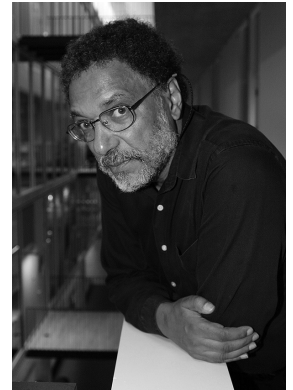


Beyond duplicity and ignorance in global fisheries

Ever increasing industrial fishing efforts have caused a global fisheries crisis with repeated collapses of fish stocks worldwide, reports **DANIEL PAULY**. If this continues it will lead to further depletion of biodiversity and fish resources and the transformation of marine ecosystems into dead zones. Fisheries can be sustained into the future only if fish resources are allowed to recover and rebuild and fishing efforts are reduced. Fisheries management and fisheries science must be transformed into life-affirming disciplines.



Freshwater and coastal fisheries of ancient times had the capacity to induce severe decline and even to obliterate vulnerable species of marine mammals, fish and invertebrates.¹ But it's only since the onset of industrial fishing in the 1880s, with use of fossil-fuel powered vessels and the first steam-powered trawlers, that successive depletion of inshore stocks became routine followed by depletion of more offshore stocks.

The three decades after World War II were a period of rapidly increasing fishing effort and landings, but also of spectacular collapses, particularly in small pelagic (open sea) fish stocks. Operations became increasingly industrialised from the 1950s with onboard refrigeration, acoustic fish-finders, and,

later, GPS. In this period a toxic triad of catch under-reporting, ignoring scientific advice and blaming the environment emerged as standard responses to ongoing fisheries collapses, which became increasingly more frequent, finally engulfing major North Atlantic fisheries where it took only a few years for accumulated coastal stocks of flatfish and other groups to be depleted, forcing the trawlers to move on to the central North Sea, then further away, all the way to Iceland.² The response to depletion of traditional fishing grounds was an expansion of North Atlantic and northern hemisphere fisheries in three dimensions.

Geographic expansion: A southward expansion began towards the tropics³ and in developing industrial fishing in the nascent Third World, often through



Over-fishing mackerel.
NOAA

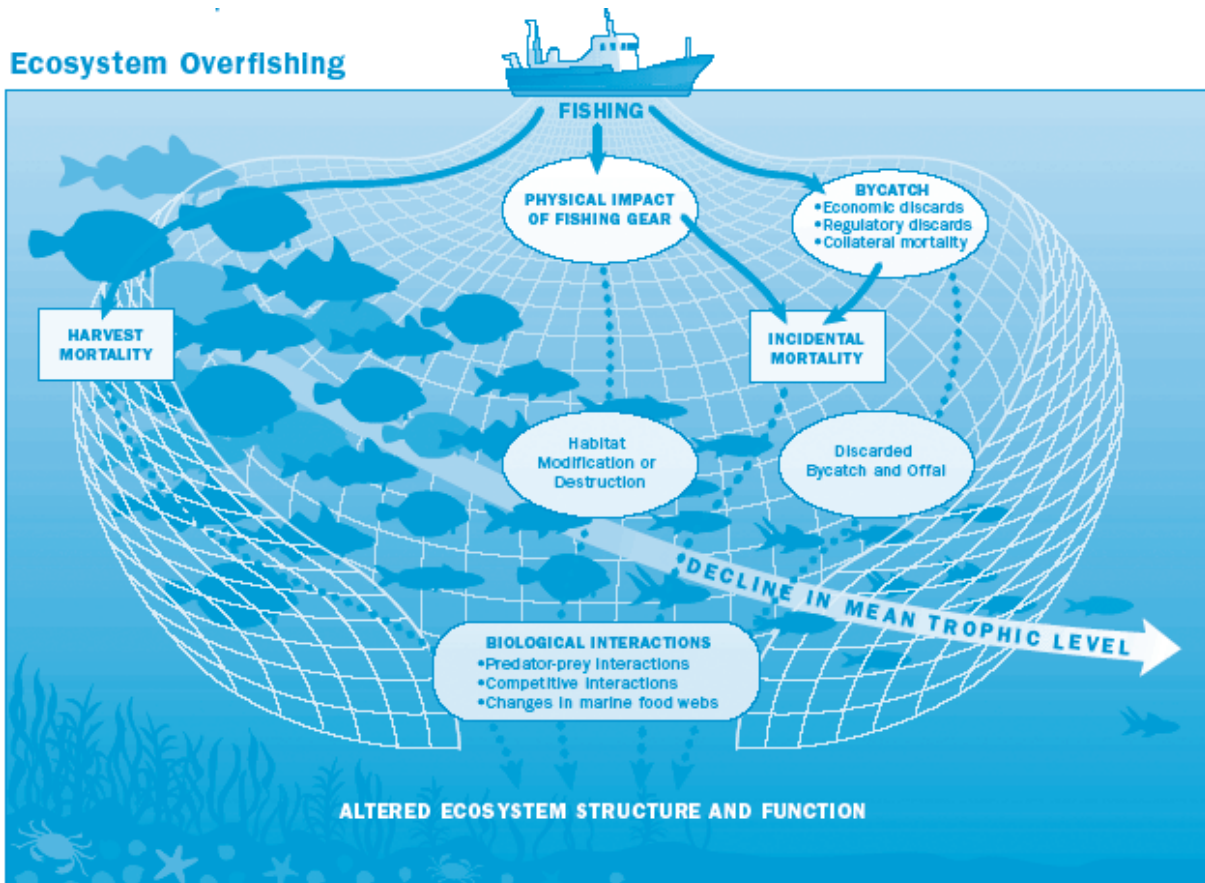
joint ventures with European, e.g. Spanish or Japanese firms.⁴ This created new resource access conflicts and or intensified earlier ones, hence the protracted ‘cod war’ between Iceland and Britain, or the brief ‘turbot war’ of March 1995 between Canada and Spain. At the close of the 20th century, the demersal (near sea floor) resources of all large shelves of the world, all the way South to Patagonia and Antarctica had been depleted mainly by trawling, along with those of seamounts and oceanic plateaus.⁵

Bathymetric expansion: The second dimension of fishing expansion was in depth, i.e. offshore, which affected both the pelagic and the demersal realms. In the pelagic realm, exploitation of tuna, billfishes and increasingly sharks for their fin,⁶ by long-lines and similar gear has strongly modified oceanic ecosystems, which now have much reduced biomasses of large predators.⁷ Exploitation is intensified by use of fish aggregating devices (FADs) starting around the Philippines⁸ and spreading through the inter-tropical belt. This made accessible fisheries of small tuna and other fish which could not be captured before, and is an additional expansion.

In the demersal realm, trawlers were deployed that can reach to depths of several kilometres. They yield

a catch increasingly dominated by slow-growing, deep-water species with low productivity, which cannot be exploited sustainably.⁹ As the high seas, the waters outside Exclusive Economic Zones, are legally unprotected against such depredations, their oceanic plateaus and seamounts are subjected to intense localised fishing pressure, with subsequent collapse of resources; the same is then repeated on the adjacent plateau or seamount. This fishing mode is no more sustainable than tropical deforestation. Resulting changes in biomass via altered food webs induce massive changes in demersal and pelagic communities, which can be demonstrated and quantified in various ways.¹⁰ The Marine Trophic Index,¹¹ i.e. the mean trophic level of fisheries landings, is one of the most widely used indicators for this purpose. The MTI is declining worldwide, with fisheries catches increasingly based on small fish and invertebrates at the base of the ocean’s food webs.¹²

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Source: Adapted from Pauly et al., 1998; Goñi, 2000.

Art: John Michael Yanson

Taxonomic expansion: refers to previously spurned taxa being caught and processed.^{13,14} This intensifies the effect of the other two expansions and is the reason why North American and European markets increasingly display unfamiliar seafood. It offers many opportunities for mislabelling products and misleading consumers.^{14,15} Mislabelling seafood unfamiliar to North Americans and Europeans also reduces the impact of seafood guides and similar sustainability efforts.

The fisheries expansion provided many opportunities for mischief, as illustrated by the European Union's negotiated 'agreements' for access to the fish resources of North-west Africa, China's agreement-fee exploitation of North-west Africa, and Japan blaming resulting resource declines on the whales.

Fisheries crisis drivers

The trend of expanding fisheries established in the 1980s and 1990s has led to the crisis at the onset of the 21st century which includes the following factors:

Firstly, a huge over-capacity in the global fisheries sector of excess fishing vessels, estimated as two to three times that required to generate present catches.^{16,17} This is probably an under-estimate, given increased efficiency in locating and catching fish of about 4–5% yearly across a wide range of vessels, which implies a doubling of effective fishing effort in about 15 years.¹⁸

Secondly, the biomass of traditionally targeted large fish (cod and other demersal fish, tuna and other large pelagics) has been reduced by at least one order of magnitude since the onset of industrial exploitation.^{19–21} This has been contested but can be easily

reproduced by anyone willing to reconstruct population sizes prior to industrial exploitation, as done, for New England cod in 2005 by Rosenberg *et al.*²² Arguments about depletion are useless without such reconstruction as subjective perceptions of abundance are biased by shifting baselines,²³ a bias empirically shown to be very strong.²⁴

Thirdly, an aspect of global fisheries often not perceived as the scandal it is, is that about one third of the world fisheries catch, sardines, anchovies, mackerel and other small pelagic fishes, is wasted as animal feed (mainly as fishmeal with about half consumed by aquaculture), although it could easily be converted to human food.^{25,26} This would contribute far more to human nutrition, including omega-3 fatty acids, than aquaculture, which inserts

a trophic step between these fish and humans, and avoid the bioaccumulation of persistent organic pollutants which makes farmed carnivores like salmon so problematic.²⁷

Note: As the supply of small pelagics is not expected to increase in the future, aquaculture's expansion is also going to be limited, at least if conceived as raising carnivorous fish (salmon, seabass and tuna), as is usually implied in western countries (two-thirds of aquaculture production occurs in China, where the major species farmed are herbivorous freshwater fish and marine bivalves, neither of which require fishmeal). For example, increased farming of high trophic-level fish in the Mediterranean, i.e. 'farming up',²⁸ contrasts with the 'fishing down' occurring there, as elsewhere in the world.¹² Thus, large quantities of small pelagics are fished to feed relatively few farmed fish, mainly tuna, leaving no food for marine mammals²⁹ and less fish for people who cannot afford to eat bluefin tuna sushi.

Fourthly, Over 50% of the fish caught in the world is traded internationally, and many industrialised countries either have huge distant water fleets and/or purchase most of the fish they consume, as Germany and Japan do. In any case, there is a large net flow of fish from developing to industrialised countries, with serious consequences for the food security of the protein-deficient, least developed countries.^{30,31}

Fifthly, Various market-style initiatives in industrialised countries are based on the belief that changing consumer behaviour will change the way fish stocks are exploited.^{15,14} The UK-based Marine Stewardship Council (MSC) is the best known of these, along with a multitude of seafood guides meant to advise consumers on the 'sustainability' of species offered, for example in restaurants, see www.seafoodguide.org. Even if this goal was reached, it would still not solve the food security problem caused by the transfer of fish from developing to industrialised countries.

Sixthly, government subsidies to fisheries are the grease that keeps the creaky system going. Recent research of fisheries subsidies for 148 maritime countries from 1989 to the present, found total global fisheries subsidies for 2003 were between US\$25 billion to \$29 billion, which is higher than an earlier World Bank estimate of between US\$14–20 billion.³² 'Bad' fuel subsidies were found to be about 15–30% of total global fishing subsidies, and capacity enhancing subsidies were US\$16 billion or about 60% of total subsidies. These results imply the global community is paying the fishing industry billions each year to over-exploit marine resources. Fuel subsidies allow profitable exploitation of depleted stocks, which directly contribute to the over-fishing crisis. Yet this

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could hint at a solution, as most industrialised fisheries, particularly the fuel-intensive trawl fisheries, depend on subsidies, especially fuel subsidies, making them very sensitive to increasing fuel costs.⁹ This will be enhanced by fallout from the bank collapses of 2008, and the eventual outcome of negotiations of the World Trade Organisation, which intends to abolish subsidies as they distort markets.^{33,34} To halt the current decline in global fisheries, it is crucial that harmful capacity-enhancing subsidies are eliminated.

Masking effects

Other factors, some bordering on duplicity, some crossing that border, contribute to the fisheries crisis being masked, or misapprehended, which adds to the decline of marine biodiversity and ecosystem over-exploitation. The first factor was the massive over-reporting of catches by China through the 1990s, which misled the FAO and the world into believing that global landings were increasing, while they were slowly decreasing.³⁵ This occurred because an independent statistical system does not exist in China, i.e. favourable production statistics can be manufactured by a mid-level official seeking advancement, including in the fisheries sector.³⁶ The FAO, which now presents world fisheries statistics with and without China, now also has slight doubts about Chinese aquaculture statistics as well (www.fao.org).

Another masking factor is that per capita consumption in industrialised countries, especially in the EU and US, is still increasing. This implies, given a stagnating or declining global catch, that per capita consumption in developing countries (excluding China) should decline. Reliable data on fish consumption in developing countries do not exist to test this, which will be convenient to some. In the meantime, consumers in the EU and the USA are left to enjoy *frissons* of guilt when ordering seafood not sanctioned by their many seafood guides.

But the most potent masking factors, are the denials of self-styled 'sceptics', and their misuse of 'uncertainty' as in the case of global warming, since they provide governments with excuses not to intervene to counter negative trends. The sceptics are effective because science needs scepticism and must recognise uncertainty, fisheries science being no exception. In a brilliant paper Ludwig *et al* (1993) outlined how scientific uncertainty is being used in fisheries to hold off intervention until it is too late to prevent stock collapses, i.e. it is not used in a precautionary fashion. This problem can be aggravated when the sceptics also combine their denials with innuendos on the objectivity and ethics of conservation-orientated

scientists, the journals that publish their research and the donors funding it.

Under-reporting catches

Except for China, whose political system encourages over-reporting of domestic catches, and a few instances of strongmen insisting on increasing catches in the countries they thought they controlled (e.g. Ferdinand Marcos in the Philippines in the early 1980s), the catch data available to the public and most scientists are biased downward, and against small-scale fisheries.

This occurs in two steps: (1) government scientists generally study and monitor only commercial fisheries and not recreational and small-scale, artisanal or subsistence fisheries, even if they collectively land the bulk of the national catch;³⁷ (2) the national agencies that report national catches to the FAO, which compiles and maintains the only global database of fisheries statistics, are usually not departments of fisheries or similar entities, but ministries of agriculture, or finance, or statistical offices, which also tend to emphasise 'cash crops,' exportable products like shrimps and tuna, while giving short shrift or worse, completely ignoring small-scale fisheries catches, even though it's these catches which feed their rural populations.^{38,39}

These two problems are so widespread that the Sea Around Us Project⁴⁰ has initiated a systematic reconstruction of the real catch, including those of IU (illegal and unreported) fisheries, of the world's maritime countries which will be completed in 2013.

Collapse or fisheries renewal?

We now have a situation where a substantial fraction of the fishing industry is willing to sacrifice the future of fisheries, a future that can be sustained only if the resources are allowed to recover and rebuild their biomass. There are basically two alternatives for fisheries science and management: one is continuing with business as usual, accommodating subsidy-driven over-capacity without bothering about externalities. This would lead to further depletion of biodiversity and intensification of 'fishing down the marine food web,' which ultimately involves the transformation of marine ecosystems into dead zones.⁴¹

The other alternative is to convert fisheries science and fisheries management into life-affirming disciplines, which, instead of maximising return to fisheries, would be devoted to implementing a more balanced, ecosystem-based fisheries management, requiring consideration of more stakeholders than the fishing industry alone. The most important task to renew fisheries and fisheries research will be to reduce

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This transformation would also require extensive use of ocean zoning and spatial closures, including no-take marine protected areas (MPAs), which must be at the core of any scheme intending to put fisheries on an ecologically sustainable basis. Currently they cover a cumulative area of only 0.7% of the world's oceans, and the annual increase of this area, about 5%, is not high enough for various internationally agreed targets to be reached, that is 10% coverage in 2010, as agreed by the Parties of the Convention for Biological Diversity.⁴² If marine biodiversity is to be maintained and functional ecosystems re-established where uncontrolled exploitation has obliterated them, we will have to set up larger MPAs, at a faster pace, which is also advocated by most marine ecologists, and by all non-governmental organisations working on the marine environment.

The fisheries crisis can be seen as an opportunity to renew both the industry's structure, away from fuel-intensive large-scale fisheries and its governance, and to renew the disciplines which study fisheries, creating a fisheries conservation science in the process.

This article is abridged for *Pacific Ecologist* (KW) from a talk, 'Beyond duplicity and ignorance in global fisheries' given by Dr Daniel Pauly in Barcelona, Spain at the 2008 Ramon Margalef Prize Award. Dr Pauly is Professor at the Fisheries Centre of the University of British Columbia, Vancouver, Canada. He is also Principal Investigator of the Sea Around Us Project (see www.seaaroundus.org), funded by the Pew Charitable Trusts, Philadelphia, and is devoted to studying, documenting and promoting policies to mitigate the impact of fisheries on the world's marine ecosystems. Dr Pauly worked for many years at the International Center for Living Aquatic Resources Management (ICLARM), in Manila, Philippines.

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