COD CATCHES ON A FISHING BOAT OFF THE LOFOTEN ISLANDS, NORWAY (Photo: getty images)



### **OVERFISHING** AND OTHER THREATS TO AQUATIC LIVING RESOURCES

Goal of hunger eradication without improving fisheries management. Almost two-thirds of the GIWA regional teams predicted that the effects of unsustainable fishing practices would increase in severity in their region by 2020. Overfishing was identified as the priority concern in many parts of East Asia and Australia & the Pacific Islands. Virtually all of the mega-regions determined that the overexploitation of fish and other aquatic living resources, and the use of destructive fishing practices are major concerns. By contrast, excessive by-catch and discards were only determined to be critical at the mega-regional level in South America and Southeast Asia. Excessive fishing effort and the employment of destructive fishing practices are attributed to a complex web of root causes, including the common pool nature of fisheries resources, poverty, insufficient knowledge regarding the status of the fisheries, inappropriate subsidies, a lack of appropriate incentives and weak enforcement of fisheries regulations.

Today, the fisheries industry employs over 200 million people and exploits virtually all international waters. The achievement of the Millennium Development Goal (MDG) to eradicate hunger will be partly dependent on the ability of the fisheries and their ecosystems to supply animal protein to the populations of most developing countries. However, there is widespread concern over the sustainability of the fisheries. The Food and Agriculture Organization reports that 52% of the world's marine fish stocks are fully exploited, 16% are overexploited and 7% are depleted (FAO 2005). Furthermore, many of the ecosystems that support critical fisheries are degraded.

GIWA assessed the sustainability of international fisheries (Box 15) by targeting the following issues: (i) overexploitation; (ii) excessive by-catch and discards; (iii) destructive fishing practices; (iv) decreased viability of stocks through pollution and disease; and (v) impact on biological and genetic diversity.

#### BOX 15. TRANSBOUNDARY FISHERIES

GIWA uses the following characteristics to define international fisheries:

- River basins, lakes, and marine ecosystems that are divided by political borders which do not match the distribution and migratory patterns of fish stocks;
- Fleets operating in the Exclusive Economic Zone (EEZ) of foreign countries;
- Two or more countries disputing the location of their respective EEZs;
- Consumers buying fish caught in another country's EEZ;
- Fleets fishing on the high seas, which are international commons (the high seas were not assessed by GIWA).

#### Global situation and trends

- Overfishing and other threats to aquatic living resources were assessed as the priority concern in over one-fifth of the GIWA regions/ sub-systems.
- Almost 60% of the GIWA regional teams assessed overexploitation as severe. In nearly every lake and Large Marine Ecosystem (LME) assessed by GIWA, several fish stocks are overexploited.
- Overfishing is primarily caused by the excessive fishing effort of industrial fishing fleets, but small-scale fishers also overexploit nearshore fish stocks.
- Excessive by-catch and discards exacerbate overfishing and can threaten endangered species; trawling fisheries in the North Atlantic and in numerous tropical regions typically have significant by-catch.
- In three-quarters of GIWA regions/sub-systems, destructive fishing practices are degrading habitats and communities that support fisheries.



FIGURE 18. OVERALL ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS OF OVERFISHING AND OTHER THREATS TO AQUATIC LIVING RESOURCES



FIGURE 19. FUTURE ENVIRONMENTAL TRENDS OF OVERFISHING AND OTHER THREATS TO AQUATIC LIVING RESOURCES



FIGURE 20. IMPACTS OF OVEREXPLOITATION OF FISH

- Aquaculture is the fastest growing animal-based foodproducing sector, particularly in developing countries.
  However, the widespread environmental and social drawbacks of the industry need to be addressed.
- Although the majority of the GIWA regional teams predicted that the impact of overfishing and other threats

to aquatic living resources would increase in severity, the situation in over 20% of GIWA regions/sub-systems is expected to improve by 2020 following the adoption of sustainable management practices (Figure 19).

### ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

#### Overexploitation

Overexploitation occurs when fish and other living resources are caught at a rate which exceeds the maximum harvest that allows the population to be maintained by reproduction. Overexploitation of fish was assessed as severe in more regions than any other environmental issue evaluated by GIWA. It is a geographically widespread problem, affecting most LMEs and many lakes, including the East African Rift Valley Lakes/47b,c,d.

Overexploitation firstly affects large, slow-growing predatory fish, such as cod, halibut and grouper, and highvalue invertebrates, such as shrimp, lobster and large shellfish. In many GIWA regions the depletion of large predators has led to 'fishing down the food web', whereby the average catch composition is gradually replaced by short-lived, fast-growing, plankton-eating fish and invertebrates at lower trophic levels, as the predatory fish populations succumb to intensive fishing effort (Pauly et al. 1998). The Argentinean hake (Merluccius hubbsi), for example, was the species principally targeted in the South Atlantic Drainage System (Patagonian Shelf/38b). After years of overfishing, hake stocks finally collapsed in 1997, whilst stocks of the short-lived and fast-growing Anchoita (Engraulis anchoita) tripled over the same period. The collapse caused extensive unemployment in the fishing industry, severely impacted fish processing plants and reduced export revenues.

In the Caribbean Small Islands region (Caribbean Sea/3a), fisheries production escalated to unsustainable levels, from 9 000 tonnes in 1950 to 60 000 tonnes in 2000 (Figure 21). Many commercial species are currently at risk as a result of overexploitation and a loss of critical habitats for fish and shellfish reproduction, such as mangroves, seagrass beds and reefs.

It is often difficult to determine the degree to which fish stocks are depleted as a result of overexploitation or climatic variability. For example, the cod stocks of the Greenland Seas are sensitive to changes in water temperature, and have subsequently declined over the last 30 years (East Greenland Shelf/15 and West Greenland Shelf/16). According to Sherman (2003), climate is the key controlling factor of fishing yields in about half of the world's LMEs. However, overexploitation exacerbates the effects of climate variabil-



ity, such as in the major upwelling areas of the Benguela Current/44, Canary Current/41 and Humboldt Current/64 (Box 16).

The affect of overfishing on the trophic structure of fish communities is exemplified in the Barents Sea/II. In the 1980s, overfishing and natural fluctuations drastically depleted Capelin (*Mallotus villosus*) stocks. Cod (*Gadus morhua*), the most commercially important fish in the Barents Sea, preys mainly on Capelin. The subsequent lack of prey and continued overfishing of cod itself reduced the cod spawning stock biomass, and catches declined to 20% of their highest levels. Although cod stocks were restored during the early

#### box 16. Climate variability and fisheries: the el niño southern oscillation (enso)

Fish biomass and catches are strongly linked to climatic variability, particularly in high latitude and upwelling Large Marine Ecosystems (LMEs).

Many studies have explored the relationship between fisheries, climate, and climate modes. The latter are dynamic patterns of climate variability, such as the El Niño Southern Oscillation (ENSO). ENSO dominates the inter-annual climatic variability of the southern Pacific Ocean and influences global climate. Several ecosystem responses to the ENSO affect the fisheries. In the Humboldt Current/64 LME, cold nutrient-rich upwelling ceases in El Niño years. The consequences are dramatic, including reduced primary production, the collapse of the anchovy fisheries and the migration of jack mackerel (*Trachurus murphyi*) to inshore waters where they are subjected to high predation.

#### BOX 17. SOCIO-ECONOMIC IMPACTS OF THE UNSUSTAINABLE EXPLOITATION OF FISH: CASE OF THE SOUTH CHINA SEA



The GIWA assessment of the South China Sea/54, which includes the EEZs of nine countries, highlights the range and severity of the socioeconomic effects of overfishing. Throughout the region, the reduction and collapse of the fisheries has led to a widespread loss of income and employment.

In many areas, particularly around the Philippines and Indonesia, fish are mostly exported causing local fish consumption to decline by a third. This has contributed to the malnutrition of many children. In coastal communities, alternative livelihoods are rarely available. Injuries and deaths from blast fishing and diving are common. Conflicts provoked as a result of declining fish stocks are frequent among local fishing groups, and with foreign fishers.



It is estimated that fishing effort will need to drop by 50% to restore many fisheries to sustainable levels, particularly near urban areas. The major deficit in wild-caught fish production is expected to lead to increased aquaculture to meet growing demand (see Box 18). (SOURCE: SOUTH CHINA SEA/54)

to mid-1990s, intense fishing during the late 1990s depleted stocks again. At the end of the 1980s, 75 000 people were employed in the fisheries sector in northwest Russia, but this figure had dropped to only 30 000 a decade later. Coastal settlements experienced food insecurity, further unemployment and reduced income in other sectors of the regional economy.

Nearshore stocks are also increasingly overexploited by artisanal fishers. The number of artisanal fishermen in India is unsustainable, having increased by 300% over the past 20 years (Bay of Bengal/57). Artisanal fishing communities are particularly vulnerable to the impacts of overfishing. In the Guinea Current/42 region, 60% of landings are made by artisanal fishers, and since a downturn in fisheries production, unemployment has increased and conflict has been provoked between artisanal fishers and commercial trawlers. In the adjacent Canary Current/41 region, overfishing has led to 80% unemployment in the Senegalese fisheries sector.

Overexploitation of living resources affects many sectors of the economy. In the Bahamas (Caribbean Islands/4), as in many SIDS and other regions dependent on coastal resources, the fisheries are critical for economic development, tourism and food security. The exploitation of living resources for export results in local communities losing their best source of protein. The decline in the nutritional value of the local diet leads to protein deficiency.

The effects of destructive fishing practices and overfishing are also evident in many freshwater systems. Fish account for 25-40% of total animal protein supply in the Lake Tanganyika Basin. Rapid population growth and poor management of the resource has reduced per capita fish consumption in Malawi by over 40%, leading to malnutrition in some areas. Destructive fishing activities and overfishing put a substantial proportion of those employed in Lake Malawi's commercial fisheries (nearly 290 000) at risk. In Lake Tanganyika, overfishing and destructive fishing practices have led to large-scale unemployment following the collapse of Burundi's industrial fishing fleet in the early 1990s.

#### Excessive by-catch and discards

By-catch refers to the incidental capture of non-target fish, invertebrates, marine mammals, sea turtles, and seabirds, as well as under-sized specimens of target species. But discards refer to undesired by-catch thrown overboard; the survival rate of most species discarded is extremely low. In many of the regions assessed by GIWA, excessive by-catch accompany overexploitation.

By-catch changes the age structure of fish populations, disrupts food webs and threatens endangered species. In the transboundary waters of many tropical and subtropical GIWA regions, by-catch, particularly from shrimp trawling (see figure 22), was assessed as having severe environmental impacts. In the Somali Coastal Current and South African waters, the ratio of prawns to by-catch is 1:7 and 1:4 for trawlers, respectively. By-catch of endangered species is also a concern, particularly in the Pacific Islands/62 and Somali Coastal Current/46.

By-catch and discards can have serious socio-economic implications. In the Sea of Okhotsk/30, fleets discarded large quantities of juvenile pollock during the 1990s, which destabilised the age structure of the stock. The volume of pollock catches have subsequently declined by one-third over the last 10 years. In 2000, fishing companies lost revenues in excess of 100 million USD.



FIGURE 22. BY-CATCH FROM SHRIMP TRAWLING IN THE GULF OF MEXICO (photo: minden pictures)

Discards also create major transboundary problems if the discards from one fishery include species which are valuable to another. For example, foreign fishers dominate offshore fishing in the Somali Coastal Current/46 region, and discard significant amounts of edible by-catch. When rotting fish carcasses are carried shoreward, local fishermen complain that foreigners are destroying their fisheries.

#### Destructive fishing practices

Destructive fishing methods, including bottom trawling, blast fishing, fishing with poisons, muro-ami nets, and several other locally employed fishing methods, significantly degrade aquatic habitats. Almost three-quarters of GIWA regional teams reported that destructive fishing practices cause moderate to severe impacts (Figure 23).

Although bottom trawling was originally developed for use in deepwater in the North Atlantic, it is now also employed when fishing shallow seagrass beds in tropical regions, causing extensive damage. However, deepwater and hard seabed bottom trawling is also highly destructive to benthic habitats and communities. In the Gulf of California/27, the recurrent use of trawling nets has severely altered the composition of benthic communities.

Blast or bomb fishing, which uses small explosives to kill or stun fish, is predominantly used in tropical regions where it destroys the structure of coral reefs and can subsequently cause the collapse of reef fisheries. Poison fishing with toxic chemicals, such as bleach and cyanide, is also highly destructive to coral reefs. The GIWA assessment found blast and poison fishing to be major problems throughout Southeast Asia, as well as in the Brazil Current/39, Caribbean Sea/3 and Somali Coastal Current/46. Cyanide is widely used in the live reef food fishery and the ornamental aquarium fishery in East Africa, East Asia and Southeast Asia.

Destructive fishing practices are the greatest threat to the reefs of the Sulu-Celebes Sea/56 region. While the short-term benefits to fishermen are high, often returning 15-40 USD for a 1-2 USD investment, the social and environmental costs are considerable. Blast fishing is expected to cost Indonesia at least 3 billion USD over the next 20 years, and cyanide use a further 50 million USD. A sustainable hook and line fishery, in contrast, could create net benefits of 320 million USD. In some regions, human consumption of poisoned fish has led to hospitalisation, and even death.



FIGURE 23. IMPACTS OF DESTRUCTIVE FISHING PRACTICES

# Decreased viability and biodiversity impacts of aquaculture

Bacterial or viral diseases can spread from aquaculture stocks and decrease the viability of wild commercial stocks. The introduction of disease through shrimp aquaculture in North Sumatra has resulted in the collapse of wild shrimp stocks. In the Humboldt Current/64, outbreaks of disease in shrimp farms have cost 600 million USD annually, excluding the subsequent economic impact on wild stocks. Aquaculture or restocking programmes that introduce alien species or genetically modified organisms can affect the biological diversity and structure of ecosystems, as observed in several regions in Central America and South East Asia. In the Philippines and Vietnam, introduced species have extirpated native species. Box 18 discusses the characteristics and impacts of the aquaculture industry.

#### BOX 18. AQUACULTURE INDUSTRY

Aquaculture, both inland and coastal, is one of the fastest growing food producing sectors in the world, with the annual growth Exports of aquaculture products provide substantial foreign exchange for many coastal states. Unfortunately, this is often clearance of coastal habitats, such as mangroves, and can cause eutrophication and other pollution. Some aguaculture opera-

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