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## Marine Protected Areas: an Ecosystem-Based Fisheries Management Tool

by Bob Pomeroy

Coastal marine and freshwater living resources are under stress. Many populations, along with the ecosystems upon which they depend, are showing signs of collapse as a result of increasing overexploitation and habitat degradation by fishing activities. At present, the United Nations Food and Agriculture Organization reports that roughly 70 per cent of fish stocks for which data are available are fully exploited or overfished. The potential impact of the degradation of coastal and marine ecosystems on human health, food security, conservation of biodiversity, and local and national economies will be multiplied as coastal populations continue to increase. The pressure on these systems will be multiplied as well.

Approximately one billion people rely on fish as a major source of their food, income and/or livelihood. Assuming that this is accurate, at least 85 per cent of these people rely on fish as their major source of protein. For 60 per cent of populations in developing countries, 40 to 100 per cent of their animal protein comes from fish. For example, fish contribute more than 50% of total proteins in Bangladesh, Congo, Ghana, Guinea, Indonesia, Japan, and Senegal, as compared to less than 20 per cent in the United States.

The sea was long thought to be an inexhaustible supply of animal protein for human use. Recently, however, as the impacts of human use have become more apparent, our understanding of the limits of the seas' wealth has become clearer. In the U.S., of 905 fish stocks monitored within the 200-nautical mile Exclusive Economic Zone, 164 stocks are in an overfished condition. Closer to home, commercial fisheries in Connecticut and Long Island Sound are in transition as well, with a number of fish stocks overfished and one commercially important stock (lobster) suffering from a severe die-off due to yet unknown causes.

Obviously, the seas' resources are not inexhaustible and they must be used sustainably. There has been a call for sustainable



Kelp and fish interact in the lush kelp forests of the Monterey Bay Marine Sanctuary, an example of a Marine Protected Area.
Photo: Peter Auster, National Undersea Research Center, UCONN.

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fishing, that is, fishing activities that do not cause or lead to undesirable changes in biological and economic productivity, biological diversity, or ecosystem structure and functioning from one human generation to the next.

In recent years, the collapse of some populations and social impoverishment of some of the world's best known and most productive fishing grounds (e.g., George's Banks) has fueled a widespread and growing belief that the conventional fisheries management approaches, such as using various harvest control regulations, is more part of the problem rather than of the solution of fisheries overexploitation.

In the last decade, following concerns about conventional management as well as fishery overexploitation and environmental degradation, the objectives, approaches and policies of fishery management systems have begun to change. The objectives have shifted from maximizing annual catches and employment to sustaining stocks and ecosystems, and from maximizing short-term interests to addressing both short- and long-term interests. There is a shift from using only conventional production and stock- and speciesbased approaches to include conservation and ecosystem-based management.

Ecosystem-based management is an approach to maintaining ecosystem health and sustainability through emphasis on protecting the productive potential and biological diversity of the system that produces goods and services from the ecosystem, as opposed to protecting an individual species or

stock as a resource. Ecosystem management pays attention to species interactions such as competition and predation, conservation of habitat, and protecting critical life history stages of species. Ecosystem-based measures, such as marine protected areas, provide alternatives for protecting fish populations and the habitats upon which they depend.

Because of their integral role in marine biodiversity conservation and sustainable development policies, marine protected areas (MPAs) have recently emerged as a solution to intractable fisheries management problems.

Government scientists and fisheries managers in the United States, for example, proposed that 20 per cent of the continental

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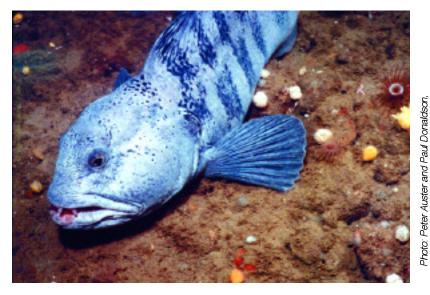
This biodiverse, productive coral reef ecosystem is found on the island nation of Mauritius, southeast of Africa, in the Indian Ocean. Such scenes are becoming more rare. Photo: Peter Auster, National Undersea Research Center, UCONN

#### **Marine Protected Areas**

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waters in the southeastern United States be governed as MPAs. Another influential report, funded in part by the World Bank, argued for the development of a globally representative system of MPAs that encompasses at least 10 per cent of the marine environment. A global group of marine scientists has prepared a petition calling upon governments to protect 20 per cent of the world's oceans within a globally representative system of MPAs by the year 2020.

A marine reserve, one type of MPA, is a spatially-defined area in which all populations are free of exploitation. The primary purpose of MPAs is to protect target species from exploitation in order to allow their populations to recover. Perhaps more important, MPAs can protect entire ecosystems by conserving multiple species and critical habitats such as spawning areas and nursery beds. Stocks inside these areas can serve as a "bank account" or insurance against fluctuations in and the depletions of populations



The fearsome appearance of the wolf fish (*Anarhicus lupus*) belies the fact that it is usually found hiding between rocks. This one was found in the Gerry E. Studds Stellwagen Banks Sanctuary, off Cape Cod, Massachusetts.

outside the protected area caused by mismanagement or natural variability. MPAs can also reduce conflicts between fishers and other users by providing areas where non-fishery users can pursue nonconsumptive uses of the resources. MPAs can also play a role in helping to diversify the coastal economy through tourism and conservation work. The size of the MPA relative to home range and habitat requirements of target species is important.

Clearly, MPAs can be effective in protecting species which are sedentary or have a limited range, as in many reef fish. For species that have a large range or highly mobile life history stages (such as planktonic larvae), MPAs can serve to protect the spawning ground, spawning aggregations or the nursery area. In other cases, protecting vulnerable life history stages of the adults, such as spawning migrations, may prove effective.

While it is evident that MPAs can be a powerful means of protecting critical marine areas, the extent to which MPAs can enhance fisheries is still unclear in many areas. MPAs should be considered a necessary but not sufficient component of fisheries management. One of the main concerns about relying too much on MPAs is that they simply displace fishing into adjacent areas, leading to greater local depletion there. This, in turn, increases the difference in abundance between protected and exploited areas, which may increase emigration of fish from the former to the latter, thus reducing abundance in the protected areas. In addition,



This commercial fishing vessel uses trawl nets, one of many types of fishing gear operated in the coastal waters of the U.S. These nets sweep across the bottom, held open by "doors" on each side of the net.

Photo: Center for Coastal Studies



A commercially important groundfish species, the haddock (*Melanogrammus aeglefinus*) is closely related to the cod. It is distinguished by the black "thumbprint" found on each side of its body. This is one of many species overfished at Georges Bank, now closed to fishing harvest.

Photo: Peter Auster, National Undersea Research Center, UCONN

MPAs do not always result in higher density for target species or in higher biodiversity. Well-planned studies of MPAs are still needed to understand how protected areas work.

Marine protected areas come in many types, shapes and sizes. Around the world, they encompass everything from small, locally managed marine areas established by coastal communities to help conserve dwindling marine resources or site of cultural interest to vast multiple-use areas that have a range of conservation, economic, and social objectives.

In the United States, for example, 12 marine sanctuaries have been established in federal waters. No one approach has emerged as best in every situation;

each can make a valuable contribution to maintaining biological diversity, depending on the ecological and socioeconomic factors in each area.

In some circles, MPAs have come to be advocated as the solution for all fisheries and ecosystem management problems. In reality, MPAs are not substitutes for fishery management, but are one of several tools in the toolbox. Keys to the success of MPAs include stakeholder participation, understanding and local acceptability, and monitoring and enforcement. Goals for the scope and purpose of MPAs must reflect a balance between scientific and social and economic needs and realities. **W**\$\mathcal{L}\$

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