen tuna for sale at a Tokyo fish market. Japan is the fifth-largest fishing nation in the world.



6.13 > Classic approaches to fisheries management either focus directly on restricting catches or attempt to limit fishing effort. However, monitoring these regimes is often fraught with difficulty.

quotas, especially if there is a desire to ensure the survival of small, less economically efficient fishery enterprises. As small fishery enterprises can opt to sell their quotas, however, they are clearly in a more favourable position than would be the case without the option of quota trading.

As a rule, quotas are specified in tonnes and are broken down by species. However, the actual catch consists of fish from different age groups and levels of quality, and therefore different values. This often encourages fishermen to engage in the practice of high grading, i.e. the selective landing of fish so that only the best-quality fish are brought ashore. Lower-quality fish are discarded back into the sea so that the quota is filled with high-grade fish.

This practice reduces fish stocks without benefiting the consumer. In some fisheries, bycatch amounts to 40 per cent or more of the catch. This bycatch is discarded overboard like waste. Despite these difficulties, rights-based management of fisheries has performed well overall. New studies based on large datasets show that this management approach promotes not only economic efficiency but also sustainability of fisheries. For example, the share of depleted stocks in fisheries subject to rights-based management is just 14 per cent – far less than the 28 per cent in fisheries without a similar type of regulation.

As an alternative to tradable quotas, there is also the possibility of regulating overfishing using landing fees. These fees operate in a similar manner to individual tradable quotas. The difference is that the fisherman does not buy additional quotas but pays a fee, based on the amount of fish actually caught, to a designated authority. The landing fee ensures that the true economic price is paid for the fish, thereby removing any incentive for overfishing.

Similar to the data requirements for setting a TAC, the fees can only be set at the optimal level if information is

A negative example – EU fisheries management

One example of a fisheries management regime which is widely regarded as a failure is the current Common Fisheries Policy (CFP) adopted by the European Union. The stated aim of the CFP is to help conserve fish stocks and to contribute to an economically viable and competitive fisheries and aquaculture industry. And yet, in recent years, there has been a dramatic decline in fish stocks in some cases, as well as a significant decrease in fishing industry profits.

There is one primary reason for this: every year, the European Commission makes recommendations on the Total Allowable Catch (TAC) to the Council of Ministers based on scientific evidence. The Council of Ministers, however, often disregards these recommendations because, as a rule, the priority for these ministers seems to protect jobs in the short term, not to maintain sustainability. As a consequence, the annual catch agreed to by the Council of Ministers is generally around 48 per cent more than the scientists' recommended figure. The fact that 88 per cent of European fish stocks, measured against maximum sustainable yield (MSY), are overexploited is due in part to these excessively high catch quotas.

Furthermore, the minimum sizes of fish that may be landed are often so small that 50 per cent of the fish have no chance of ever spawning before they are caught. The minimum legally permissible mesh sizes of fishing nets also allow fish smaller than the minimum landing size to be caught. These fish – amounting to as much as 40 per cent of the catch – die as a result of capture and are generally discarded overboard. The CFP has introduced a range of regulatory instruments, such as the annual Total Allowable Catch (TAC), restrictions on the permissible number of fishing days, fleet reductions, and limits on the size and engine power of fishing vessels. Besides numerous regulations relating to fishing technology, such as minimum mesh sizes, the CFP also allows some fishing grounds to be closed. Enforcement of the regime involves monitoring and sanctions. However, in a highly diverse community like the European Union, this is fraught with difficulty, for in practice every Member State applies the regime with varying levels of efficiency. There is very little incentive for a Member State to impose stringent controls on its fishing fleet if neighbour states fishing the same waters fail to do so. A further problem is that bycatch is not recorded or sanctioned. This means that fishermen can fish above their quota and simply discard the surplus by dumping it overboard. This common practice, which is known as high grading, consistently undermines the annual fishing quotas set by the Council of Ministers.

In response to this situation, the Community Fisheries Control Agency (CFCA) was established in 2005 to organize operational coordination of fisheries control and inspection activities by the Member States and to assist them to cooperate so as to comply with the rules of the Common EU Fisheries Policy. However, there is still a lack of reliable data about catches, violations of the regime, and illegal fishing. In fact, there is some evidence that even the European Commission is reluctant to impose sanctions on Member States which violate the CFP. For example, the Commission rarely makes use of its powers, conferred upon the Commission in respect of Member States by Articles 226 and 228 of the EC Treaty, to bring matters before the European Court of Justice (ECJ) if they fail to enforce the CFP in their own country.

Furthermore, the subsidies paid to the European fishing industry create the wrong incentives. Between 2000 and 2006, some 4 billion euros were paid out in subsidies for, among other things, fleet modernization and the fish processing industry. There are also numerous regulations governing how the individual subsidies are to be used. These regulations are intended to prevent further increases in overcapacity in the fishing fleets. In total, the European Union has an estimated 2000 rules and regulations relating to the fishing industry, many of them difficult to understand and in some cases even contradictory. From a legal perspective, a further factor in the failure of the CFP is thus the lack of transparency in the measures adopted by the European Union. Due to the different interests and priorities, as well as the different election schedules in the various Member States, it is very difficult to achieve a consensus among the national ministers responsible for fisheries, who decide the annual Total Allowable Catches (TACs) in the Council of Ministers. As a consequence, measures adopted within the CFP framework generally tend to be geared toward the lowest common denominator. Given the flawed state of fisheries in the European Union, the European Union is now planning a comprehensive reform of the CFP. At present, numerous proposals are being discussed for the framing of a new CFP to be adopted in 2012. In order to ensure that the new CFP has legitimacy, the existing regional advisory bodies that bring together various interest groups – fishermen, scientists, politicians and environmental organizations – should be expanded. Admittedly, it is still too early at this stage for a conclusive assessment, but hopefully this will promote more transparency and more broad-based practical support for the CFP's objectives.

Fixing Total Allowable Catches (TACs) within the framework of the EU's Common Fisheries Policy

European Commission
- Directorate-General for Maritime Affairs and Fisheries

Proposes a Total Allowable Catch (TAC) to the Council of Ministers, based on scientific recommendations.

Scientific Advice
- International Council for the Exploration of the Sea (ICES)
- Scientific, Technical and Economic Committee for Fisheries (STECF)

These bodies review stock trends and recommend Total Allowable Catches.

Supervision of Fisheries
- Community Fisheries Control Agency (CFCA)
- National agencies (e.g. Federal Agency for Agriculture and Food [BLE] in Germany)

Responsible for recording catches and monitoring compliance with legal provisions by carrying out inspections.

Council of the European Union
- Agriculture and Fisheries Council
- Council of Ministers

Responsible for the annual/multiannual fixing of the TAC and allocation to Member States.

Member States
Germany:
- Federal Ministry of Food, Agriculture and Consumer Protection (BMELV)
- Federal Agency for Agriculture and Food (BLE)

These implement fisheries policy and allocate national quotas to individual fishermen.

Fisheries
- Enterprises and cooperatives

These report catches, fishing regions and times to the supervisory authorities.

Fishing gear	How it works	Bycatch (other fish species)	Bycatch (turtles, seabirds, mammals)	Adverse impacts on sea floor
Gillnet	The gillnet is anchored at a fixed position in the water. The fish are caught in the mesh.	Low level of bycatch of other species, not least due to the specific sites selected for the setting of gillnets.	High levels in some cases. The use of acoustic deterrent devices (pingers) is not particularly effective.	Minimal
Pound net	The net is anchored at a fixed position in the water. Fish are caught in the closed end of the net.	Not a problem as bycatch remains alive.	Nets should be covered to prevent birds from being caught. Very little data available about bycatches of mammals and turtles.	Minimal
Purse seine	The purse seine is a net that is used to encircle a school of fish. The net is then drawn together to retain the fish by using a line at the bottom, allowing the net to be closed like a purse.	Low, as purse seines target schools of one species.	High levels of dolphin bycatch. Mitigation techniques are now reducing dolphin bycatch in purse seine gear.	None
Pelagic trawl	This is a funnel-shaped net that is towed by one or two vessels. The fish are captured in the "cod end", i.e. the trailing end of the net.	Can be a problem in some areas, depending which species is being targeted for trawling.	Low	None
Bottom trawl	Works in a similar way to the pelagic trawl, but is dragged along the seabed.	Can be a problem in some areas, depending which species is being targeted for trawling.	Low	High, depending on the type of trawl gear used.
Beam trawl	The net is mounted on a heavy metal beam and is towed along the seabed.	Can be a problem in some areas, depending which species is being targeted for trawling.	Low	Very high: the beams and chains plough up the seabed to a depth of several centimetres.
Long-line	Consists of a long main line with a large number of short lines (called snoods) carrying numerous baited hooks.	Can be a problem in some areas, depending which species is being targeted. Sharks are the most common bycatch.	Problematical in some fisheries, posing a threat to seabirds and turtles.	None

6.14 > Different fishing techniques have various impacts on fish stocks and the marine environment.

available about the structure and size of fish stocks. Here, the main problem is that fishermen reject the concept of direct payments for, unlike quotas, which are allocated free of charge, these fees reduce their earnings. Landing fees therefore play only a minor role in practical fisheries policy at present.

Restricting fishing effort

In addition to the use of quotas, fishing can also be regulated by restricting the fishing effort. For example, fishing capacity can be limited by capping the number of licences available for allocation to fishing vessels or by restricting the engine power or size of vessels. It is also possible to limit the duration of fishing, e.g. by capping the number of days that may be spent at sea.

Effort-based regulation offers fishermen a number of loopholes, however. Fishermen frequently circumvent the restrictions on fishing time by increasing their fishing capacity. They can thus harvest the same quantity of fish in a reduced number of days spent at sea. A well-known example is the Pacific halibut fishery, where at the end of the 1980s, fishing was only permitted for three days a year. In practice, during this very short fishing season, a vast fishing fleet was deployed and caught the same quantity of fish as had previously been harvested in an entire year.

Moreover, an effort-based regime requires constant adaptation to bring it into line with the latest technological developments. Increasingly efficient technology to locate fish shoals, for example, makes it possible to track and harvest a given quantity of fish in ever shorter time periods. Increasingly detailed legal provisions are also required, ultimately leading to overregulation and generating high economic costs.

Nonetheless, experts agree that some regulation of fishing technology and practices is essential. For example, fishing methods that inflict particularly severe damage on the marine ecosystem are banned in many regions; these methods include blast fishing, which uses explosives and indiscriminately kills all the fish within a given area.

6.15 > Blast fishing – the practice of using explosives to kill fish – is banned in most places around the world as it kills a large number of marine organisms. In areas where there is very little control of fishing practices by the authorities, some fishermen continue to deploy this devastating technique, as seen here in Brazil.

Allocating fishing rights

Territorial use rights in fisheries (TURF) are an alternative to centralized approaches to fisheries management. Here, individual users or specific user groups, such as cooperatives, are allocated a long-term and exclusive right to fish a geographically limited area of the sea. Catches and fishing effort are decided upon by the individual fishermen or user groups.

This self-organization by the private sector can also help to achieve a substantial reduction in government expenditure on regulation and control. Users also have a vested interest in ensuring that they do not overexploit the stocks, as this is necessary to safeguard their own incomes in the long term. However, a use right for a stock of fish or other living resource in the ocean is exclusive only for non-migratory species such as crustacea and molluscs.

One example of successful management by means of territorial use rights is the artisanal coastal fishery in Chile, which mainly harvests bottom-living species, particularly sea urchins and oysters. Fishermen here have shown that they have a vested interest in pursuing sustainable fishing once they have the prospect of obtaining secure revenues from these fishing practices over the long term.

Toward more sustainable fisheries

> In order to improve the situation and ensure that fish stocks are managed sustainably, the current approach to fisheries management urgently needs to be reformed. To protect fish stocks in the future, greater account must also be taken of the ecological linkages between various fish species and their habitats, as so far, stocks have tended to be viewed in isolation.

Tangible scope for improvement

In view of the weaknesses described, a reform of the existing approach to fisheries management is urgently needed. It would be sensible to start by applying the classic instruments used to regulate catches far more consistently and enforce them more effectively. It must be borne in mind, in this context, that a quota can only be effective if it is set at a sufficiently stringent level. In addition to better quota regimes, instruments such as the establishment of marine protected areas and certification of sustainable fisheries can also contribute to sustainable fisheries management.

Marine protected areas – havens for endangered species

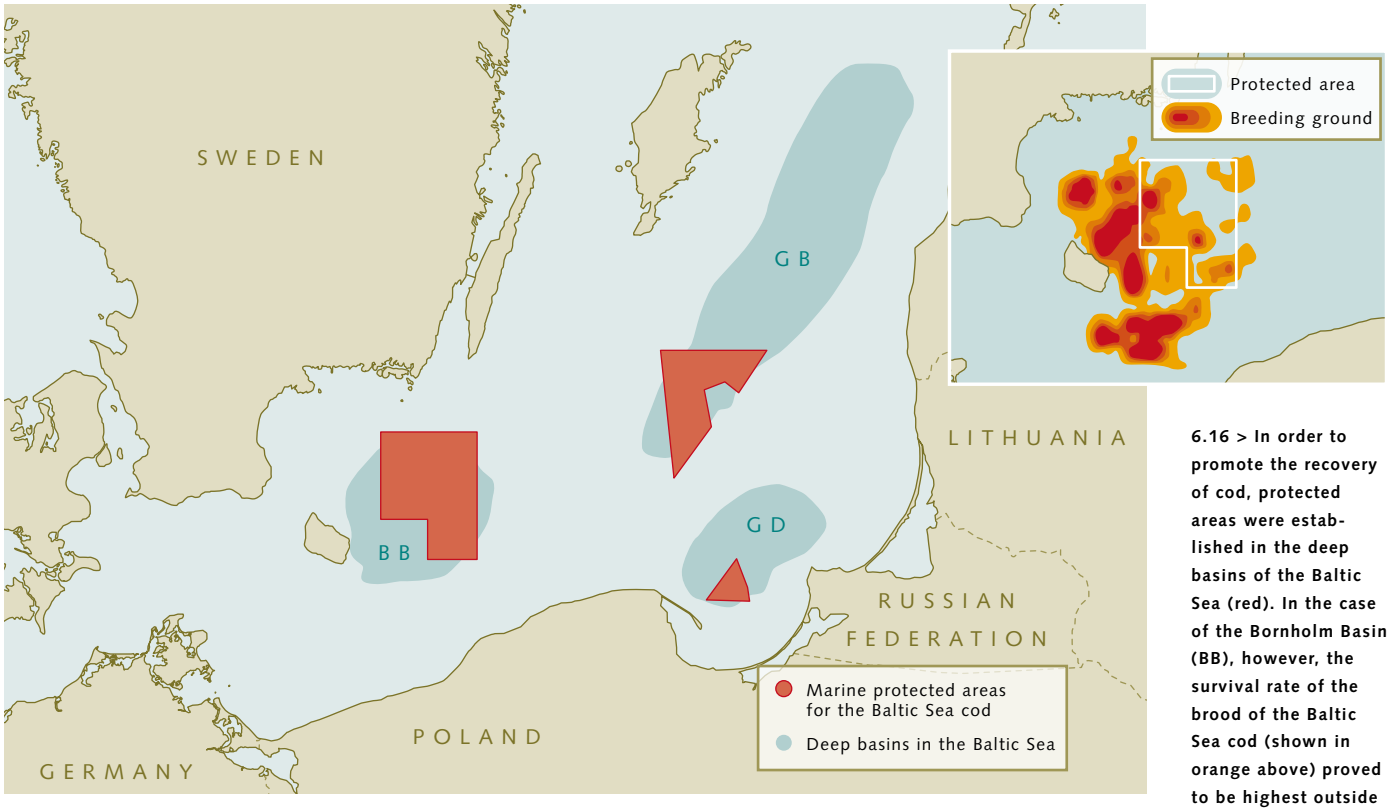
Marine protected areas are geographically defined areas of the sea in which all or some economic activities – especially fishing – are prohibited. Closing off these areas helps to conserve marine ecosystems, especially by protecting endangered species or unique habitats such as coral reefs. Since 2004, for example, the North East Atlantic Fisheries Commission (NEAFC) has banned the use of bottom trawls in some areas in order to protect cold-water corals.

Various studies have shown that marine protected areas can help to support the recovery of fish stocks. One advantage of protected areas is that they are relatively easy to establish and monitor. Satellite-based location and electronic logbook systems, known as Vessel Detection Systems (VDS) and Vessel Monitoring Systems (VMS), enable the routes taken by industrial fishing vessels to be tracked. However, one problem is defining the right size for the protected area. If the protected area is too small, its effect will be limited, as fish will migrate out of the protected area and will be caught elsewhere. And indeed, a higher level of fishing activity has been observed on the periphery of existing protected areas compared with elsewhere. If it is too large, however, the stock may recover within the protected area, but this does not benefit the fishery, which has no access to these increased fish stocks.

It would seem that areas providing refuge for juveniles are most suitable as protected areas for the purpose of fisheries management. Heavily overfished maritime regions, where very few fish can be caught in any case, may also be suitable for designation as marine protected areas. However, the refuge areas used by the juveniles of various species are often distributed across many different maritime regions, so a single protected area may not always help to protect several species at once.

The difficult quest for the right protected area – the case of the Baltic Sea cod

It is extremely difficult to determine exactly which region is the right one in which to establish a marine protected area, as the example of the Baltic Sea cod clearly illustrates. As a result of severe overfishing and unfavourable environmental conditions such as oxygen depletion in the deep water, stocks of Baltic Sea cod massively declined in the 1980s, falling to around one-seventh of their former levels within just a few years. Despite some



6.16 > In order to promote the recovery of cod, protected areas were established in the deep basins of the Baltic Sea (red). In the case of the Bornholm Basin (BB), however, the survival rate of the brood of the Baltic Sea cod (shown in orange above) proved to be highest outside the protected area.

recovery in recent years, stocks are still well below a level that would permit harvesting at maximum sustainable yield (MSY).

In order to constrain the fishing of spawning populations and stabilize the radically depleted stock, fishing bans were imposed in some areas of the Baltic Sea. The Bornholm Basin (BB) is particularly important for the continued existence of the Baltic Sea cod, as the survival rate of eggs and larvae in the more easterly spawning grounds such as the Gotland Basin (GB) and the Gdansk Basin (GD) is relatively low due to the often poor oxygen conditions here.

The fishing ban area in the Bornholm Basin was first established for the period from May to August 1995. Despite the progressive expansion of the protected area in subsequent years, however, no significant stock improvement was observed. The reason for this is that, although the protected area is located in an area of the sea with high spawning activity, current studies show that there are spatial differences in mortality. The highest survival rates of larvae and juveniles are, it seems, found on the margins of the Bornholm Basin, i.e. outside the current protected area.

This study suggests that the wrong location may possibly have been chosen for the protected area. As a consequence, the areas that are important for the survival of the species are inadequately protected, and there is even a risk that the protected area has a counterproductive effect, as fishing activity is now shifting to the major spawning grounds.

Despite these setbacks, however, protected areas are an important building block for the conservation or recovery of a stock. However, the example also shows that the establishment of protected areas is only really beneficial if it is based on adequate ecological and economic data.

6.17 > Cod is common throughout the North Atlantic. Its western stocks have been depleted by fishing, however. Protected areas for cod have been established in the Baltic Sea.

Certification of sustainable fisheries

The complex economic interactions between the various influencing factors, such as consumer demand for different species of fish, are often still not considered in conventional fisheries management. For this reason, non-governmental organizations and some initiatives supported by the private sector are opting for a different solution.

Their aim is to influence consumer demand by means of information campaigns and the certification of sustainable fishery products with a view toward reducing demand for overexploited species, and encouraging consumers to choose products from sustainable fisheries instead. The idea is to encourage producers, over the long term, to respond to this shift in consumer demand and switch to more sustainable methods of production.

Certification is therefore conditional upon fulfilment of specific production criteria, such as a commitment to refrain from fishing endangered stocks and from deploying destructive fishing techniques that have attracted particular criticism, such as the use of beam trawls, which destroy seabed habitats. Two of the best-known movements are the Marine Stewardship Council and the Friend of the Sea initiative.

The Marine Stewardship Council (MSC) was founded in 1997 by an environmental organization and an international food corporation, and has operated on an independent basis since 1999. The Friend of the Sea initiative was also established by an environmental organization and is notable for the fact that it certifies aquaculture products as well. Critics of these certification schemes complain about the often inadequate ecological criteria established for certified fishery products. A further point of contention is to what extent demand for certified fish is genuinely replacing the demand for conventionally caught fish, or whether it is in fact generating additional demand for fishery products.

Overall, then, demand-oriented approaches may be a good way of enhancing sound fisheries management, but are not an sufficient solution on their own to guarantee sustainable fisheries.

6.18 > The Marine Stewardship Council was established by the nature conservation organization WWF and the food corporation Unilever in 1997 in order to promote responsible fishing.

Conclusion

Is sustainable fishing feasible?

Fishing contributes significantly to our food supply and provides a source of income for millions of people. Most fish stocks worldwide, however, have been fished to the limits of their capacity or beyond. In the interest of sustainable fishing, it would be sensible to start by applying the classic instruments used to regulate catches far more consistently than hitherto, and to enforce them more effectively. It must be borne in mind, in this context, that a quota can only be effective if it is set at a sufficiently stringent level. The basic prerequisites for a sustainable and efficient fishing industry are effective national and international institutions to establish and monitor fisheries policy. One of the greatest challenges arising in the future will be to achieve a better understanding of the connections between human influence on the ecosystems and the development of natural resources, in order to establish a sustainable and economically viable marine fisheries sector. Furthermore, successful fisheries management must take account of the economic interactions between various fisheries.

Maintaining natural resources is, ultimately, the key prerequisite for achieving long-term and sustainable revenues. Successful fisheries management will increase the profitability and productivity of the fishing industry. If stocks are given the chance to recover, this will also benefit the industry. Much higher yields could then be achieved in the long run, at greatly reduced fishing costs.

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