Editorial

Conservation Biology and Marine Biodiversity

Although conservation biologists come from the widest diversity of disciplines and perspectives, we broadly agree on at least one thing—the need to conserve biological diversity at all levels of organization, from genes to ecosystems, at all spatial scales, from woodlots to biomes, and on all corners of the planet. As we near the close of the Society for Conservation Biology's first decade, it is useful to ask if our efforts in this daunting task have been fairly distributed.

Even a cursory look reveals a very large gap in our focus—the sea. We have known about this gap since the Society's earliest days when Les Kaufman labeled marine biodiversity the "sleeping dragon" and the pages of this journal urged us to pay more attention to the beast. Since then, marine biodiversity has received book-length examination by Thorne-Miller and Catena, Norse, and Butman and Carlton. It was a major topic of discussion at the recent Second Session of the Conference of the Parties of the Convention on Biological Diversity in Jakarta, Indonesia in November 1995. The U.S. Agency for International Development, State Department, and National Oceanic and Atmospheric Administration have launched an international Coral Reef Initiative to encourage efforts to save, study, and sustainably use coral reef ecosystems and their constituent species. Marine conservation is starting to rise in the global consciousness.

Our conservation-related research on the sea, however, has not kept up with the output of similar research on terrestrial environments. Irish and Norse (this issue) have tallied papers in *Conservation Biology* and found that only 5% have focused on marine ecosystems and species, compared with 9% freshwater and 67% terrestrial in their subject matter. They also found that only 3% of the pages in Meffe and Carroll's leading conservation biology text focus on the sea, whereas 6% and 45% focus on freshwater and land-based ecosystems. These disparities make it difficult to dispute Norse's estimate that the development of marine conservation biology lags behind terrestrial conservation biology by about two decades.

Our profession's inattention to marine biodiversity is unfortunate in view of the sea's richness, its importance to humankind, and the immediate threats to it. Oceans, coastal waters, and estuaries constitute by volume more than 99% of the Earth's habitat for plants and animals. Thirty-three of the 34 recognized animal phyla occur in the sea, 15 of them exclusively. Certain marine taxa, particularly small benthic organisms are nearly as poorly known as terrestrial anthropods, suggesting that we have greatly underestimated oceanic species diversity. Grassle and Macioleck's estimate of 10^7 species in the abyssal sea alone suggests that marine and terrestrial species diversity could be roughly comparable. And ecosystem diversity in the sea is undoubtedly higher. The sea has forests, grasslands, canyons, caves, and hot springs as does the land. Marine ecosystems without terrestrial analogs, including the sea-air interface, sea ice, and the water column, are inhabited by pleuston, neuston, plankton, and nekton. Along with filter-feeding bottom dwellers, these represent ways of life largely or completely unrepresented on land. Moreover, among the ecosystem services provided to humankind, marine biodiversity is vital as a protein source, a future medicine cabinet, a storm surge bulwark, and a regulator for global atmosphere and climate. We should not forget that the oceans have also been the primary stage upon which the history of life on Earth has been played. The major expansions of Earth's diversity and the most wide ranging extinctions have taken place in the seas, leaving an unparalleled legacy of knowledge for us to unlock.

Many not so well-publicized scientific observations indicate that marine biodiversity is severely threatened. Since Kaufman's warning, Carlton has documented the first modern extinction of a marine invertebrate and more are coming to light. Once bounteous populations of Atlantic cod have been fished to commercial extinction on Grand and Georges Banks, potentially presaging a marine repeat of the Passenger Pigeon's story. Estuaries and coastal seas are increasingly plagued by exotic species: American comb jellies that apparently hitchhiked in a ship's ballast tanks have devastated Black Sea fisheries. Tropical Atlantic sea urchins hit by an epidemic of unknown cause in 1983-1984 have not yet recovered. Zooplankton abundance has dropped 80% off southern California since 1951, apparently due to sea surface warming and diminished upwelling.

Dolphins, porpoises, and seals in the Gulf of Mexico, North Sea, and Sea of Cortez have succumbed to newly discovered viral epidemics and poisonings. Immunosuppression from body contaminant loads may be a com-

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mon link in these marine mammal die-offs, although the research is not yet conclusive. There is little mystery in the case of north Atlantic right whale population. Long term over-exploitation followed by high mortality in vessel collisions and overall poor reproductive performance, recently reported to have reached alarmingly low levels at the Society for Marine Mammology Biennial Conference, presents a foreboding forecast for the future for this apex predator on the eastern seaboard of the United States and Canada. Unfortunately, Carl Safina's 1993 account in these pages of international defiance of solid scientific evidence resulting in gross overfishing and collapse of the North Atlantic bluefin tuna fishery is but one of myriad depressing examples indicating that the availability of good science is not enough to encourage necessary policy changes.

On a more hopeful note, our terrestrially-oriented science may well provide knowledge and guidance that could help arrest these disturbing trends; although we have done little to explore what can be safely extrapolated to the marine realm. How do patterns of population genetics, demography, and disturbance regimes in the sea differ from those on land and in freshwaters? For example, can models of prairie plant seed dispersal be applied to the disseminules of marine algae, invertebrates, and fishes? Is extinction risk in the sea higher or lower than that on land and for which taxonomic groups with what life history patterns? How do sociobiological processes that can affect conservation status in marine species, such as killer whales, compare with those of their terrestrial counterparts? What management tools hold the greatest promise for arresting population declines and restoring marine populations? What are the benefits of marine protected areas and how should the distinctive characteristics of marine organisms influence their design? How do we deal with organisms that cross arbitrary political boundaries during their lifetimes? And how do prevailing ethical, social, and economic factors affect prospects for conserving marine biodiversity?

To begin to address such questions, the Marine Conservation Biology Institute and the Society for Conservation Biology will hold the first Symposium on Marine Conservation Biology at SCB's annual meeting at the University of Victoria, British Columbia on 6-9 June 1997. We hope the insights of our members will contribute to closing the gap between terrestrial and marine conservation, and that marine scientists will share their insights on questions that are less readily answered on land. This kind of cross-pollination, so integral to achieving conservation goals, will energize and inform conservation efforts in all Earth's realms.

The Symposium on Marine Conservation Biology will run concurrently with other sessions, so people with lesser interests in the sea will have much to participate in. Vancouver Island offers an ideal setting for ideas from land and sea to meet; indeed, the Pacific Northwest region has long been a focal venue for conservation biology. Plans for the meeting are proceeding, with the ongoing involvement of Society member Elliott Norse, who has worked on both forest and marine conservation. Norse conceived the symposium concept when he was chief scientist for the Center for Marine Conservation, and will be our partner as founder of the Marine Conservation Biology Institute in bringing the program to fruition.

Eight years ago Les Kaufman urged us to look seaward, to choose the right questions, and to champion the funding needed to answer them. The Symposium on Marine Conservation Biology is a belated, but historic, first step in that direction. Conservation biologists have shown that we can provide the knowledge and ideas to improve decision making on terrestrial conservation issues. Now it is time to extend conservation biology to the other 99% of the biosphere that is marine and awaken the sleeping dragon.

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