

Part VI

Assessment of Marine Biological Diversity and Habitats

Chapter 33. Introduction

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The biodiversity of the world's oceans directly supports many of the services and industries reviewed in Parts III, IV, and V, and may be affected by how the various social and economic benefits are used. To ensure the ongoing availability of those benefits to current and future generations, and to maintain healthy oceans, it is essential that the uses made of the ocean are sustainable, both individually and in the aggregate. In Part VI we examine ocean biodiversity from several perspectives, and when trends are apparent, link those trends to their main drivers. From this multi-perspective investigation of biodiversity trends, we obtain the third part of the information to be integrated in this first Assessment. This information may contribute importantly to improving global ocean literacy worldwide, and informing policies and selection of management measures from local to global scales.

The Convention on Biological Diversity¹ (CBD 1992) emphasizes that “biodiversity” exists on many scales: from genetic diversity within populations, through diversity of populations of the same species, the diversity of species in ecosystems, to the diversity of habitats within geographic areas. The diversity at all of these scales reveals patterns and structures that are crucial to the functioning of ecosystem processes and the delivery of ecosystem functions. However, in-depth analyses of patterns and trends, linking them to all drivers that underlie them and their ecological, social, and economic consequences are not feasible for the entire ocean, at even one of these scales.

Therefore Part VI presents overviews of these biodiversity features first spatially, and then followed by more focused examinations of key species groups and habitats. From these overviews, it is possible to present an analysis that integrates how global ocean biodiversity is changing as a result of the impacts of humanity's uses of the ocean, with the ability of the ocean to sustain itself, and humanity's uses of it into the future.

Chapters 34 and 35 present the main global patterns of diversity of populations, species, and habitats. Chapter 34 summarizes what has been learned about the nature and scales of those global patterns of diversity in species, and the dominant natural

¹ United Nations, *Treaty Series*, vol. 1760, No. 30619.

gradients that underlie those patterns, including features of the seabed such as depth, topography and types of substrate, of the water column such as temperature, salinity, nutrients and currents, and planet-scale features such as latitude, seasonality, and proximity to coasts. These patterns and their natural drivers underlie natural variation in biodiversity and provide the foundation for evaluating the potential for supporting human uses and sustaining perturbations from those uses. The ocean is vast and complex, hence these patterns in global biodiversity are incompletely quantified and their natural drivers are not fully understood. Chapter 35 summarizes the degree to which the biodiversity of the world's oceans has been sampled at even a descriptive level, and the subset of places and taxa for which sufficient sampling exists to quantify trends in biodiversity components in space and time, and to provide strong evidence linking those trends to specific natural and anthropogenic drivers.

Two contrasting messages emerge:

(a) An immense amount remains to be learned about the ocean's biodiversity. Sampling has been insufficient to fully quantify patterns and relationships with potential drivers in most of the ocean, and even to describe the biodiversity present in many parts of the ocean. This presents major challenges to fulfilling a core task of this Assessment – setting baselines against which to measure future changes.

(b) Nevertheless, with the current levels of sampling, much can be concluded about how the ocean has changed in the past decades and centuries and trends that may continue into the future. These past changes and current trends provide information about the sustainability of human interactions with marine biodiversity, whether those interactions take the form of direct use or indirect impacts. Although relationships between biodiversity variation and its drivers need to be better quantified almost in all parts of the world, we have sufficient knowledge to indicate which outcomes are likely to be more sustainable or less sustainable, and thus inform our choices. Nevertheless, we must acknowledge that uncertainties will remain and surprises will be encountered.

Chapter 36 comprises the largest part of Part VI. That chapter presents the major temporal trends in biodiversity from the primary and secondary producers (phytoplankton and zooplankton), through the benthos and fish to the top predators. To the extent that they are known in each case, it also links the major trends to their key natural and anthropogenic drivers. Where important changes in trends are documented, the knowledge of the degree to which the changes are due to natural causes to impacts of human uses or to responses to efforts to mitigate past impacts, is summarized. This provides the raw material for integration of biodiversity trends with sustainability of human uses of marine biodiversity. Chapter 36 is subdivided into eight divisions, presenting similar assessments of trends in biodiversity for the northern and southern sub-basins of the Atlantic and the Pacific Oceans, for the Indian Ocean, the

Arctic Ocean and the Southern Ocean, and for the open-ocean and deep-sea areas of all the oceans together.

For all but the open-ocean division, the trends are generally reported separately for coastal and offshore/shelf areas, because the species and habitats, and the main drivers of trends, often differ in the near-shore and the offshore/shelf areas. Even at this level of subdivision, only major trends in biodiversity can be reported, and often it is necessary to report the patterns and trends at finer geographic scales, because these sub-basins and oceans contain many partially independent marine ecosystems, with differing species and habitats, different temporal trends, and possibly different drivers of trends.

None of these regional assessments can be exhaustive of all trends in biodiversity at the regional scale. They focus on trends that are well documented, and likely to be representative of what is happening to biodiversity at those regional scales. Illustrative examples of the trends and their relationships to drivers are presented consistently, and some chapters are supported by technical annexes with additional data and references to enable more in-depth documentation of the conclusions in the sub-chapters. Although several divisions of Chapter 36 have made some use of traditional knowledge in assessing patterns and drivers, in all divisions, institutional assessments and scientific publications were the predominant source of information on patterns, trends, and drivers. That creates an unavoidable (but unintentional) bias towards more extensive assessment of biodiversity trends and drivers in the parts of the world with larger investments in scientific research and monitoring, and where such investments have occurred over longer periods. If the divisions of Chapter 36 report fewer trends in biodiversity in parts of the world with less research and monitoring, this reflects the mandate of this Assessment to use only published sources. Hence at least some of the differences among the regional assessments arise from differences in the quantity of information that informs this Assessment, and not necessarily differences in what is happening to marine biodiversity at these large regional scales. When strong trends are present consistently in regional assessments where appropriate data are available, it would be precautionary and sound scientific practice to consider them as relevant information for less data-rich areas as well.

Regional assessments are only one perspective for documenting, and to the extent possible explaining, trends in biodiversity. Other perspectives are legitimate, and for some aspects of biodiversity the regional assessments may not be the most powerful assessment approach, for two reasons. First, some species groups include wide-spread and highly migratory species; hence no one region captures the trends in the populations, and some habitat types important to biodiversity often are found in relatively small individual occurrences (as well as, rarely, larger ones) but in many of the regions, and a piecemeal regional approach may be inefficient. Second, some groups of species and certain types of habitats are considered particularly vulnerable to natural and anthropogenic drivers. Hence assessments of trends and drivers are most powerful

when all the relevant information is viewed together, regardless of the specific regions from which the parts of the whole story were documented.

Therefore Part VI concludes with short chapters on five key species groups with the above characteristics: marine mammals, seabirds, marine reptiles, elasmobranchs (sharks, rays, and their relatives), and tuna and billfish. Chapters then follow on a number of key habitats. Many are near coastal habitats of known high biodiversity value and subject to multiple human pressures, such as estuaries, kelp forests, and similar habitats. Several are offshore or deep-sea habitats known often to be biodiversity hotspots, and to be attracting increasing pressure from direct or indirect human uses. Examples include seamounts, tropical and sub-tropical corals, cold-water corals, cold seeps and hydrothermal vents. These shorter and more focused assessments of species groups and habitats that are both highly valued economically, culturally, or both, and highly vulnerable to impacts from unsustainable use, provide flagship cases to integrate ecological, social, and economic aspects of marine biodiversity and its contributions to human well-being.

Collectively, across Part VI, this Assessment evaluates the patterns of occurrence of marine biodiversity (Chapter 34) and the extent to which it is known (Chapter 35), the major trends in coastal, offshore, and deep-sea biodiversity, usually at regional scales and sometimes sub-regional scales, as well as the main known drivers of those trends (Chapter 36A-36H), and examines issues of particular concern for species (Chapters 37-41) and habitats (Chapters 42-51). This provides the third main pillar of this Assessment, for integration with Parts II-V in Part VII (Overall Assessment).