Biodiversity Research Still Grounded

LAST WEEK, THE UNITED STATES DESIGNATED NEARLY 140,000 SQUARE MILES OF THE PACIFIC OCEAN northwest of Hawaii as the largest protected marine reserve in the world. This is good news, considering that earlier this year, 4000 delegates left the international Conference of the Parties to the Convention on Biological Diversity (held in March 2006 in Brazil) with mixed feelings. Portrayal of the conference as successful by the Executive Secretary was in stark contrast to the frustration expressed by environmentalist groups about the failure to progress toward creating large marine protected areas. Paradoxically, the fact that the oceans are the patrimony of all nations creates a legislation gap that is the major obstacle to increasing the percent of protected ocean to the 10% targeted by the convention. This obstacle is augmented by a lack of awareness by legislators and the general public about the role, status, and prospects of biological diversity in oceans relative to the land. Until a better understanding of the diversity of and threats to life in the oceans is achieved, there will be no progress in protecting marine biodiversity.

The vast richness of marine biodiversity remains to be discovered, particularly in remote habitats such as the deep ocean. There is a widespread misconception that extinction in the ocean is unlikely because of its huge biogeographical ranges and high connectivity of habitat. But recent surveys and molecular analyses of ocean samples have revealed marine invertebrates with biogeographical ranges as small as 4 km. Specialized communities in deep-sea habitats, such as hydrothermal vents and cold seeps, are isolated across thousands of kilometers. Marine diversity is much more extensive and vulnerable than previously thought. Moreover, much of this diversity is microbial and therefore generally unappealing to society. Indeed, more charismatic animals and plants receive most of the conservationists’ attention. Scientific research must unveil the importance of ocean life diversity, test for declines in important taxa and ecosystems, elucidate the causes of these declines, and provide remedial options to change these perception biases.

Although research on biodiversity has increased, these efforts are dominated by studies on land. Between 1987 and 2004, only 9.8% of published research dealt with marine biodiversity. This severe imbalance percolates through international programs. For instance, only about 10% of the First Open Science Conference of the Diversitas Programme (November 2005 in Mexico) that dealt with biodiversity science addressed marine biodiversity.

This disproportionately small research effort on marine biodiversity is in sharp contrast to the large genomic diversity in the oceans as compared to that on land. Most branches of the evolutionary tree of life thrive in the oceans, whereas most terrestrial species are contained within only two branches, a result of the extended history of life in the oceans (3500 million years). The genomic richness of the ocean is an untapped resource for biotechnology, pharmacy, and food. The number of marine species brought into aquaculture exceeds, after only 30 years of development, the number of animal species domesticated over 10,000 years of husbandry on land. Realizing these opportunities requires progress to improve our present knowledge about sustainably managing marine resources.

The oceans have lost much of their fish biomass and megafauna to hunting, and key coastal habitats are lost globally at rates 2 to 10 times faster than those in tropical forests [also see the Report by Lotze et al. in this issue (p. 1806)]. Anthropogenic inputs to the ocean are causing hypoxia and widespread deterioration of water quality, and anthropogenic CO₂ emissions are causing ocean acidification, which is emerging as a global threat to calcifying marine organisms.

The concept of protected areas that emerged from studies of life on land cannot be readily extrapolated to the ocean. Until last week, the total protected marine area was 10 times smaller than that on land, and most marine protected areas are too small to be effective. Mounting evidence indicates that marine food webs are connected across oceanic scales, but the forces driving these connections are poorly understood. We must improve our understanding of how the global ocean ecosystem works in order to design networks of protected areas that effectively preserve biodiversity. Indeed, as Mora et al. point out in this issue (p. 1750), the present design of some marine protected areas may not be optimal. Further promoting marine biodiversity research requires a larger scientific community and more resources than currently exist. This can be achieved through increased international cooperative efforts and networking. We must do this before we face a future depleted of marine resources.

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10.1126/science.1128548