

## MARINE BIODIVERSITY : RESEARCH AND CONSERVATION

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### Contents

1. Introduction: What is Biodiversity?
2. The Human Impact on Biodiversity
3. Marine Biodiversity
  - 3.1 Special Features of Marine Biodiversity
  - 3.2 How Many Marine Species?
  - 3.3 Marine Biodiversity: Still a Lot of Unknowns
  - 3.4 Goods and Services Provided by Marine Biodiversity
    - 3.4.1 Resistance and Resilience to Change
    - 3.4.2 Resistance to Invasions
  - 3.5 The Threats to Marine Biodiversity
  - 3.6 Why and How to Protect Marine Biodiversity
  - 3.7 Marine Biodiversity Research
    - 3.7.1 Scientific Knowledge on the Origin, Maintenance, Distribution, and Dynamics of Biodiversity
    - 3.7.2 Technology and Data Information Systems
    - 3.7.3 Application in Conservation and Restoration Ecology
    - 3.7.4 Application in Management of Living Resources
    - 3.7.5 Applications in Water Quality Studies
    - 3.7.6 Economic Valuation of Marine Biodiversity
    - 3.7.7 Coastal Zone Management
    - 3.7.8 Education, Training, and Awareness
- Bibliography
- Biographical Sketch

### Summary

Marine biodiversity, most often defined as species diversity, is less well known than terrestrial biodiversity and many species remain to be described. The importance of these species in marine ecosystem functioning and for the sustainable delivery of a series of goods and services is therefore not well known. Still, marine biodiversity is under increasing human pressure, especially in the coastal areas around the world. This represents a threat to an important natural resource and poses increasing challenges for management, conservation and restoration of marine ecosystems worldwide.

### 1. Introduction: What is Biodiversity?

Variation and variability are key characteristics of biological entities, such as genes, individuals and populations, and of the landscape in which they occur. The term biodiversity has been coined to catch variation and variability in a single conceptual

framework. Traditionally, diversity has mostly been equated with species diversity. The term was used by taxonomists to refer to classical floristic and faunistic inventories in various types of habitats and ecosystems, and by ecologists to present some measure of species richness, the number of species in a given area. Today biologists include in their thinking about biodiversity the total pool of genetic information as well as the relationships with ecosystems and habitats in landscapes. Biodiversity therefore represents variability at different linked levels of organization and operating at very different scales of space and time but in practice biodiversity is often equalled to species diversity.

The Definition of Biodiversity as accepted at the 1992 UN Conference in Rio de Janeiro is :

The variability among living organisms from all sources, including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

## 2. The Human Impact on Biodiversity

Humans have extensively altered the global environment, changing global biogeochemical cycles, transforming land, and enhancing the mobility of biota. Together these changes have already significantly altered the biological diversity of the Earth. Many species have been eliminated from areas dominated by human influences. Even in nature reserves, native species are often threatened by organisms introduced from elsewhere. Extinction is now occurring at an unnaturally rapid rate as a consequence of human activities. Already we have caused the extinction of 5–20% of the species in many groups of organisms, and current rates of extinction are estimated to be 100–1000 times greater than pre-human rates. In the absence of major changes in policy and human behavior, our effects on the environment will continue to alter biodiversity. On land, land-use change is projected to have the largest global impact on biodiversity by the year 2100, followed by climate change, nitrogen deposition, species introductions, and changing concentrations of atmospheric carbon dioxide (CO<sub>2</sub>). In the oceans, the analogue to land use is the direct exploitation of living resources.

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### Bibliography

Carlton J. T., Geller J. G., Reaka-Kudla M. L., and Norse E. A (1999). Historical extinctions in the sea. *Ann.Rev.Ecol.Syst.* **30**, 515-538. [Describes a number of examples of marine populations that went extinct and critically reviews the literature.]

Heip C. (1996). Biodiversity of Marine Sediments. In: F. di Castri and T. Younes (eds.). *Biodiversity, Science and Development. Towards a New Partnership*. pp. 139-148. [A summary of the special characteristics of marine sediments and a review of the arguments for assuming a high species number in the deep sea.]

Jackson J. B. C., Kirby M. X., Berger W. H., Bjorndal K. A., Botsford L. W., Bourque B. J., Bradbury R. H., Cooke R., Erlandson J., Estes J. A., Hughes T. P., Kidwell S., Lange C. B., Lenihan H. S., Pandolfi J. M., Peterson C. H., Steneck R. S., Tegner M. J., and Warner R. R (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science* **293**, 629-638. [Critical review of many case studies showing that fisheries are the most important human factor affecting changes in coastal ecosystems.]

Loreau M. (2000). Biodiversity and ecosystem functioning: recent theoretical advances. *Oikos* **91**, 3-17. [An important and lucid review of modern, mainly terrestrial, theory on the links between species and ecosystem functioning.]

Ormond R. F. G., Gage J. D., and Angel M. V. (1997). *Marine Biodiversity: Patterns and Processes*. Cambridge University Press. [A collection of good papers focusing on marine biodiversity and therefore compensating for the lack of information in the next book.]

Schluter D. and Ricklefs R. E. (1993). Species diversity: an introduction to the problem. pp. 1-10 In: *Species diversity in Ecological Communities. Historical and Geographical Perspectives* (edited by Ricklefs and Schluter). The University of Chicago Press. [An excellent collection of papers dealing with many aspects of biodiversity, but focused mostly on terrestrial ecosystems.]

### **Biographical Sketch**

**Carlo Heip** (born November 18, 1945, Belgian nationality) did his MSc (1969) and Ph.D (1973) studies at the State University of Gent in Belgium with research on population dynamics of harpacticoid copepods and ostracods. He founded the Marine Biology Section in Gent, which mainly focused on benthic research on meiofauna and later on macrofauna and fish. He worked for one year in Algeria for UNESCO where he coordinated the Postgraduate Oceanography Curriculum at the University of Algiers. In 1987 he became director of the Delta Institute for Hydrobiological Research in the Netherlands and in 1992 director of the Centre for Estuarine and Coastal Ecology of the Netherlands Institute of Ecology. His research then turned to multidisciplinary studies in the department of Ecosystem Studies, mainly on biogeochemistry and benthic biology. The department carried out many EU-sponsored projects, including OMEX (Ocean Margin Exchange) and ECOFLAT, part of ELOISE (European Land-Ocean Interaction Studies). During the last five years, as President of the European Marine Research Stations' MARS network, he was involved in creating a marine biodiversity research program in Europe.