OPINION

Environmental cost of conservation victories

Ray Hilborn[1]

School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195

In recent years, Marine Protected Areas (MPA), where fishing is severely restricted or not allowed, have become the Holy Grail of marine conservation for both nongovernmental organizations and governments. In the United States, the Papahānaumokuākea Marine National Monument in the NW Hawaiian Islands became the first large-scale reserve closed to fishing in 2006 (1). This reserve is 90% the size of California and was followed by the Pacific Remote Islands Marine National Monument, about half the size of California, in 2009 (2). In total, the United States has established MPAs 19-times the size of California or roughly the area of the Continental United States.

The United States is not alone. The South Georgia and South Sandwich Islands Marine Protected Area in British sub-Antarctic waters is roughly 2.5-times the area of California, and most recently Australia has declared its economic zone in the Coral Sea a no-take area of 3.1 million square kilometers, an area eight times the size of California. All of these areas are heralded as great conservation victories and the Convention on Biodiversity has set a target of 10% of the ocean protected by 2020.

Are these indeed victories? Not necessarily. I suggest it is likely that the world's environment is actually worse off once such victories are evaluated globally.

To understand this idea, we must look at the world food supply, which is highly connected, and fish are the most-traded food commodity (3). Assume, for example, that Australia closed all its waters to fishing. Would Australians not eat fish? Hardly. As it stands now, Australia already imports 85% of its fish, the majority from aquaculture and capture fisheries processed in Thailand, China, and Vietnam (4). Even if Australia never again caught a single fish, Australians would still be able to eat all they want or can afford. However, most of those fish would come from parts of the world where fisheries are poorly managed or from aquaculture in the developing world, rather than from well-managed Australian fisheries.

To establish any net environmental benefit from large ocean MPAs, we must determine what is actually "saved" and at what cost when the saving causes reduced food production. The environmental costs of alternative food production are increasingly available (5, 6), and the costs of closing large marine areas in Australia, the United States, and Europe can be calculated.

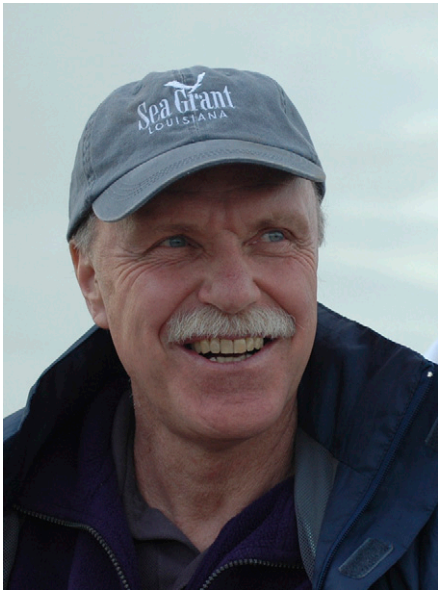
Not all lost seafood production will necessarily be replaced by other seafood; some of the protein will come from the land, where food production has increased greatly in the last 50 years, primarily by increasing yield per acre and to a lesser extent opening new lands to cultivation. Most of the new land was gained by clear-cutting forest in tropical regions, particularly Central and South America and southeast Asia (7), generating losses of biodiversity. Increase in yield has been achieved by more irrigation, more fertilizer and pesticides, and better crop genetics.

Paradoxically, in many cases the same conservation groups promoting large ocean MPAs also work to prevent loss of tropical forests and to reduce the soil loss and pollution associated with livestock, apparently unaware or at least ignoring that the fisheries and terrestrial food production are inextricably connected. We are ill-served by such a narrow focus on each individual "saving" action and it is high time that we closely scrutinize the trade-offs. The information on trade and environmental consequences of alternative food production is now available to calculate these trade-offs.

Although there is a general recognition that provisioning services are connected [e.g., reducing carbon emissions in the United States and Europe by export of dirty industries to China, resulting in a net increase in carbon emissions (8)], marine conservation has never considered the costs associated with food production when evaluating closing large portions of the ocean to fishing.

Much of the fish currently imported to both Australia and the United States comes from aquaculture. Here again, we must look at environmental costs of, as well as gains from, protected areas. In general, species that are fed crops and animal protein (as in salmon and shrimp that dominate US imports of seafood) are similar to livestock, but aquaculture species that feed themselves, such as shellfish, are much less environmentally costly (7).

It is not that we should necessarily forgo large MPAs, but rather that we need to broaden the conversation and analysis to understand the global environmental consequences of such actions. The world is irrevocably connected, and nowhere more so than in food and especially fish. Ideally, conservation actions should not be considered in isolation. Any action that significantly alters food supply will necessarily have ramifications in other parts of the world, and those interested in the global environment should seek a global understanding of the consequences of such efforts in the name of conservation.



Ray Hilborn.

1 UNESCO (2013) Papahānaumokuākea. Available at http://whc.unesco.org/en/list/1326. Accessed April 7, 2013.
2 US Fish and Wildlife Service (2013) Pacific Remote Islands Marine National Monument. Available at www.fws.gov/pacificremoteislandsmarinemonument. Accessed April 7, 2013.
3 Smith MD, et al. (2010) Economics. Sustainability and global seafood. *Science* 327(5967):784–786.
4 Fisheries Research and Development Corporation (2010) A study of the value, composition and utilisation of imported seafood in Australia. FRDC Project Report 2010/222/. (Australian Government Fisheries Research and Development Corporation, Canberra) Available at http://frdc.com.au/research/final-reports/Pages/2010-222-DLD.aspx. Accessed April 7, 2013.
5 Hall SJ, Delaporte A, Phillips MJ, Beveridge M, O'Keefe M (2011) *Blue Frontiers: Managing the Environmental Cost of Aquaculture* (World Fish Center, Penang, Malaysia).
6 Steinfeld H, et al. (2006) *Livestock's Long Shadow: Environmental Issues and Options* (Food and Agriculture Organization of the United Nations, Rome), pp 390.
7 Gibbs HK, et al. (2010) Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. *Proc Natl Acad Sci USA* 107(38):16732–16737.
8 Caldeira K, Davis SJ (2011) Accounting for carbon dioxide emissions: A matter of time. *Proc Natl Acad Sci USA* 108(21):8533–8534.

Author contributions: R.H. wrote the paper.

The author declares no conflict of interest.

[1]E-mail: rayh@u.washington.edu.