



Letter to the Editor

Are fisheries ‘sustainable’? A counterpoint to Steele and Hoagland

John Steele and Porter Hoagland present a *Viewpoint* in *Fisheries Research* (64 (2003) 1–3) in which they ask if fisheries can ever be sustainable, given the temporal co-incidence of natural population fluctuations of many exploited marine organisms with human technological change for harvesting such organisms. They illustrate their point by reference to the commonly used analogy between fishing and forest clear-cutting (Levy, 1998; Watling and Norse, 1998). The authors then ask if we can really apply lessons learned from management of terrestrial systems to those in the sea. They conclude by suggesting that by better understanding the causes of natural, physical and ecological cycles of the resources we will derive better management to address the problem.

In contrast, we argue that the problem with fisheries and ‘sustainability’ is not that the (uncertain) cyclic nature of fish populations may coincide with time spans of fisheries development. Rather, the fundamental and more significant problem is that overfishing has reduced the biomass of populations so drastically, that they may not recover from lows in their (natural) fluctuations, leading to population collapses (Fig. 1a, modified from Pauly et al. (2002, p. 692)). This might be happening to the North Atlantic cod (*Gadus morhua*) of Newfoundland, orange roughy (*Hoplostethus atlanticus*) in the southern ocean, and likely many other overfished stocks. The problem also applies if the amplitude of natural fluctuations of stocks is reduced at low population sizes (Fig. 1b). Furthermore, we argue that better management will not be achieved through simply knowing more about the natural cycles, as suggested by Steele and Hoagland. To take such a position ignores the harsh reality that we have simply overfished many stocks, that economics and social issues help drive such overfishing (often independent of

how good or bad the science), that we have largely ignored the ecosystem consequences of this overfishing, and that we have largely ignored effects of gears on habitats.

Some additional points raised by Steele and Hoagland warrant comment:

1. The authors draw a comparison between terrestrial ecosystems (e.g., forests), which are viewed as fluctuating significantly on time scales measured in decades or centuries, and marine systems (identified as phytoplankton and top predators—fish) viewed as fluctuating significantly on time scales measured in days or years, and rarely decades. The comparison, as presented by the authors, is flawed, as they compare an *ecosystem*, i.e., a forest, with *components* of an ecosystem, i.e., fish or phytoplankton, rather than comparing both *ecosystems*, e.g., a forest ecosystem versus the Georges Bank ecosystem. The correct analogy is that fishing with mobile benthic gear is comparable to clear-cutting forests not for the trees, but in the course of hunting for deer (Pauly et al., 2002). Such an activity, a ‘clear-cutting based industrial deer hunt’ aimed at maximizing tonnage of deer caught, clearly is not sustainable in the long-term, nor would it be politically acceptable. Yet, we seem to have accepted it in the ocean, and imagine it to be ‘sustainable’ there. A comparison of mobile fishing gears and forest clear-cutting is presented in Watling and Norse (1998), and they, as well as others (e.g., Hall, 1998; Collie et al., 2000), conclude that these activities have large and long-lasting effects on marine communities. Furthermore, marine *ecosystems*, the appropriate conceptual target of the clear-cutting analogy, have recovery periods measured in years to centuries (Watling and Norse, 1998). This is not different from the recovery periods of many

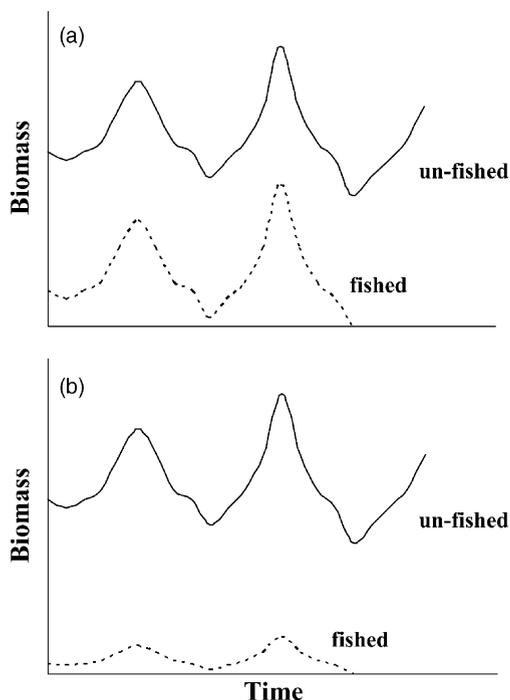


Fig. 1. Schematic representation of the often unpredictable fluctuations of marine resource populations under unfished conditions (solid) and under conditions of intensive fishing pressures (dashed), illustrating the increased risk of heavily exploited population crashing during declining phases of natural fluctuations. (a) Assuming that the amplitude of fluctuations do not differ for exploited and unexploited stocks. (b) Assuming that the amplitude of fluctuations diminishes for exploited stocks. Modified from Pauly et al. (2002).

terrestrial ecosystems, used as a point of argument by Steele and Hoagland.

- The authors argue that the changes observed in some of the overfished ecosystems are 'ecologically acceptable responses', e.g., the shift in dominant catch from cod to invertebrates on the Grand Banks. They imply that these new ecosystem patterns are 'utilizing alternative pathways within the upper levels of the ecosystem'. However, the authors overlook the fact that these invertebrates are not in the upper levels of marine food webs, like for example cod, but rather are at intermediate or lower trophic levels (Bundy et al., 2000). Hence fishing has reduced (or even functionally eliminated) top trophic levels. Intensive fishing is reducing the numbers and lengths of pathways in a food chain, and hence sim-

plifying food webs, a phenomenon now called 'fishing down marine food webs' (Pauly et al., 1998, 2001). This process has potentially significant negative effects on the likely resilience of such ecosystems in the face of increasing fishing and other anthropogenic pressures (Pauly et al., 2002). Indeed, one could argue that fishing fleets have replaced top predators in marine food webs. This could be deemed an acceptable policy by society, from the perspective purely of exploitation by humans, if fleets (and management) would behave in sync with natural patterns, rather than in line with economic expectations (profit, growth) and social and cultural demands (employment, life style). Unlike natural predator populations, which generally respond to declines in their food sources with rapid declines in population size (declines that are part of the natural cyclic fluctuations referred to by Steele and Hoagland), fishing fleets do not rapidly shrink in response to diminishing prey (the ratchet effect, caused by sociopolitical and economic decisions). Instead, after undertaking 'prey adjustments' (as many natural predators) by shifting to other target organisms (usually of lower trophic level), fishing fleets ultimately get subsidized into maintaining excessive capacity levels (Munro and Sumaila, 2002), leading to sequential overfishing of stocks progressively lower in the food web.

Significantly, making direct comparisons between fisheries management and management of forestry or agriculture can be erroneous, since fishing is not an agricultural activity. In fact, fishing is the only human industrial activity (including so-called 'cultural' fisheries, *sensu* Steele and Hoagland) that is a hunting activity on an enormous scale. No human activity does this on an industrial and global (or even regional or national) scale on land, e.g., trees or beef cattle are not 'hunted'. Thus, fishing is not an activity that can be readily compared to farming or forestry for answers to management problems. The question we really need to pose is: How do we regulate hunting of a renewable resource that is often unpredictable in nature (has 'cyclic' or chaotic fluctuations, as well as being influenced by climate change), whose preda-

tors and prey are themselves hunted simultaneously by different sectors of the same industry (targeted or bycatch), and whose habitats (at least for demersal stocks) are sometimes substantially impacted by the activity of the ‘hunting’ gear? Clearly, our problem is far more complicated than a ‘simple’ matter of knowing more about the natural cycles in order to derive appropriate long-term management regimes, as suggested by Steele and Hoagland. There is a growing consensus that current approaches to fisheries management are, with few exceptions, not successful in dealing with these multiple problems effectively (Pauly et al., 2002; Christensen et al., 2003).

What kind of approach do we need to make a ‘hunting’ industry that exploits a renewable resource sustainable? We argue that the only hunting approaches that are sustainable are those that access only a fraction of the entire spatial ecosystem framework. Thus, only through judicious removal of substantial areas of ocean from all resource exploitation (Walters, 1998; Roberts et al., 2001; Pauly et al., 2002), combined with significant reductions of fishing capacity (Munro and Sumaila, 2002; Pauly et al., 2002), can fisheries be sustainable. Under this plan, controlled industrial hunting would be permitted only in selected parts of the oceans. Furthermore, we argue that such an approach will allow us to have both commercial and cultural components of fisheries in an acceptable balance. More significantly, it will buffer the resource from the effects of natural fluctuations and avoid the scenario illustrated in Fig. 1.

Enough knowledge now exists to indicate that fisheries management is often unsuccessful in achieving and maintaining sustainable levels of catches, and especially at controlling unacceptable impacts on ecosystems in which fisheries are embedded. We have a global fisheries crisis (Pauly et al., 2002). While the concepts of ‘ecosystem-based management’ and ‘precautionary approach’ are conceptually on the right track, we have not, as yet, acted in a concerted manner to implement these, despite having laid some general instrumental frameworks (e.g., FAO Code of Conduct, Anonymous, 1995). In line with our arguments above, the only truly precautionary and ecosystem approach is to remove fishing permanently from substantial areas, accompanied, of course, with effective management of the fished areas, including the well recognized need to address gear effects on

habitats, and substantially reduce effective fishing capacity in most, if not all, fisheries. There is growing consensus that no-take zones are effective at rebuilding biomass and age-structures of overfished stocks, resulting in increased stock production which can be exported to surrounding fished areas (through larval dispersal as well as potential direct biomass export), while simultaneously protecting habitat structures essential for fish stocks (Bohnsack, 1998; Roberts et al., 2001; Pauly et al., 2002; Russ, 2002). Thus, no-take zones need to be viewed as a precautionary, holistic ecosystem-based fisheries management tool par excellence. By taking such a bold step, decision makers will be able to state, for the first time, that they are indeed acting in a ‘precautionary’ manner, or as recently expressed more humorously by Koeller (2003): ‘Be careful! Push away from the table! Don’t be so bloody greedy or you will lose the rest of it!’ Given the current depleted states of marine ecosystems (Jackson et al., 2001; Pauly et al., 2002; Christensen et al., 2003; Myers and Worm, 2003), we will need to provide sufficient time for ecosystems to recover to some form of ‘healthy’ structure. Such a process has to be measured at least in decades, maybe longer, and has to take into account the shifting baseline syndrome (Pauly et al., 2002). However, taking this step will enable society to achieve long-term sustainable catches outside the no-take areas. The mechanism to achieve this will be the likely net export of target biomass from no-take to fished areas in the long-term (Russ, 2002). At the very least, the no-take areas will act as an insurance policy against future management failure (Bohnsack, 1998), and thus buffer against extreme and dangerous biomass declines as discussed above. In line with this argument, we have been calling for a global effort to change the fundamental legal concept and framework underlying ocean resource use (e.g., in UNCLOS and other instruments) away from the entrenched concept of *Mare Liberum* (acknowledging its importance to navigation) to a novel concept termed *Mare Reservarum* (Russ and Zeller, 2003; Zeller, 2003). The first step in this direction can be through regional leadership by one or more nations (actions like those taken on the Georges Bank by the US and on the Great Barrier Reef by Australia are encouraging). Eventually, however, it would require a series of UNCLOS style global conferences

specifically focusing on use of renewable marine resources. Multi-topic regional discussions by expert groups on 'Revisiting the Law of the Sea' are underway, and illustrate the growing need to revise these international instruments.¹

To conclude, the fundamental problem with fisheries is not the cyclic nature of fish populations (no matter how chaotic or uncertain), nor the potential time-line overlap with human industrial endeavors, but rather the dramatic depletions in population biomass and changes to the structure of ecosystems within which these population fluctuations now occur. This is driven by vastly excessive global fishing capacity (maintained by perverse economic incentives). Fishing fleets can now, thanks to massive technological advances over the last 50 years (irrespective of time-line coincidence), fish most areas of the ocean, thereby removing the last natural spatial and temporal refuges which historically have acted as population and ecosystem buffers. This exposes populations and ecosystems to a rapidly increasing risk of collapse, and drastically reduces ecosystem resilience. The answer to the problem is strategically simple (although politically challenging): we have to recreate sufficient natural refuges through ocean zoning on a large scale, centered around substantial, permanent no-take zones, to enable ecosystem restoration (*Mare Reservarum*, Russ and Zeller, 2003). In addition we need to drastically reduce excess fishing capacity through reduction and elimination of perverse incentives. Only then can we consider ourselves on the path of making fisheries 'sustainable'.

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¹ One example of these expert discussions is the 'Meeting of Experts' organized by the Maritime Awards Society of Canada in early 2003. The associated report can be found at <http://www.maritimeawards.ca/>.

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