Encyclopedia of Earth

Marine fisheries

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Humans have been exploiting marine coastlines for millennia. At first, people may have been gathering invertebrates, and harpooned or otherwise caught larger vertebrates -- fishes, turtles, marine mammals -- only as they swam inshore. Of these larger vertebrates, only those that had narrow coastal ranges were affected by such exploitation, and incurred the risk of being overfished.

The development of better fishing vessels, with greater ranges, subsequently enabled people to exploit resources further offshore. However, for a very long time, distance offshore, and storms (or the likelihood of storms) continued to prevent the exploitation, and hence the overexploitation of most marine species. This is the reason for the perception that fisheries were sustainable in the past, and by extension, that contemporary artisanal fisheries, and fisheries conducted by aboriginal peoples, are sustainable, whatever gear they may deploy (Pauly et al. 2002). The growth and expansion of European fishing fleets in the 17th and 18th century did not affect this perception, even when their exploitation, e.g., of cod in the North Atlantic, affected the stocks so much that localized depletions occurred (Rosenberg et al. 2005).

The Industrial Revolution saw the advent of steam trawlers, which began operating along the coasts of Britain, gradually expanding their operating radius, and depleting one coastal stock after the other (Pitcher 2001), then moving on to offshore stocks. Subsequent technical developments -- diesel engines, hydraulic winches, inboard refrigeration, echo-sounders and access to real-time oceanographic data -- allowed fishing boats to rapidly locate, catch and process large quantities of fish, and to land them in better condition from longer distances, thus making the entire North Atlantic, then the world ocean, accessible to European-based fishing fleets (Cushing 1988; Pauly et al. 2002).

The same transformation of fisheries occurred in other industrialized parts of the world, e.g., in North America, North Asia, and Australia. There also, it occurred mainly in the wake of the two World Wars, both of which encouraged technological developments that were subsequently transferred onto fishing vessels.

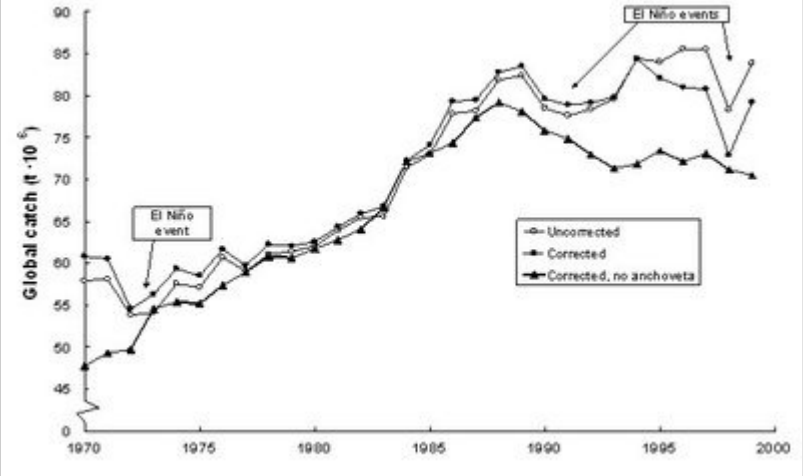

Figure 1. Trends in world global marine fisheries catches (i.e., excluding freshwater catches and aquaculture production), displaying - since the late 1980s - a downward trend that is visible once the over-reporting of catches from China is corrected for, and the widely fluctuating Peruvian anchoveta are dis-considered (modified from Watson and Pauly 2001).

These trends became intensified after World War II, when industrial fleets began a global expansion whose effects were magnified by another major wave of fisheries expansion emanating from Latin America, and from newly independent and other countries of Southeast Asia and Africa. Global catches increased rapidly from the late 1940s to the late 1960s, grew more slowly in the 1970s and peaked in the late 1980s, when for the first time, catches from new fishing grounds failed to compensate for depleted areas (Watson and Pauly 2001; Figure 1). Global catches have been declining since, despite continuing high fishing pressure everywhere.

Continuation of present trends will thus lead to a significant decrease in global fish supply. This potential shortfall is

particularly worrisome given an increasing demand, unlikely to be met by fish farming (especially not the farming of carnivorous fishes such as salmon, which require meal and oil derived from small fishes also suited for human consumption; Naylor et al. 2000).

Marine fisheries systems mainly exploit the productive shelves surrounding continents, down to a depth of about 200 m, and the deeper, oceanic waters of tropical, temperate and polar areas. In these systems, fisheries activity is the dominant force behind environmental change. Though extremely variable in term of their physical features, these systems are all strongly and similarly impacted by fisheries, whose biomass withdrawals modify ecosystem biodiversity and functioning (Pauly et al. 1998; Figure 2), the latter also through the habitat modification resulting from bottom trawling (Watling and Norse 1998; Chuenpagdee et al. 2003).

Also, with the increasing high-end technology onboard vessels (e.g., fish finding and navigation) having enabled access to previously inaccessible natural refugia (great depths and distances offshore, rough bottoms, etc.), fisheries have caused numerous local extinctions of marine fish and higher vertebrate populations, and caused widespread habitat alteration and loss. As some of these are still reversible, this has led to increasing calls for the (re-) establishment of marine refugia (Russ and Zeller 2003), and other forms of ecosystem-based management approaches (Pikitch et al. 2004; National Research Council 2006) that would encourage resource conservation.

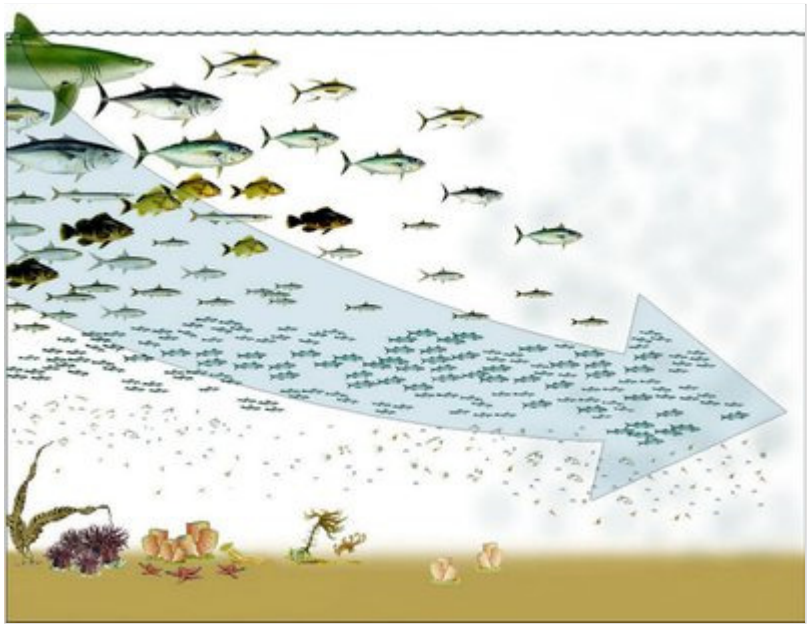

Figure 2. Schematic representation of 'fishing down food webs,' wherein a fishery starts by catching abundant large fish high in the food web (upper left corner), then gradually shifts to smaller fish, lower in the food web, as the former resource becomes less abundant. This process, which occurs in virtually all fisheries of the world, usually goes along with habitat destruction and alteration, as illustrated here by the gradual disappearance of the bottom structure created by bottom organisms.

There is still time for sustainable marine fisheries, but only if they are reinvented not as the source of an endlessly growing supply of fish for an endlessly growing human population, but as provider of a healthy, but limited complement to predominantly grain-based diets. Particularly, fisheries cannot remain a free-for-all for pillaging distant water fleets; they can, however, become a regular source of income for communities whose members act in accord with the finite nature of marine resources (Pitcher 2001). One key element of such reinvented fisheries will be their smaller size, and their reliance on fish biomass being exported from marine reserves, the protected ocean areas that we must establish if we are to allow marine ecosystems and the species therein to rebuild some of their past abundance, and to share this abundance with us.

Further Reading

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