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Reconciling Fisheries with Conservation: The Challenge of Managing Aquatic Ecosystems

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The concept of "conservation" is deeply embedded in the history of fisheries science, as documented, for example, in the name of fisheries management organization such as the International Commission for the Conservation of Atlantic Tuna. In this, conservation is similar to "sustainability," incorporated deep inside the quantitative models – recall maximum sustainable yield—which, since the 1950s, have inspired fisheries management.

Thus, all the three basic models proposed in that period—the recruit versus parent stock relationship of Ricker (1954), the surplus-production model of Schaefer (1954, 1957) and the yield-per-recruit model of Beverton and Holt (1957)—involve a convex curve, whose optimum identifies a population (or stock) size ensuring its conservation, while providing us with high, but sustainable, catches.

We now know that fixed target such as maximum sustainable yield are not appropriate for managing variable fish populations, but we will still briefly follow on one implication of our earlier "aim-for-the-maximum" approach. That is, given these models, fishing effort beyond that needed to generate the maximum implied overfishing, and thus lack of sustainability and conservation. Thus, given an observation of excess effort as defined here, fisheries scientists should have been able to agree with other biologists, including those involved with conservation-orientated groups, that the excess effort in question must be reduced. Also, the implication of the aim-for-the-maximum approach should have been that fisheries scientists working for governments, and those working for conservation-orientated groups should have been able to jointly develop tactics and strategies for maintaining fishing effort at optimum levels, and develop, in the process, a unified science of what may be called "fisheries conservation."

What we have seen instead is 50 or more years of isolation of fisheries science from conservation biology, as reflected, for example, in distinct journals, whose contributions usually fail to acknowledge the existence of the sister discipline. The Fourth World Fisheries Congress is probably the first major event in fisheries science that acknowledges the problem that the chasm between these two disciplines represents, if mainly through its motto of "Reconciling Fisheries with Conservation."

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Building on the solid achievements of the classic phase of fish population dynamics—the key papers cited above—I propose that the basic models developed during that period, while not any more useful for tactical management of fisheries, could still be used to identify the areas of reconciliation (i.e., potential collaboration) between fisheries (management) and conservation. This would amount, in practice, in identifying those stocks that have fallen below 30–40% of their original biomass (and which thus are overfished in terms of the classical models), and agreeing on a range of approaches to reduce the fishing mortality impacting on them.
The task will be huge, as the overwhelming majority of commercial stocks, throughout the world, have been reduced by a factor of 10 or more in the last 50 years, accelerating trends initiated much earlier (Jackson et al. 2001). This was documented, in the keynote, through a series of maps illustrating biomass declines in the North Atlantic (Christensen et al. 2003a), Southeast Asia (Christensen et al. 2003b), Northwest Africa (Christensen et al. 2004), and globally (Myers and Worm 2002), and all included in the PowerPoint presentation documenting my keynote, available at www.seaaroundus.org/WFC4F.HTM.

These maps, and the strong biomass decline they illustrate, document the emergence of a new way of looking at fisheries, which have so far tended to be perceived as local affairs, involving predictions for one, or a small suite of, resource species, and shorter time spans, the equivalent of predicting the "weather" of fisheries. The maps, rather, describe long-term, planet-wide trends, equivalent to the "climate" of fisheries. Fishing down marine food webs (Pauly et al. 1998), now a well-established phenomenon (Pauly and Palomares 2004), is the most conspicuous of the trends paralleling the biomass declines mentioned above. This goes along with 1) size reduction among the fish landed, and those remaining in marine ecosystems, 2) reductions of the length and complexity of the food webs structuring those ecosystems, and 3) in shelf systems impacted by trawling, a gradual transition from the benthos to the open water column as the major site for consumption of primary and detrital production. Jointly, these features imply increased variability of, and uncertainty about the ecological processes leading to fisheries catches, which, as well, are likely to continue their global decline (Watson and Pauly 2001).

Global mapping of fishery catches (Watson et al. 2004), besides being a requirement for the mapping of biomass presented above, also allows direct identification of another set of major trends characterizing the global 'climate' of fisheries, and its changes over the last fifty years.

Thus, mapping catches as function of water depth and latitude shows that fisheries, since 1950, have been relying increasingly on fish caught over, then at, great depths, and particularly so in the Southern Hemisphere. This reflects the geographic expansion of fisheries, and also the fact that increasingly, fish consumed in the developed countries of the Northern Hemisphere (notably the USA, Japan, and some countries of the European Union) originate from developing countries, and southern hemisphere waters. These trading patterns have long masked, for consumers in the developed countries of the north, the effects of the large-scale depletion of marine resources in the traditional fishing grounds (e.g., of the North Atlantic). Nevertheless, these effects are gradually becoming visible to the public at large—often via the media campaigns of environmental nongovernmental organizations (NGOs), and the government agencies in charge of fisheries, throughout the world, are forced to respond.

One of the issues that regulatory agencies will have to address is the limited use so far of ocean zoning as a tool for regulating fisheries, especially the creation of large marine protected areas (MPAs, including no take reserves at their core), the obvious analog to the national parks used to conserve the biodiversity of terrestrial systems. The geographic expansion of fisheries alluded to above should be seen, in this context, as the invasion, by increasingly sophisticated and powerful fishing vessels, of the natural marine reserves which, through their depth or distance from various ports, or rocky grounds, had protected populations previously exploited at the shallow, nearshore, soft bottom ends of their distributions (Pauly et al. 2002; 2003).

Indeed, one can show the geographic expansion, over time, of the fished areas of the world (i.e., of what may be called marine unprotected areas [MUA]). Thus, demands for MPAs do not introduce an arbitrary, novel concept into the debate about fishing management, but rather seek to re-establish the balance between MUA and MPA that prevailed a few decades ago, and which now appear to be a prerequisite to sustainable fisheries and their reconciliation with conservation.

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