

The Role of Recreational Fishing in Global Fish Crises

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Exploitation of fishery resources has become a major conservation issue on a global scale. Commercial fisheries have been repeatedly blamed for the worldwide declines in fish populations. However, we contend that the recreational fishing sector also has the potential to negatively affect fish and fisheries. Here we present evidence to show that both recreational and commercial fishing sectors deserve consideration as contributors to the exploitation of fish in marine and inland waters. The lack of global monitoring and compiling of statistics on recreational fishing participation, harvest, and catch-and-release has retarded our ability to understand the magnitude of this fishing sector. Using data from Canada, we estimate that the potential contribution of recreational fish harvest around the world may represent approximately 12 percent of the global fish harvest. Failure to recognize the potential contribution of recreational fishing to fishery declines, environmental degradation, and ecosystem alterations places ecologically and economically important resources at risk. Elevating recreational fishing to a global conservation concern would facilitate the development of strategies to increase the sustainability of this activity.

Keywords: recreational fishing, fisheries crisis, commercial fishing, fish conservation

Global fishery resources are facing a number of threats, which have principally been attributed to commercial exploitation (Jackson et al. 2001, Hilborn et al. 2003, Pauly et al. 2003, Watson et al. 2003). Although we recognize the dramatic effects that commercial fisheries have had on marine fish stocks (Reynolds et al. 2001) and marine ecosystems (Hall 1999), current analyses seem to ignore the potential role of the other principal fishery sector, recreational fishing. Furthermore, previous analyses have focused exclusively on marine environments, with little consideration of the role of fisheries in freshwater environments (but see Arlinghaus et al. 2002, Post et al. 2002). If these evaluations are to represent global fisheries issues and trends accurately, it is our belief that all aquatic systems and all fishery sectors must be included. Here we estimate the global magnitude of recreational fishing and briefly highlight the potential for recreational fisheries to contribute to fishery declines.

Magnitude of recreational fishing

Recreational fishing is fundamentally different from commercial fishing in that the primary reason for participation is leisure, although this does not preclude the catch being taken for domestic consumption, as is often the case (Cowx 2002). This definition does not include the many individuals in developing nations who fish as part of artisanal or subsistence fisheries, with the sole intention of collecting food. Although angling participation rates (e.g., from about 1 percent in southern European countries to more than 40 percent in Finland) and the proportion of catch retained for consump-

tion (up to 90 percent in Scandinavia) vary among regions, the yield from recreational fisheries is considerable (Cowx 1995).

If recreational fishing participation rates in Canada from 2000 (the most complete data available; DFO 2003) reflect global trends, roughly 11.5 percent of the world's population engages in this activity. Assuming a global human population of 6.33 billion, similar extrapolations of Canadian recreational capture rates would suggest that 47.10 billion fish are landed on a global basis annually, of which 36.3 percent (17.09 billion fish) are harvested, weighing 10.86 million metric tons (assuming a mass of 0.635 kilograms per fish; US Department of Commerce 2003). This compares with global harvest rates of 80.47 million metric tons per year when both commercial inland and marine finfish fisheries are combined (FAO 2003). Thus, when the harvest from these two sectors is summed, global fish harvest rates may be approximately 14 percent higher than current commercial statistics suggest (note that this estimate does not account for strictly

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artisanal or subsistence fishers, for which data are even more scarce).

Although these simple calculations are fraught with assumptions (e.g., that angler behavior in Canada is representative of the global picture), we believe this to be a realistic assessment using the most complete data currently available. That said, we hope that the uncertainty and limitations associated with this estimate will help to encourage global recording and standardized reporting of recreational fishing statistics.

Comparison of fishing sectors

Recreational and commercial fisheries differ with respect to the systems they target. Recreational fisheries have access to most of the world's freshwater systems as well as the nearshore regions of the oceans, including estuaries, reefs, mangroves, and embayments, while large-scale commercial fisheries operate in more accessible locales (based on depth and economic profitability), often more distant from coastal regions or in larger inland water bodies. The nearshore zones targeted by recreational fishing are often critical habitats for multiple life stages of many fish (e.g., spawning, nursery, feeding, migration; Jackson et al. 2001), and recreational fishers often target immature life stages in these regions (McPhee et al. 2002).

Evidence of the negative consequences of recreational fishing harvest in both freshwater and marine systems is mounting rapidly. In Canada, four important inland fisheries showed evidence of collapse that could be attributed to recreational fishing (Post et al. 2002). In marine systems, this problem has become evident with the imposition of protected areas. Reserves that permit recreational fishing show differences in population structure and abundance from those where no fishing is permitted (Schroeder and Love 2002). There are many examples in which the recreational harvest rates for individual species exceed those of commercial fisheries (Schroeder and Love 2002, US Department of Commerce 2003).

Although many fish captured by anglers are released (approaching 100 percent for some species), there can be substantial postrelease mortality (Muoneke and Childress 1994, Cooke and Suski forthcoming) as well as more subtle sublethal effects on growth and fitness (Cooke et al. 2002). Release mortality in recreational fisheries is analogous to bycatch discards in commercial fisheries, an internationally recognized conservation problem (Alverson et al. 1994).

In addition to contributing directly to global fishery declines through harvest or mortality, recreational fisheries can contribute to alterations in system function and quality. Harvest or postrelease mortality can act as a selective force in recreational fisheries (Policansky 1993), as it has been observed to do in commercial fisheries (Heino and Godo 2003). Although fewer examples exist in recreational fisheries, trophic or ecosystem-level effects can also be observed (McPhee et al. 2002). Environmental degradation from fishing was once attributed primarily to commercial activities (Dayton et al. 1995), but the recreational sector is now understood to have its fair share of responsibility (Cryer et al.

1987). Discarded fishing line and hooks can foul birds, marine mammals, corals, and other marine life, resulting in substantial injury and mortality (Cowx 2002, MCPhee et al. 2002). Also, the accumulation of lead sinkers can result in mortality of waterbirds and have effects at higher trophic levels (Cowx 2002). Anglers may disturb wildlife, trample riparian vegetation to gain access to the water, and increase nutrient loading through ground baiting (distribution of organic bait to attract fish). Recreational boat traffic and the associated noise pollution, waves, erosion, and scarring also contribute to environmental degradation (Cowx 2002, MCPhee et al. 2002).

Recreational fisheries are also responsible for an as yet undetermined degree of degradation of fish stocks through fishery enhancement practices (Cowx 1998) or introductions (Cambray 2003). Notwithstanding these issues, the position of recreational fisheries must be balanced against the huge value (billions of dollars) of the sector to regional and local economies (Cowx 2002).

Recreational fishing and global fish crises

Several factors may explain the lack of attention to recreational fisheries in the consideration of global fishery crises. Collapses induced by recreational fishing may be difficult to detect (Post et al. 2002). Few long-term monitoring programs exist that could be used to detect declines in a global context. Furthermore, anglers exhibit complex behavior, and fisheries respond dynamically to exploitation (Post et al. 2002). Also, because recreational anglers represent a vocal and effective constituent group, the standard response to perceived or actual decline or alteration in population structure is supplementation (Cowx 1998). Hence, the impact of recreational fishing is typically addressed by curing symptoms rather than by addressing underlying causes.

We believe that there is a pressing need for the global statistics of the Food and Agriculture Organization of the United Nations (FAO) to include information on recreational angling participation and harvest rates, particularly for developing countries. However, a major challenge in collecting such statistics is that many management agencies are poorly equipped to acquire and analyze such records. Although the FAO would play a key role in collating and disseminating this information, local and federal government agencies would have to be responsible for data collection. Anglers would also have a role to play in collecting data, through the use of tools such as creel cards and angler diary programs. Beyond assessing participation and harvest metrics, efforts should also be devoted to experimentation or long-term monitoring of populations that are not subjected to stock enhancement or supplementation practices to assess the suite of effects that may be caused by recreational angling *per se*. We encourage the global aquatic research and management community to elevate recreational fisheries to a conservation issue and to consider the role of recreational fishing in changing the structure and yield of global fish stocks. Although it is unlikely that an individual angler can have a measurable effect on global fish

stocks, the potential for cumulative impacts of recreational angling is real, because it is such a widespread activity and because it is focused in defined, insular, and often critical habitats. Indeed, overfishing is a problem irrespective of its source.

Several years ago, attention was drawn to the systematic distortion of harvest data from commercial fisheries (Watson and Pauly 2001). In essence, the sole reliance on commercial data in estimating the global fish harvest, with no data on recreational fishing harvest and discard mortality, is also a distortion (albeit an unintentional one). Failure to recognize the contribution of recreational fishing to fishery declines, environmental degradation, and ecosystem alterations places ecologically and economically important resources at risk.

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References cited

- Alverson DL, Freeberg MH, Pope JG, Murawski SA. 1994. A Global Assessment of Fisheries Bycatch and Discards. Rome: Food and Agricultural Organization of the United Nations. FAO Fisheries Technical Paper 339.
- Arlinghaus R, Mehner T, Cowx IG. 2002. Reconciling traditional inland fisheries management and sustainability in industrialized countries, with emphasis on Europe. *Fish and Fisheries* 3: 261–316.
- Cambray JA. 2003. Impact on indigenous species biodiversity caused by the globalisation of alien recreational freshwater fisheries. *Hydrobiologia* 500: 217–230.
- Cooke SJ, Suski CD. Do we need species-specific guidelines for catch-and-release recreational angling to conserve diverse fishery resources? *Biodiversity and Conservation*. Forthcoming.
- Cooke SJ, Schreer JF, Dunmall KM, Philipp DP. 2002. Strategies for quantifying sublethal effects of marine catch-and-release angling—insights from novel freshwater applications. *American Fisheries Society Symposium* 30: 121–134.
- Cowx IG. 1995. Review of the status and future development of inland fisheries and aquaculture in western Europe. Pages 25–34 in O'Grady KT, ed. *Review of Inland Fisheries and Aquaculture in the EIFAC Area by Subregion and Subsector*. Rome: Food and Agricultural Organization of the United Nations.
- , ed. 1998. *Stocking and Introduction of Fish*. Oxford (United Kingdom): Blackwell Science.
- . 2002. Recreational fisheries. Pages 367–390 in Hart PBJ, Reynolds JD, eds. *Handbook of Fish Biology and Fisheries*, vol. II. Oxford (United Kingdom): Blackwell Science.
- Cryer M, Corbett JJ, Winterbotham MD. 1987. The deposition of hazardous litter by anglers at coastal and inland fisheries in South Wales. *Journal of Environmental Management* 25: 125–135.
- Dayton PK, Thrush SF, Agardy MT, Hofman RJ. 1995. Environmental effects of marine fishing. *Aquatic Conservation: Marine and Freshwater Ecosystems* 5: 205–232.
- [DFO] Department of Fisheries and Oceans. 2003. 2000 Survey of Recreational Fishing Statistics in Canada. (3 August 2004; www.dfo-mpo.gc.ca/communic/statistics/recreational/canada/2000/index_e.htm)
- [FAO] Food and Agricultural Organization of the United Nations. 2003. *State of World Fisheries and Aquaculture 2002*. Rome: FAO.
- Hall SJ. 1999. *The Effects of Fishing on Marine Ecosystems and Communities*. Oxford (United Kingdom): Blackwell Science.
- Heino M, Godo OR. 2003. Fisheries-induced selection pressures in the context of sustainable fisheries. *Bulletin of Marine Science* 70: 639–656.
- Hilborn R, Branch TA, Ernst B, Magnusson A, Minte-Vera CV, Scheuerell MD, Valero JL. 2003. State of the world's fisheries. *Annual Review of Environment and Resources* 28: 359–399.
- Jackson JB, et al. 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* 293: 629–637.
- McPhee DP, Leadbitter D, Skilleter GA. 2002. Swallowing the bait: Is recreational fishing ecologically sustainable? *Pacific Conservation Biology* 8: 40–51.
- Muoneke MI, Childress WM. 1994. Hooking mortality: A review for recreational fisheries. *Reviews in Fisheries Science* 2: 123–156.
- Pauly D, Alder J, Bennett E, Christensen V, Tyedmers P, Watson R. 2003. The future for fisheries. *Science* 302: 1359–1361.
- Policansky D. 1993. Fishing as a cause of evolution in fishes. Pages 2–18 in Stokes TK, McGlade JM, Law R, eds. *The Exploitation of Evolving Resources*. Heidelberg (Germany): Springer-Verlag.
- Post JR, Sullivan M, Cox S, Lester NP, Walters CJ, Parkinson EA, Paul AJ, Jackson L, Shuter BJ. 2002. Canada's recreational fishery: The invisible collapse? *Fisheries* 27: 6–17.
- Reynolds JD, Jennings S, Dulvy NK. 2001. Life histories of fishes and population responses to exploitation. Pages 147–168 in Reynolds JD, Mace GM, Redford KH, Robinson JG, eds. *Conservation of Exploited Species*. Cambridge (United Kingdom): Cambridge University Press.
- Schroeder DM, Love MS. 2002. Recreational fishing and marine fish populations in California. *California Cooperative Oceanic Fisheries Investigations Reports* 43: 182–190.
- US Department of Commerce. 2003. *Fisheries of the United States 2002*. Silver Spring (MD): National Marine Fisheries Service.
- Watson R, Pauly D. 2001. Systematic distortions in world fisheries catch trends. *Nature* 414: 534–536.
- Watson R, Tyedmers P, Kitchingman A, Pauly D. 2003. What's left: The emerging shape of the global fisheries crisis. *Conservation in Practice* 4 (3): 20–21.