A Global Strategy for Conserving Biological Diversity in the Sea

by Elliott A. Norse and Leah R. Gerber

Since the 1972 UN Conference on the Human Environment in Stockholm, it has become increasingly clear that economic advances cannot be sustained unless we maintain the health of the environment. And since biological diversity appeared on the conservation agenda (Lovejoy 1980; Norse and McManus 1980), it has become clear that the precipitous loss of our planet's genes, species, and ecosystems is among the greatest challenges that humankind faces. Yet, among the general public, decision makers and scientists alike, concern has focused largely on the terrestrial environment.

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This understandable bias—we are terrestrial animals—nonetheless is perilous because it ignores the marine realm, including the open ocean, coastal waters, and estuaries, which covers 71 percent of earth to an average depth of about 4 kilometers and has the planet's tallest mountains, longest mountain range, and deepest canyons. The sea's permanently inhabited volume is at least 200 times that of the land, and its vastness and topographic complexity accommodate high biological diversity. It is far richer in phyta than the land (Ray 1988); nearly half of all animal phyta are exclusively marine. Recent estimates (Grassle and Maciolek 1992) of 10^7 undescribed species in the deep sea are the same order of magnitude as in tropical forests. Marine ecosystem diversity is likely higher than the land's.

The sea has its forests, grasslands, deserts, islands, caves, and hot springs, but also contains ecosystems without terrestrial analogs, such as sea surface and underwater ecosystems, and supports lifestyles—neuston, plankton, nektan, and filter-feeding bottom-dwellers—that are not found or are poorly represented on land. Marine ecosystems have both the highest measured primary production (wave-beaten northeast Pacific intertidal kelp beds: Leigh et al. 1986) and huge expanses in which there is no autochthonous primary production at all, as well as ecosystems based wholly on chemosynthesis, not photosynthesis.

A Biological Pump

Marine life, inherently no less important than life on land, is also an essential source of products and ecosystem services for our species. The sea provides a substantial fraction of our animal protein—at least half in countries such as Ghana and Japan. Its diversity of chemically defended species generates high potential for new medicines. Coral reef, seagrass, mangrove, and salt marsh communities create new land and protect shorelines. The sea's primary producers, which generated our oxygen-rich atmosphere, are still critical in planetary gas exchange. Marine organisms work as a "biological pump" by absorbing atmospheric carbon dioxide and conveying it into the deep sea, where it resides for centuries, slowing the atmospheric buildup of the most important greenhouse gas, thereby delaying global warming.

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Unfortunately, the sea is neither an inexhaustible cornucopia nor a toilet with limitless capacity to assimilate our wastes. In October 1990, 11 eminent marine scientists meeting at the Smithsonian Institution in Washington, D.C. to examine the basic dimensions of the marine biological diversity issue (Norse 1991) came to a remarkable but disconcerting conclusion: the entire marine realm is at risk.

From the mangroves fringing tropical coasts to the hydrothermal vent communities huddled miles beneath the surface, no place has escaped the hand of humankind. Soil blown from desertified land in Africa settles on the sea surface off South America; fishing boats deploy their gear many thousands of kilometers from their home ports; marine algae and invertebrates from Japan now crowd out native species on both sides of the North Atlantic; tarballs, plastic debris, and DDT metabolites contaminate the remotest ocean areas. Marine species have been driven to extinction by human activities, more are recognized as endangered, and an unknown but undoubtedly still larger number are being pushed to the brink.

Many of the most valuable fisheries have been decimated (for example, populations of North Atlantic bluefin tunas [Thunnus thynnus] have been reduced 90 percent in recent decades), coral reefs worldwide are showing signs of stress, and no pristine estuarine ecosystems remain anywhere in the temperate zone or tropics. Being biogeochemically "downstream" from the land, the sea accumulates insults from it; agriculture, deforestation, and pollution in marine drainages are even more harmful to the marine realm than alterations we make in the sea per se. As on land, the cumulative impact of 5.5 billion people is depleting the sea's biological diversity; stopping this loss is crucial to human health and survival.

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Landmark Global Marine Strategy Lays Foundation for Survival

To lay the foundation for doing so, the Center for Marine Conservation, in cooperation with the World Conservation Union (IUCN), World Wildlife Fund, the United Nations Environment Program, and the World Bank, has just released Global Marine Biological Diversity: A Strategy for Building Conservation into Decision Making (Norse 1993). Three years in the making, this companion document to Global Biodiversity Strategy (World Resources Institute et al. 1992 [see DIVERSITY 5(1):4]) was written by 106 authors and reviewed by hundreds of experts from more than 40 nations.

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The strategy examines comprehensively the value of maintaining marine biological diversity, the threats to marine species and ecosystems, and ways to protect, study, and sustainably use marine biological diversity. The Strategy then provides a framework for marine biodiversity conservation to the year 2000 and beyond by offering some 140 recommendations for action at global, regional, national, and local levels.

As the Strategy details, there are five major proximate threats to biological diversity in the sea:
- Overexploitation
- Physical ecosystem alteration
- Pollution
- Introduction of alien species
- Global atmospheric change

Although their magnitude is generally underappreciated, overexploitation and marine pollution have long been recognized, but few people have realized the magnitude of the other three. There has been scant research, for example, on effects of various kinds of physical alteration, such as bottom trawling, diversion of riverine flow, and sedimentation caused by deforestation, on marine species and ecosystems. As on land, species introduced for mariculture or in the ballast tanks of ships into biogeographic regions where they did not historically occur are a growing plague that distorts ecological relationships that evolved over eons. In the sea, stressors usually act in concert; rarely are marine species or ecosystems subject to just one, which might explain the increasing incidence of sea urchin population crashes in the Caribbean, dolphin die-offs in the Atlantic, toxic blooms of phytoplankton (the so-called red and brown tides), and episodes of coral bleaching worldwide. The biological diversity, economic productivity, and integrity of the entire marine realm are, indeed, at risk.

Five root causes underlie the above threats to marine life:
- There are too many people.
- We consume too much.
- Our institutions degrade, rather than conserve biodiversity.
- We do not have the knowledge we need.
- We do not value natural systems enough.

Biological “Finds” of the Century

A brief look at the fourth root cause hints at the scope of the problem. Marine biologists are continually being reminded about how much is not yet known. Until 1938, scientists believed that coelacanths (fishes related to the ancestor of all amphibians, reptiles, birds, and mammals) had died out at least 65 million years ago; the discovery of the first living one (Latimeria chalumnae) on the continental slope of the Indian Ocean was one of the major biological finds of the century.

Steller’s sea cow (Hydrodamalis gigas), driven to extinction 27 years after its discovery

Not until 1989 did scientists realize that bacteria and viruses play a far greater role in marine food webs than anyone had previously imagined.

Not until this decade (Carlton et al. 1991) did scientists document the first modern extinction of a marine invertebrate, the eelgrass limpet Lottia alveus.

At this date, not even the best-studied coastal country (the United Kingdom) has anything approaching a complete invento-

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Scientists did not know until 1952 that the seas are still home to Neopilina galatheae, a living representative of a remarkable group of living fossils called monoplacophorans, which are probably ancestral to all of the world’s living mollusks.

It took until 1976 for humankind to discover the bizarre, 15-foot long plankton-feeding “megamouth” shark Megachasma pelagios off Hawaii, a find that has been likened to stumbling over a new kind of elephant in one’s backyard.

Until 1977, no one had an inkling of the existence of the most unusual ecosystems on earth: the deep-sea hydrothermal vents, with their spectacular faunas of species that depend on bacterial chemosynthesis rather than plant photosynthesis.

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and, increasingly, in coastal waters worldwide. The fact that currents, migrating adult organisms, drifting larvae, and pollutants do not respect the lines that nations impose on the sea leads to non-sensical management regimes on different sides of borders. For example, Alaska pollock (Theragra chalcogramma) that survive the tremendous but nominally regulated trawling pressure within North Pacific EEZs are subject to unregulated fishing as soon as they enter the “Donut Hole,” an area outside the jurisdiction of any country, which has precipitously decreased their populations. Such legal problems often overshadow biological considerations in conserving marine biological diversity.

Regrettably, conservation remedies that work on land might not in the sea. For example, ex situ conservation of marine species will be insignificant for the foreseeable future. Ecosystem restoration, which is dicey enough on land, is currently still less practicable in the sea. Declaring that a small area is protected without managing the flow of organisms and people across its boundaries, which works poorly on land, is even less promising in the sea.

The sea’s distinctive attributes require some special tools to maintain its biological diversity. Many of these tools, such as integrated area management (IAM), especially IAM based on ecosystem patterns and processes, have been tried and are working (most outstandingly in the Great Barrier Reef Marine Park). But they require new ways of thinking that go beyond narrow sectoral interests and jurisdictional boundaries.

Conservation Must Be Built into Decision Making

We need to make a fundamental change in our course by building conservation into the decision-making process. Affected people must be involved in the decision-making process and decision makers need to have options that permit sustainability and rewards for choosing them. No other system is sustainable.

To make management decisions with far-reaching implications, we need knowledge that is not available given the current state of marine research. In particular, there needs to be a dramatic strengthening in taxonomy, biogeography, and ecology of marine organisms—indeed, the creation of a new science of marine conservation biology—to adapt what is transferrable from terrestrial conservation biology and to fashion anew the concepts that underlie sustainable use of the sea.

Because marine resources are treated as common property, overexploitation is almost universal.

At present, for example, there are no marine analogs to the Bailey, Küchler, and Udvardy geographic ecosystem classification schemes that are used to determine gaps in protected area coverage on land. Marine conservation biology lags terrestrial conservation biology by about 20 years. It lacks recognized leaders, central paradigms, graduate training programs, and significant dedicated funding. We also need a global monitoring network to inform decision makers of crucial events that indicate the health of the sea. Lacking these, the challenge of protecting marine biological diversity will be grievously limited by the lack of understanding.

A New Marine Conservation Ethic Is Required

Understanding is essential, but it is not sufficient. There must be new mechanisms to coordinate action by people in coastal countries worldwide who are in a position to do something to protect and manage marine species and ecosystems, such as the
International Marine Conservation Network, that will link decision makers in governments and conservation organizations around the world.

Finally, there is overwhelming need for a new marine conservation ethic. At present, individuals and institutions are generally free to act until it is proven that their actions are overwhelmingly harmful. The burden of proof needs to be shifted onto those whose acts would diminish marine biodiversity. Under the do-no-harm or precautionary principle, polluters, developers, and other users must demonstrate that their activities are not harmful to the sea before engaging in them. By shifting the burden of proof, conservation and management become proactive, not reactive.

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Maintaining the biological diversity, productivity, and integrity of our planet is not a luxury that can be left to someone else. It is an imperative that we must choose. The Strategy is an ambitious effort to move us in that direction. In conjunction with the other regional and global efforts that have arisen in the last two decades, it holds promise for mobilizing us to save our home and ourselves. We have an increasingly sound foundation. The question is whether we as a species and we as individuals will act effectively and quickly enough, before it is too late.

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For copies of A Global Strategy for Conserving Biological Diversity in the Sea, send US$27.50 + US$2.75 for postage and handling to the Center for Marine Conservation, 1725 DeSales Street NW, Washington, DC 20036, USA, tel: 202-429-5609, fax: 202-872-0619 or contact the publisher, Island Press.

References


