

## Editorial

# One Ocean, One Health

I have faith in man's future, faith in the possibilities latent in the human experiment: but it is faith in man as a part of nature, working with the forces that govern the forests and the seas: faith in man sharing life, not destroying it.

—Marston Bates (*The Forest and the Sea*, 1960)

Two decades after sounding the clarion call on the state of the world's forests, especially tropical rain forests, science is finally turning its attention to the oceans, the other great biome on our planet. The parallels are striking. With unsustainable rates of logging and clearing for agriculture identified as the proximate causes, estimates of global tropical rain forest loss were identified to be on the order of 1% annually (in the millions of hectares). Now, with unsustainable rates of fishing cited as the primary historic cause, estimates of the global rate of degradation of coral reefs are in the same range. Tropical rainforests and coral reefs share the distinction of being the Earth's richest repositories of biodiversity; thus degradation contributes disproportionately to the alarming rate of biodiversity loss (with estimates on the order of thousands of species and greater annually). The disappearance of extraordinarily large numbers of unique genomes and bioactive compounds, for which rainforest and coral reef organisms are renowned, translates into the loss of untold benefits to society, including sources of new medicines. Tens of thousands of marine species are suspected to already have been extinguished due to human impacts before their discovery. That science has only been able to document the extinction of a handful of marine species—four sea snails, five seabirds, and three marine mammals—speaks to our ignorance of the oceans.

On the positive side, there are two key areas where scientific understanding has advanced considerably since

biodiversity loss became widely recognized as a global problem two decades ago. First, we are considerably more aware of the inherent and functional losses that occur with species extinction and loss of biodiversity. Second, there is also increased understanding of the interdependence of health across the diverse species and systems within the biosphere—providing the impetus for a “one health” perspective that bridges human, wildlife, and ecosystem health.

We now know vastly more about bio-assessment and ecological monitoring, and how to craft ecosystem management and policy responses on this basis that are tuned to societal values, needs, and aspirations. For example, as it has been widely demonstrated in studies on forests and other land-based ecosystems, five categories of stresses explain dysfunction or collapse: overharvesting, physical habitat change, chemical and nutrient pollution, invasive species, and extreme environmental events. A similar pattern has now emerged for the oceans: 60–70% of the world's fisheries are considered near or exceeding sustainable harvest levels, resulting in significant functional changes in many regional and local marine ecosystems. Coastal zones, including essential fishery nursery habitat, coral reefs, and the sea floor are being physically altered by coastal development and destructive harvesting practices. Point source effluent and diffuse urban and agricultural runoff contribute to a cumulative load of nutrients, toxic wastes, plastics, radioactive waste, antibiotics, and bioaccumulating persistent organic compounds (such as dioxins, PCBs, and other endocrine disruptors) that are entering our oceans. Invasive species, spread via ballast water, the aquarium trade, and other transport mechanisms, have overwhelmed native ecological communities, contributing to the collapse of coral reefs and other inshore and nearshore marine ecosystems whose resilience frequently already is compromised by overfishing. Climate

change has been implicated in the increasing frequency and intensity of shifts in currents, in productivity declines, and in coral bleaching.

Complementing the paradigm applying the concept of health to ecosystems, the articles in this issue describe important research developments that explicitly address links between oceans, wildlife, and human health. The idea of the combined health of people, wildlife, and ecosystems—one health—is emerging from this increasingly apparent but still largely overlooked web of linkages. Symptoms of marine ecosystem distress due to nutrient loading with potential contributions of anthropogenic global climate change are associated with the frequency and intensity of harmful algal blooms (HABs) and associated toxicity for marine mammals and humans. Many populations of marine animals, marine birds, and sea turtles are exposed to pollutants from agricultural runoff, human sewage, and pathogens of terrestrial origin best described as pathogen pollution. Thus, as described in this issue's Special Section on Marine Sentinel Species, the health of marine animals is seen to reflect the health of their ecosystems, and ultimately of humans. Furthermore, we must not forget that oceans provide 60% of the biosphere's

economic value and direct subsistence for over 200 million people. The decline of ocean-based livelihoods provides a critical reminder of the linkages between oceans and human health that extend beyond infectious disease to the already growing rate of chronic illnesses associated with socioeconomic stress. Finally, we must keep in mind that the current threats to human and wildlife health may eventually seem trivial if we fail to grasp the fundamental contribution of oceans to health and global sustainability, and continue to ignore what the oceans are telling us.

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