The Exploration of Marine Biodiversity

Scientific and Technological Challenges

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Offprint of the Chapter

INTRODUCTION

by

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THE OCEAN IS THE CRADLE of life on our planet as well as the single largest habitat in the biosphere. Yet while biodiversity exploration in terrestrial ecosystems is running out of novelties, with the dominant life forms all described, the exploration of marine biodiversity is still in its infancy. We can identify three main reasons for this contrast:

1. The technological constraints facing oceanic exploration. For instance, life below 200 metres depth – a habitat that comprises over 90% of the living space available on this planet – was not directly observed until as recently as the 1960s, and few countries have the equipment needed for direct visualisation of the deep ocean.

2. Marine biodiversity is dominated by microscopic organisms with a metabolic repertoire far superior to that of their terrestrial counterparts. It is also a continu-ing source of surprises. Hence, for instance, the two groups of photosynthetic organisms most abundant in the oceans, and responsible for 40% of marine primary production, were described for the first time just over two decades ago. The oceans, unlike the continents, can also yield surprises at higher taxonomic ranks, such as phyla (cf. chapter 1), and some of the largest animals on earth (giant quid for example) have yet to be observed in their wild environment. Meantime, the best discovery opportunities in marine biodiversity lie in remote or extreme habitats like oceanic trenches, underwater caves, hydrothermal vents and hypersaline or anoxic waters; logically the habitats that have been least explored.

3. Far less research effort has gone into the exploration and conservation of marine biodiversity than into the biodiversity of terrestrial systems. This lag is perfectly illustrated by the following objective facts: (1) research effort, as measured by scientific articles in international journals, is ten times less in marine

◀ **Photo 0.1: Underwater view of *Rhizophora* mangrove forest in Borneo, Indonesia.** Mangrove forests are confined to tropical coasts, where they have adapted to growth in intertidal zones by exchanging gases with the atmosphere through their protruding roots. They are highly productive ecosystems that sustain a wide diversity of species.

Photo 0.2: Seagrass *(Posidonia oceanica)* meadow in the Spanish Mediterranean. *Posidonia oceanica* is among the 60 species of marine angiosperms (higher plants), and its meadows comprise one of the most productive and biodiverse ecosystems of the Mediterranean. These are ecosystems that take centuries to form and are currently retreating due to the impact of human activity.

than in terrestrial biodiversity (Hendriks, Duarte and Heip 2006); (2) papers on terrestrial biodiversity presented to the first conference of the Diversitas programme for global biodiversity research were ten times more numerous than those dealing with marine biodiversity issues (www.diversitas-international.org).

The exploration of marine biodiversity thus faces major technological challenges, like the need to develop more advanced equipment to prospect for and study deep-sea life (ROVs, submarines, manned deep-sea platforms, etc.) or the development of molecular sonars capable of identifying new oceanic microbes. The knowledge unlocked by this kind of technological stimulus could be of great benefit to our society. The immense genetic richness of the oceans is already an important source of wealth and commercial opportunities for the biotechnology and pharmaceutical industries (Munro et al. 1999). The number of marine species being harvested is rapidly increasing (Naylor et al. 2000) and, after only 30 years of intensive aquaculture, far exceeds the number of land animals farmed in nearly 10,000 years of livestock breeding.

The paucity of marine biodiversity research compared to its terrestrial counterpart finds its parallel in the lesser conservation of oceanic systems. Habitats playing a key role in marine biodiversity conservation such as coral reefs, seagrass meadows, mangrove forests and marshlands are disappearing two to ten times faster than the tropical forests (Hendriks, Duarte and Heip 2006). Yet paradoxically marine areas under protection sum less than 0.1% of the ocean surface, while the percentage of protected land is now approaching the 10% target set by the Convention on Biological Biodiversity (Hendriks, Duarte and Heip 2006). Marine biodiversity conservation is based furthermore on models of protection developed for terrestrial habitats, which are hard to apply effectively in the oceans' open waters.

In order to realise the potential of marine biodiversity as a source of services for our society and develop concepts and models that ensure its conservation, we need to progress from what is still a very limited understanding of life in the oceans, and explore them more fully while improving our capacity to manage their myriad resources. Meeting these goals will require new technologies to inventory deep-sea life, and poses challenges comparable to the investigation of outer space. It is not surprising then to learn that NASA is among the main promoters of deep-sea exploration (Fiala and Stetter 2004).

This publication takes its contents from the first in a series of debates organised jointly by the Spanish Scientific Research Council (CSIC) and the BBVA Foundation around the work of the Cap Salines Coastal Research Station (Mallorca, Balearic Islands), with the dual aim of focusing attention on key scientific issues in the biodiversity area, and championing the conservation of our oceans and coasts.

In its pages, leading international experts offer their reflections on the current situation in marine exploration and conservation, and on the scientific challenges that lie ahead.

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