Chapter 53. Capacity-Building Needs in Relation to the Status of Species and Habitats

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1. Introduction

Knowledge of the status of species and habitats forms a fundamental basis for understanding biodiversity at all scales (Chapter 34) and ecosystem functions and services (Part III and Millennium Ecosystem Assessment, 2005). This facilitates identifying the capacity-building needs for appropriate interventions that will enhance and promote sustainability. This creates a need for knowledge of marine biological diversity and habitats from a marine ecosystem approach, and of how biodiversity varies in relation to various levels of anthropogenic perturbations. Gaps in scientific knowledge, technological advances, human skills and infrastructure for the conservation of marine biodiversity and habitats are crucial. Part VI addresses these issues focusing on the major oceans in relation to marine ecosystems, habitats and major species groups that are emerging from our assessments as potentially threatened, declining or needing special attention. All these categories need a variety of capacity building, technical skills, technology and infrastructure to address their trends. To facilitate this capacity building, we undertook the identification of knowledge gaps mainly from the Part VI Chapters, and the capacity building needed to address socio-economic issues for human well-being. Chapter 32 and this Chapter both address capacity-building needs. However, whereas the identification of needs in Chapter 32 was based on outcomes of regional workshops and the Chapters of Part V, this chapter is based on all the authored chapters, which also include identification of gaps from literature reviews on the oceans.

To address the objective of the Regular Process to ensure that capacity building and technology transfer are done through promoting cooperation, not only North to South but also South to South cooperation (UNGA, 2010; UNGA/AHWGW, 2009; UNGA/AHWGW, 2010), the synthesis is done in geographical areas following the oceans and the major regional seas addressed in Chapter 36. Further capacity needs were identified in relation to the knowledge gaps from the chapters focused on the overall status of the major groups of species and habitats, including the socio-economic aspects of their conservation.

The marine species groups that were given special attention or protection are: marine mammals, seabirds, marine reptiles, sharks, tuna and billfish. These were dealt with globally without specifically linking them to particular oceans. The same general analysis was followed for specific marine ecosystems and habitats addressed in Chapters 42-51, including cold-water corals, warm-water corals, estuaries and deltas, open-ocean

deep-sea biomass, hydrothermal vents and cold seeps, high-latitude ice, kelp forests and seagrass, mangroves, salt marshes, Sargasso Sea, seamounts and other submarine geological features potentially threatened by disturbances.

There are already many international initiatives to build capacities (both in terms of skills and of equipment) to meet many of the capacity-building gaps identified in this Assessment. One example among many is the programme of the Food and Agriculture Organization of the United Nations, supported by Norway, using the Research Vessel Dr. Fridtjof Nansen. However, on the information available, it is impossible to say what gaps currently exist in arrangements to build these capacities: conclusions on where the capacity-building gaps exist could only be reached on the basis of a survey, country by country, of the capacity-building arrangements that currently exist and how suitable they are for each country's needs. This applies more generally, but is particularly important in relation to capacity-building in relation to marine bodiversity. The initial inventory of capacity-building arrangements[1] compiled by the Division for Ocean Affairs and Law of the Sea as part of the Regular Process would provide some initial information on which to base such a review, but it would take much more detailed study than has been possible in the first cycle of the Regular Process to match this with the needs of each country.

2. Outcomes based on regional workshops on capacity-building needs

The following regional workshops were held: South-West Pacific region (UNGA, 2013a), Wider Caribbean region (UNGA, 2013b), Eastern and South-Eastern Asian Seas (UNGA, 2012a), South-East Pacific region (UNGA, 2011), the joint North Atlantic, Baltic Sea, Mediterranean and Black Sea region (UNGA, 2012b), the Western Indian Ocean (UNGA, 2013c) South Atlantic Ocean (UNGA, 2013d) and Northern Indian Ocean (UNGA, 2014). From the regional synthesis based on the outcomes of the regional workshops, it appeared that some needs were regionally cross-cutting and some were directly relevant to Chapter 53. The following were more specific to species and habitat relationships across the regions:

(1) Taxonomy and genetics

(2) Bio-physical/chemical research on the ocean environment

(3) Socio-economics of oceanic natural resources focusing on biodiversity and habitats

(4) Skills in integrated assessments, including modelling

(5) Infrastructure with relevant supportive technology, especially in research vessels and laboratories to support multidisciplinary research

(6) Geographical Information System mapping skills.

[1] See A/67/87, Annex V.

3. Outcomes based on chapters focusing on knowledge gaps to inform capacity-building needs

3.1 Overview of marine biological biodiversity

The global biological diversity patterns are described in relation to key taxa and habitats and to the identification of key environmental and anthropogenic drivers. The gradients in marine biodiversity are assessed using a taxonomic framework of well-known key groups of organisms (for example, marine mammals; turtles; finfish; plankton (phytoplankton and zooplankton), and seabirds in Chapters 34-36. In addition, a habitat framework was used when the taxonomic identity of the species was of secondary importance to the type of community or conditions in which they occurred, the species and habitat framework focusing on marine ecosystems, species and habitats (Chapters 37-51, Section B).

3.2 Overall status of marine biological diversity in the oceans and knowledge gaps

The Atlantic and Pacific Oceans are relatively more studied than the Indian Ocean, which is the third-largest ocean and almost entirely surrounded by developing countries. By contrast, both the Atlantic and Pacific Oceans are mostly surrounded by developed countries or economies in rapid transition. However the North Atlantic and the North Pacific Oceans are comparatively better studied than the South Atlantic and South Pacific Oceans.

In terms of identifying the global diversity patterns, the gradients in marine biodiversity of the North Atlantic and the North Pacific are assessed primarily in terms of taxonomic frameworks, whereas for the South Atlantic and South Pacific the taxonomic framework is used when possible, but is often augmented by the habitat frameworks in areas surrounded by developed countries and developing countries, respectively. For areas surrounding the Indian Ocean, where many knowledge gaps are found, the gradients in marine biodiversity are assessed primarily in terms of habitat frameworks. As regards the Polar waters, the Antarctic has been more studied than the Arctic, but it is necessary to increase scientific efforts for the Arctic and Antarctic due to their uniqueness.

3.3 Deep-sea environment

Shallow coastal waters are comparatively better researched than the deep sea because of their greater accessibility. It is necessary to build the essential capacity, including deep-sea platforms to provide relevant research and technical skills at regional and global levels to address the following problems:

- Despite technological advances and a sharp increase in deep-sea exploration in the past few decades, a remarkably small portion of the deep sea has been investigated in detail. There are therefore large gaps in what we know about the deep sea.
- Although the species which are specifically considered in this Assessment are vertebrates, it is important to improve the knowledge base about invertebrates, microbes and viruses.
- Deep-sea biodiversity is very poorly characterized compared to the shallow-water and terrestrial realms. Without better characterization of deep-sea biodiversity, its protection will be hampered.
- The deep ocean has many species, with genetic, enzymatic, metabolic and biogeochemical properties which may hold potential for major new pharmaceutical and industrial applications. Without better knowledge of these species and their properties, important opportunities may be missed.
- The deep oceans are estimated to have up to millions of species. Because conservation and sustainable use of biodiversity is improved when the species are known and their biological characteristics inventoried, much effort and time will be required to describe them.
- The deep seas are threatened by ongoing global climatic changes due to increasing anthropogenic emissions and resulting biogeochemical changes. The impacts of climate drivers on the deep sea biota and the magnitude of the drivers in the deep sea need to be better documented.
- The deep oceans may be threatened by, e.g., oil and gas exploitation, mining for metals, fishing practices (both destructive fishing techniques and an excessive scale of fishing) and pollution. More measurement is needed of the scale of these pressures and their potential impacts.
- Perhaps the most important knowledge gap is the knowledge of the effectiveness of alternative management options when applied in such a vast, dynamic space, much of which is beyond national jurisdiction, to reduce the impact of man-made stressors.
- The design of protected areas based on geographic definitions must necessarily account for the fluxes through the system as well as the movement of the inhabitants.
- Deep-sea observatories are becoming increasingly important in monitoring deep-sea ecosystems and the environmental changes that will affect them. These observatories aim at addressing important societal issues, such as climate change adaptation, ecosystem conservation and sustainable resource management. Tackling these issues, along with efficient and clear stakeholder communication, is particularly important for the deep sea, which remains largely unexplored, yet affects the lives and livelihoods of the global population directly or indirectly. Technological advances in recent years offer the ability to continuously monitor the ocean in time and space; in particular, the development of *in-situ* sensors, autonomous vehicles, and cyber-infrastructure,

including telecommunications and networking. If these technologies are applied more widely in the world's oceans they would add to the capacity to monitor the deep sea and feed the obtained information into science-policy interfaces and marine management and policy.

4. Specific data or knowledge gaps identified in the Assessments by key marine species or habitats

4.1 Marine species

4.1.1 Marine mammals

Data are obtained mostly from ship-board observations and use of satellite telemetry. The latter has improved offshore data acquisition, because most of the data are taken within the Exclusive Economic Zones (EEZs). USA, European and Antarctic waters are the best assessed waters. The largest knowledge gaps occur in Indian Ocean waters. Only by continuing to monitor and assess the marine mammals in EEZs and putting more research effort into the Areas Beyond National Jurisdiction (ABNJ) can sufficient data be obtained to document trends and inform decision-making.

4.1.2 Seabirds

Birdlife International, the IUCN Red List authority for birds, has the most authoritative global database on seabirds. At regional levels, Europe and North America are most thoroughly assessed; many knowledge gaps remain in the developing world.

- Important knowledge gaps exist in studies of seabird migrations, some of which cross continents, or are inter-continental, because these routes are not well known. Other gaps that cannot be filled without additional capacity include improving understanding and increasing data available on seabird coastal habitats; seabird bycatch; vulnerability to pollution (especially oil, garbage in dumpsites, marine litter and plastics); disturbances of coastal and deep-sea habitats; adequacy of habitat protection; whether and what kind of marine protected areas (MPAs) may address this gap globally; their role in ecosystem, socio-economic and livelihood services; the effectiveness of alternative conservation elements for taking the migratory habits of seabirds into account, and other factors for sustainability in protected areas.

4.1.3 Sea turtles

With respect to sea turtles, the issues where gaps in knowledge and capacity-building are involved include:

- Assessments spearheaded by IUCN's Red List of threatened species and the global listing for vulnerable species exist. However, marine turtle population traits and trajectories can vary geographically and the listing criteria could only

be applied effectively if there were a better characterization of the status and trends of individual populations and if the information was used to establish categories for regional sub-populations in addition to the single overall global listings.

- Gaps in knowledge of risks due to effects of climate change still remain a challenge because of insufficient data for analysis of long-term trends. Improved conservation of sea turtles could result from an increase in regional assessments for sea turtles due to their migratory nature. Monitoring and reporting criteria would also perform for effectively if they were augmented by information on the status and trends of population sizes, as well as global threats to the sea turtles.
- Data needs are critical for data-poor regions, especially Africa, the Indian Ocean and South East Asia.

Increased capacity to address these gaps at regional and global levels would allow more effective conservation of marine reptiles. Such efforts would benefit from cooperative regional and global partnerships, because sea turtles are migratory and transboundary.

4.1.4 Sharks and other elasmobranchs

In relation to sharks and other elasmobranchs, there is inadequate capacity in many countries and most regions to address the following issues:

- Lack of or deficient monitoring data make it difficult to assess the status of many sharks. The most data-deficient areas are: Western Central Atlantic Ocean, Eastern Central Atlantic Ocean, the Wider Caribbean Sea, South West Indian Ocean and the eastern and southeastern Asian Seas.
- In addition to obtaining data from fisheries, surveys and catch landings increasing the capacity to use emerging technologies, such as satellite tags, acoustic tracking, digital underwater photography, and sophisticated photo identification systems would facilitate population and distribution estimates in defined geographic locations.
- Although the recent decline in reported landings is consistent with declining abundance due to overfishing, any interpretation should consider that reported landings are almost certainly a gross underestimation of actual catches. To ascertain actual trends in shark catch and landings, which are likely to be even worse than expected, would require increasing the management priority of sharks by regional fisheries management organizations (RFMOs) and national management bodies. Better independent catch and bycatch monitoring data are needed to know the effectiveness of conservation measures taken by RFMOs, noting that destructive fishing is still increasing in regions such as the Indian, central Pacific and south and central Atlantic Oceans.
- Mortality due to fishing, both directly and as bycatch, is almost entirely responsible for the worldwide declines in shark and ray abundance. However, knowledge of survival of living sharks released at sea is limited.
- Persistent bioaccumulation of toxins and heavy metals has been documented in sharks feeding at high trophic levels. Levels which can be toxic to human consumers

have been reached in some areas, but their effect on the host shark remains unknown. The global extent and specificity in occurrence of various contaminant burdens are unknown. These knowledge gaps would have to be filled before the population-level threat of toxins and heavy metals could be evaluated effectively.

- Elasmobranchs (sharks and rays) play an important role in the marine ecosystem food chains as top predators; they contribute to maintaining balances in species numbers and biomass abundances. This function is, however, not very clear at local and sometimes regional scales; its overall global manifestation is not well known either as the role of temporal variability is poorly understood. These knowledge gaps would have to be filled in order to place shark conservation in the context of ecosystem functioning.
- A key challenge is to secure ongoing assessment activities, particularly the continuance of research surveys, and to expand assessment activity to encompass not only the largest, most charismatic species, but also the lesser-known species which are often more threatened, particularly the rays and shark-like rays, and the 90 obligate and euryhaline freshwater species. Geographically, greater attention needs to be paid to Central and South America, Africa, and Southeast Asia.

4.1.5 Tuna and Billfishes

These fish are an important part of the global capture fisheries sector. Billfishes are heavily fished and have therefore attracted the attention of IUCN; some species are listed as vulnerable. Capacity-building gaps exist in addressing the following gaps:

- Assessments are done by RFMOs using fisheries stock assessment methodology and capacity is inadequate in many parts of the world to employ this methodology and to establish research infrastructure with the necessary technology, including satellite tracking facilities, to facilitate the required studies. Lack of this capacity hinders conservation and management of these species. A global paucity of data exists on the population status of these species. Only with additional stock assessments would it be possible to identify and protect early enough many species possibly threatened by overfishing for effective conservation measures to be taken. This can only be done effectively if it is approached at both regional and global levels.
- Although the current exploitation status for the principal market tunas is relatively well known globally, knowledge on the exploitation status for the non-tuna billfish stocks and species is fragmentary and uncertain. Furthermore, tuna RFMOs have not yet conducted formal fisheries stock assessment evaluations or adopted management and conservation measures for any of the eight non-principal market tuna species. Therefore their current exploitation status is unknown or highly uncertain throughout their distribution range, and can only be filled by additional capacity to assess their status.
- It is generally agreed that catch estimates for non-principal market tunas and billfishes have been and still are underestimated, as the majority of these species are caught by small-scale fisheries or as a bycatch of principal market tuna

fisheries. Therefore effective assessmetns of these species requires improved catch reporting from small-scale coastal fisheries targeting both principal market tunas and the smaller non-principal market tunas. Similarly, billfish catches, which generally come from industrial tuna fisheries as bycatch, have also been commonly poorly reported and monitored.

- Climate change is another potential pressure that needs to be taken into account in the assessment of the biology, economics and management of tuna and billfish species. Climate change might have an effect on tuna and billfish species by changing their physiology, temporal and spatial distribution and abundance, but these possible relationships can only be known with much more study.
- To what extent the widespread declines in tuna and billfish populations have altered the capacity of the ocean to support vital ecosystem processes, functions and services by reducing their abundances and altering species interactions and food web dynamics is poorly known.
- Incorporating ecosystem considerations into the management of tunas and billfish fisheries would help to move their assessments into an ecosystem context.
- The main challenges to conservation responses and factors for sustainability are: (1) reduction in the existing overcapacity of fishing fleets; and (2) adoption of protocols that ensure implementation of effective Monitoring, Control and Surveillance (MSC) techniques.
- A further challenge is the paucity of knowledge of the impacts of tuna and billfish fisheries on other less productive species such as sharks, on species interactions and food web dynamics, and on the greater marine ecosystems.

4.2 Marine ecosystems and habitats

4.2.1 Cold-water corals

With respect to cold-water corals, the issues where gaps in knowledge and capacity-building are involved include:

- Information on cold-water corals (CWC) in the Indian Ocean region is scanty, even though the region covers an area between latitudes 70^0N - 60^0S, a range where seamount CWC are known to occur.
- Technology and skills for discovering CWC are still lacking in some regions, especially the developing world. Additional fine-grained and broad-scale habitat modelling are still needed to discover additional habitats, and to forecast the fate of CWC facing both direct (fisheries) and indirect (environmental) impacts.
- It is necessary to increase knowledge of the characteristic geological structures and environmental factors facilitating CWC settlement and growth. The current list includes provision of hard, current-swept substrate, and often topographically guided hydrodynamic settings. All need to be identified and mapped. The skills needed include knowledge of combined physical, bio-geo-

hydro-chemical analytical techniques (e.g., of ambient seawater characteristics and measurement of current velocities.

- Global knowledge is lacking of CWC distribution in terms of their species occurrences and population abundances; this makes it difficult to set up regional cooperation to consider these species.
- Knowledge of how cold-water corals respond to damage inflicted by pollution is limited. Without better knowledge, it will be difficult to design protective regimes and response mechanisms.

4.2.2 Warm-water corals

With respect to warm-water corals, the issues where gaps in knowledge and capacity-building are involved include:

- Damage to warm-water corals may be more serious than currently perceived because submerged reefs below 20m depth cannot be detected using satellite technology. Submerged reefs cover large areas and understanding the extent of submerged reefs is therefore important.
- GIS mapping of coral reefs is necessary to understand their spatial distribution, especially in shallow water areas where the worst affected reefs are found.
- Corals show trends that justify measures to protect them from anthropogenic impacts. Such protection can be enhanced by spatial management tools, including the creation of MPAs. Globally, only six percent of warm-water reefs are contained in marine reserves. Establishment of more spatial management measures including MPAs would address this concern and aid in reducing anthropogenic impacts, and also assist in meeting other challenges.
- Monitoring sites and the flow of information on coral ecosystems (and in some cases other marine habitats such as mangrove and seagrasses beds) have been reduced in some cases. This will not help to improve the little that is known on the status of their ecological interaction with the changing pressures.
- Restoration and enhancement of capacity for monitoring would be required to allow status and trends of these habitats to be assessed effectively.
- Where warm-water corals are damaged by cumulative impacts, measures which address the full range of the pressures will be the most effective response. This includes pressures from tourism (see Chapter 27).
- Corals provide important cultural values. Indigenous people in some developed countries have been granted rights to access and benefit sharing of genetic resources and traditional knowledge. This recognition acknowledges the importance of these cultural aspects that link human populations and reefs. Capacity building for indigenous access and benefit sharing would be beneficial to the well-being of these peoples.

It would be extremely useful to build capacity for studying and managing coral reefs, at national, regional and global levels, to provide the right skills and infrastructure to address the issues identified and continue to enable coral reefs to provide goods and services that contribute to socioeconomic well-being and the health of the planet as a whole.

4.2.3 Estuaries and Deltas

With respect to estuaries and deltas, the issues where gaps in knowledge and capacity-building are involved include:

- A paucity of knowledge exists about the threats due to human activities, global climate change and extreme natural events.
- Globally very few integrated assessments encompass multiple aspects of estuarine environments, i.e., that include habitats, species, ecological processes, biophysical and socio-economic aspects.
- It would be extremely useful for the better conservation of estuaries and deltas to develop and apply the capacity to address these issues, including incorporating hydrological modelling into coastal modelling and forecasting efforts, in order to link better with the land-coast interface where these important habitats are located.

4.2.4 Hydrothermal vents and cold seeps

With respect to hydrothermal vents and cold seeps, the issues where gaps in knowledge and capacity-building are involved include:

- The survey and research activities have mostly been undertaken in the Pacific (especially in the northeast and northwest Pacific) and Atlantic Oceans (especially the north Atlantic). Very few have been conducted in the Indian Ocean, and those few have mostly been carried out in international waters. Therefore a better global picture of trends would require survey and research efforts to be expanded.
- Increasing knowledge of vents and seeps would only be possible if essential capacity to address all these gaps were built. For developing countries, this would need to be greatly increased, because the capacity is at best low, and usually almost non-existent, in many countries.

4.2.5 High-Latitude Ice

With respect to high-latitude ice, the issues where gaps in knowledge and capacity-building are involved include:

- The ecology of the Arctic and Antarctic regions is still little known due to the challenges their unique environments pose to human beings. This has necessitated the use of special skills and technology to undertake the essential research to understand the effects of the emerging threats of climate change, not only in these regions, but also how these effects would consequently affect

wider geographical regions. Capacity to apply these skills and technologies would have to be increased to obtain the full benefit of their potential;

- The ability to manage the effects of sea-level rise caused by melting of polar ice is still a challenge. It is causing considerable social and economic losses along continental coasts and is threatening property and life on entire islands. This is due to the loss of habitats and consequently of biodiversity on which humans depend for their well-being. The costs of economic losses and level of human suffering are not fully quantified, and augmenting this knowledge is necessary to perform threat assessments of these factors;
- Further challenges stem from the inadequate understanding of the polar ecosystems; these are under increasing pressure caused by anthropogenic activities in the form of commercial exploitation of polar natural resources, which include oil and gas. With little ecological understanding of these ecosystems and therefore inadequate mitigation measures, a concern is growing as to how to deal with the looming complex environmental degradation and the need to identify and implement mitigation measures. These possible threats can only be assessed and managed if our ecological understanding is improved through expanded research and monitoring.

4.2.6 Kelp Forests and Seagrass Meadows

With respect to kelp forests and seagrass meadows, the issues where gaps in knowledge and capacity-building are involved include:

- The rate of loss of species is very high due to encroachments on these ecosystems and their proximity to coasts and consequently to human activities. The gravity and extent of these losses vary regionally and have yet to be determined in most areas. However, the causes are commonly due to coastal urbanization and industrialization, and conversion of some areas to build recreation facilities and harbours which involve heavy dredging. However, these pressures are rarely well quantified at local scales. Effective conservation and sustainable use of these habitats will require better quantification at local and regional scales.
- The costs of restoring these habitats (in the rare event that restoration is even possible) are high and the requisite restoration technology and skills are yet to be readily available in most regions. Even when restoration efforts are made, it is difficult to attain the original conditions and biodiversity that were present before degradation. Where restoration is desired or necessary for return of ecosystem services, greater study of restoration technologies would be required.
- The multitude and variety of uses of seagrass and kelp habitats (examples: aquaculture, harvesting, recreational and commercial fishing, tourism, etc.) have created conflicts over best management practices within these ecosystems. If these conflicts are going to be managed and best practices applied, improved capacity in integrated management would be necessary to address these conflicts in their early stages.

4.2.7 Mangroves

With respect to mangroves, the issues where gaps in knowledge and capacity-building are involved include:

- Despite considerable regional and global awareness campaigns on the value of mangrove ecosystems, and therefore the need to sustain their integrity so that they can provide their ecosystem services sustainably for the benefit of human well-being and the environment, estimates of increased destruction and loss in mangrove coverage continue to be reported regionally and globally at different levels of exploitation, although the actual data underpinning these estimates are unclear. If these trends are to be reversed, it is essential to document quantitatively, using the best available technological advances in skills, the various types of losses characteristic of each region and the consequences for biodiversity loss or extinction at the relevant taxonomic levels, as well as the ecosystem services that will be lost regionally and globally. This will enable assessment and quantification of the real risks and development of means to mitigate them.
- The ecosystem services provided by salt marshes are largely unknown.
- At regional and global levels, it is still not clear how to distinguish the characteristic biodiversity index of mangrove species taxonomically in a given area because of the ambiguous definition of a mangrove tree or vegetation. With existing technological advances, species identification should be based not only on morphological descriptions but also on their molecular attributes to avoid ambiguous descriptive terms like mangrove associates or hybrids. Use of these technologies in conservation and management will require building capacity for their application.
- Mangrove restoration is still at its early stages of development. It either uses seeds planted directly in the soil of mangrove habitat or seeds that are first nurtured and grown in a nursery before being planted in the mangrove habitats along the shores. These seeds are not improved in any way. If mangrove restoration is to accelerate it would be necessary to promote faster growing mangrove trees, including those improved through the use of biotechnology application and to ensure that the physical and chemical properties of the soils are optimal for their growth and that mangrove pests are eliminated or kept away from the plantations. These activities should involve local communities to enhance their education about and awareness of this ecosystem.
- Conservation and sustainable use of mangroves would benefit from promotion of ecotourism in natural and restored mangrove forests, managed by local communities for income generation; this is expected to instil in them the importance of these ecosystems in supporting their livelihoods without destroying them for unsustainable exploitation.
- To enhance carbon sequestration and at the same time increase their economic income as well as supporting mangrove conservation and enhancing mangrove

ecosystem services would require increased carbon credits to local communities that become involved in growing mangrove forests.

- Protection of mangroves will require improved understanding of why naturally occurring bare, salty, and sandy flats occur in mangrove ecosystems, which would also inform the creation of buffer zones in landward areas that will allow mangroves to migrate landward in response to sea-level rise. This is an established practice for integrated coastal zone management.
- Promotion of ecotourism in natural and restored mangrove forests, as well as management by local communities for income generation, will instil in them the importance of these ecosystems for supporting their livelihoods, without destroying the system through unsustainable exploitation.
- Capacity-building needs should be recognized if there is a desire to address acquisition of technological skills to enhance restoration, growth and management of mangrove forests, infrastructure to support development and use of biotechnology techniques to promote faster growing mangroves and to improve soils.

4.2.8 Salt Marshes

With respect to salt marshes, issues where gaps in knowledge and capacity-building are involved include:

- Salt marshes, in both tropical and temperate zones, are one of the fastest disappearing ecosystems worldwide. This is mostly due to anthropogenic activities, yet little is known about them in terms of their ecology and socio-economic contribution to human well-being.
- In the tropics and sub-tropics, the nature of the ecological interaction of salt marshes and mangrove ecosystems where they share a location is largely unknown; one result is the classification of salt marsh vegetation as associate mangrove species. In other words, the ecological role of salt marshes is masked by, or confused with, mangrove vegetation and therefore constitutes a large knowledge gap for both ecosystems.
- The ecological significance of the role of migratory fauna between salt marsh and mangrove vegetation is poorly known.

4.2.9 Sargasso Sea

With respect to the Sargasso Sea, the issues where gaps in knowledge and capacity-building are involved include:

- If the following issues are to be addressed, it is necessary to build techniques, personnel and infrastructure to address them: The Sargasso Sea is a complex habitat characterized by an interdependent mix of its physical oceanography, its ecosystems and its role in the global scale of ocean and earth processes. It is not fully known how these processes operate to produce this unique habitat.
- The Sargasso Sea ecosystem links to ecosystems in Europe, Africa, the Americas and the Caribbean. This provides a unique ecosystem for study to understand

how the divergent and convergent ecological functions of these widely spread, but interlinked, geographic ecosystem regimes operate. Targeted research could produce new knowledge of impacts caused by climate change.

4.2.10 Seamounts and other submarine geological features

With respect to submarine geological features, the issues where gaps in knowledge and capacity-building are involved include:

- Seamounts are predominantly submerged volcanoes, generally now extinct, that can rise to a few thousand metres above the surrounding seafloor. The most significant human activities around seamounts so far are fishing and, potentially, mining. To increase the knowledge available to manage activities around these features, it would be necessary to build techniques, personnel and infrastructure to address the following issues: Only about 6.5 per cent of the sea floor is mapped, so the global number of seamounts can only be estimated.
- Globally, overall species richness in seamount ecosystems is poorly known and therefore improving our knowledge of species composition would require undertaking comprehensive studies of the ecology of seamounts, ridges and other sensitive submarine benthic habitats. Appropriate conservation of these ecosystems requires scientific research.
- The interaction of the geological features with the overlying water column is poorly known.
- Impacts of acidification and de-oxygenation on these ecosystems are also unknown, and are not monitored sufficiently to detect impacts: many seamounts already experience low oxygen and low calcium carbonate saturation levels.
- Trawl gear disturbs and destroys benthic fauna and in some seamounts little decolonization is observed, even years after the closure of fishing. The destructive effects of trawl gear on benthic communities are generally incompletely known, but it is possible that these have reduced the ecological resilience and consequently also reduced reproductive potential, and contributed to the loss of genetic diversity and ecological connectivity.
- Capacity for stock assessment and sustainable management, including investment in shared infrastructure (for example, fisheries research vessels), is insufficient and capacity building would improve the possibility that such fisheries could be sustainably managed.
- Mining of seamounts would benefit from multisectoral management, especially for balancing mining and fishery interests. A first step in this direction could be to build the capacities of those involved to participate in the international work on this subject.
- Managing the effects of multiple stressors on seamounts would benefit from expanding both monitoring and research and may require building capacity to address this need. This would include capacity building for personnel and infrastructure, including multidisciplinary research teams, research vessels and laboratories.

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