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The oceans provide various ecosystem services or what are also referred to as the "benefits that people desire from ecosystems" (Millennium Ecosystem Assessment, 2005). It is therefore necessary to know the types or nature of services that humans receive from the oceans and the scale or level of human activities that can be exerted without causing imbalances that could affect sustainability. Achieving sustainability requires strong public understanding of the importance of the ocean. This therefore calls for enhanced outreach and communication efforts through the development of mechanisms and partnerships to build capacity for outreach and awareness programmes. The major types of ecosystem services are described in Chapter 3. For sustainability the following are needed: scientific understanding of the services; assessment of the level of food production which results from various ecological processes, in order

to undertake integrated assessments. Substantial capacity-building

Atlantic, Baltic Sea, Mediterranean and the Black Sea region (UNGA 2012b), the Western Indian Ocean (UNGA 2013c), South Atlantic Ocean (UNGA 2013d) and Northern Indian Ocean (UNGA 2014). The regional outcomes in terms of knowledge gaps and capacity needs were as follows:

2.1 Capacity needs for marine assessments in the south-west Pacific Region

This workshop was held in Brisbane, Australia, 25-27 February 2013 (UNGA 2013a). The focus was on linkages and upscaling from national to regional and global scales to promote synergies for building capacity which will include mentoring, learning and cooperation in communication, data and information transfer, as follows:

- The production of global marine assessments should be linked to ongoing efforts to support regional (led by the Secretariat of the Pacific Regional Environment Programme) and national state-of-the-environment reporting and streamlining of reporting arrangements (led by the Pacific Islands Forum Secretariat/Secretariat of the Pacific Regional Environment Programme). By providing capacity development and other support to these initiatives, the region will be better placed to contribute to and benefit from the Regular Process. The production of global marine assessments should be done in a way that provides mentoring and learning opportunities for less experienced scientists and practitioners.
- Active facilitation of involvement of practitioners from Pacific Island countries and territories in producing global marine assessments, including improved communication efforts to ensure awareness of the opportunity to be involved, assistance in registering for the Pool of Experts and resourcing support for and formal recognition of work done will all contribute to capacity-building in those countries.
- A large quantity of data and information exists, but it is often not readily identifiable or accessible. Enhanced regional and national capacities to store, access, share and interrogate data and information would assist the production of global marine assessments and facilitate the meeting of regional and national objectives.
- Resourcing is a substantial constraint on the capacity of the region to contribute to the production of global marine assessments. This can in part be addressed by the nature, scope and process for the development of assessments that more deliberately support national and regional objectives, as well as the objective of producing a global report. For example, the global marine assessment could provide region-specific information and access to the underlying data and information.
- Because of the limited capacity of the region to engage in the drafting of this Assessment, the review stage might be an efficient point for the region to ensure that regional information and perspectives are appropriately reflected therein. A second workshop or network among involved practitioners may provide

mechanisms for doing this. Similarly, providing support to an appropriate Pacific regional organization to facilitate and coordinate ongoing regional engagement may be useful.

2.2 Capacity needs for marine assessments in the Wider Caribbean Region

This workshop was held in Miami, United States of America, 13-15 November 2012 (UNGA 2013b). The emphasis was placed on: needs for projects to include capacity-building and have specialized research institutions and research vessels offer opportunities for training, including the use of ships of opportunity; specialized research institutions to offer learning and mentoring opportunities, especially data and information analysis and synthesis; building collaboration and networks across experts, institutions and a variety of stakeholders, and promoting a culture of manpower retention for sustaining research in institutions. Other points included:

- Previous or ongoing regional marine assessments, specifically the Caribbean Coastal Marine Productivity Programme, the Caribbean Planning for Adaptation to Climate Change Project and the Caribbean Large Marine Ecosystem Project,

in compiling and developing the first global integrated marine assessment.

3. This regional workshop would aim at gathering scientists and relevant national authorities to raise awareness of the Regular Process within the scientific

species using remote sensing capabilities, as well as creating capacity to organize databases using standardized tools and formats. It was also important to

2.7.3 Socioeconomic aspects related to fishing

The principal gaps identified by the experts in the economic evaluation of fishing activities are: (i) Scarcity of evaluations of economic consequences (risk assessment) of disasters and impact of other activities on fisheries and the living standards of fishers; (ii) Scarcity of studies on the impacts of the global economy on fisheries; (iii) Lack of data on post-fishing losses (during processing, marketing, etc.); (iv) Absence of studies on the impact of harmful algal blooms on fisheries in West Africa; (v) Lack of information on the contribution of artisanal fisheries.

The principal gaps identified by the experts on fishing practices and health and safety are: (i) Stock assessments of species caught by both the industrial and artisanal sectors (they are frequently pooled together, although some countries have good reporting systems); (ii) Scarcity of info

2.7.6 Capacity needs

A major capacity shortage facing many countries in the South Atlantic region is the ability to conduct assessments of the state of the marine environment at national to regional spatial scales. This need is mainly due to the lack of funding, but also due to the lack of resources and capability to conduct such studies, especially at the local and national levels. It is important to note, however, that capacity needs are unevenly distributed and that South-South cooperation also represents an opportunity to fill existing gaps. The experts therefore suggested that more capacity-building activities be organized under the umbrella of the Regular Process.

Another important gap concerns the geographical discontinuity of information in the South Atlantic region, and in particular the scarcity of studies on biophysical and socioeconomic dynamics in the region. This was deemed to be an important gap that hinders the development of an integrated regional assessment. Optimizing the coordination of marine environmental data-collection activities within countries and within the region should contribute to the production of an integrated regional assessment.

2.8 Capacity needs for marine assessments in the northern Indian Ocean

This workshop was held in Chennai, India, 27-29 January 2014 (UNGA 2014). The meeting focused on identifying short-term and long-term capacity-building needs that were determined through gap analyses. The capacity-building should concentrate on developing methodologies for integrated assessments and standardization of data and information generation for national, sub-regional, regional and global assessments. It is also a priority to create regional partnerships for undertaking joint research and to mobilize funds for capacity-building. Capacity-building to address biodiversity, critical habitats, microbial assessments, shipping, and environmental monitoring using satellite technology is also highlighted as a priority. Other points included:

- (1) The immediate action plan recommendation includes identification of the needs for capacity-building (including the acquisition of necessary technology) for marine monitoring and assessment (including integrated assessments). The capacity-building activities need to concentrate on the following issues:
 - (a) methodologies to obtain the information from various sources on a regular basis;
 - (b) standardization of the information content for assessments at various levels;
 - (c) developing common methodologies to carry out the assessment and to train data collectors: this is very important for uniform data collection. The procedure, data collection, formatting and preparation of reports should be standardized for all the member countries.

- (d) developing methodologies for scaling up national, sub-regional, regional and global assessments; and
 - (e) developing reporting forms to assist the integration process, with the aim of securing coherence, consistency and comparability as far as possible.
- (2) Development of a short-term capacity-building plan to mobilize the information and knowledge that is known to exist but has not yet been systematically organized in a way that would allow its use for the Regular Process. However, for this purpose, it may be necessary to identify the gap areas, and make efforts in capacity-building

stakeholders to enable them to understand the impact of ecosystem services on their well-being.

- Human capacity and infrastructure (research laboratories and institutes, observatories and oceanographic fleets) should be developed on a continual basis.

3.1.2 *Oceans and the hydrological cycle*

- Skills to quantify potential impacts on society and natural environment due to flooding and sea-level rise: the latter are acknowledged as being among the most serious issues confronting humankind.
- Capacity is inadequate to determine local sea-level changes which are also influenced by several natural factors, such as regional variability in the ocean and atmospheric circulation, subsidence, isostatic adjustment, and coastal erosion. It is necessary to study the latter too.
- Regional capacity is not sufficient to study changes in the rates of freshwater exchange between the ocean, atmosphere and continents because of their significant impacts. There is also inadequate ability to determine spatial variations in the distribution of evaporation and precipitation that create gradients in salinity and heat that in turn help drive ocean circulation.
- Capacity is insufficient to utilize traditional knowledge as an additional resource to address adaptation in given impact settings; this knowledge should be carefully evaluated within adaptation planning.
- Capacity is insufficient for standardizing methodologies to address regional differences which are due to differing data sources, temporal periods of analysis, and analysis methodologies.
- Capacity is insufficient for disaster preparedness to address high-intensity cyclones, because the scientific consensus shows that global warming will lead to fewer but more intense tropical cyclones globally. This will certainly affect coastal areas that have not been exposed previously to the dangers caused by tropical cyclones.

3.1.3 *Sea-air interface*

- Regional capacity is not adequate to determine levels of rising carbon dioxide (CO₂) in the atmosphere and increased absorption of CO₂ by the oceans, which has created an unprecedented ocean acidification (OA) phenomenon that is altering pH levels and threatening a number of marine ecosystems. It is necessary to map OA hotspots, which have now become a global problem.
- Capacity is insufficient to study the impact of shellfish farming due to acidification and to establish indicators for OA to facilitate determination of OA hot spots.

3.1.4 *Plankton productivity and nutrients*

- There are important shortfalls in regional capacity in terms of both infrastructure and human skills to enable measurement of primary production *in situ* and through remote sensing. The infrastructure includes multiplatform infrastructure, e.g., laboratories, oceanographic ships, moorings, drifters, gliders, aircraft, and satellites that can enable continuous measurements for both short-term and long-term monitoring.
- Various regions lack long-term measurements of primary production and therefore lack long-term data to construct predictive models to estimate trends.
- Phytoplankton can play a significant role in climate regulation to undertake continuous regional measurements of phytoplankton production through carbon sequestration, which is an order magnitude higher than that provided by grasslands and forest vegetation, and also form a basis for prediction of fisheries production to address food security. For both reasons it is important to undertake continuous regional measurements of phytoplankton production, and these measurements will require improved capacity for plankton monitoring.
- There is insufficient ability to identify which species of phytoplankton are most suitable for development of bio-fuels and pharmaceuticals.
- There is insufficient abil

3.1.6 Aesthetic, cultural, religious and spiritual ecosystem services derived from the marine environment

- It is necessary to identify the priority concerns in terms of the nature of the aesthetic, cultural, religious and spiritual ecosystem services derived from the marine environment in relation to the various geographical areas, developed and developing countries, and find out how humans have adapted for their own well-being.

3.2 Assessment of the cross-cutting issues: Food security and food safety

Food security and food safety are important activities which play a crucial role in human well-being in the provisioning services category of the ecosystem services panoply. The major activities covered are capture fisheries and aquaculture, as well as scientific and socioeconomic aspects. From the gap analyses, the capacity-building needs to address are as follows:

3.2.1 Oceans and seas as sources of food

- Covering 71 per cent of the earth's surface, the oceans offer a variety of habitats for various fisheries species which are used for various competing needs: these C122 0 T0.063 Tw

3.2.4 *Fish stock propagation*

- There is insufficient capacity in aquaculture technologies which will promote efficient and effective stock propagation;

calling for the harmonization of test methods and performance standards for anti-fouling systems containing biocides presents a necessity to investigate and evaluate such methods and standards.

successfully with commercial undertakings planning to install cables in such locations, they need access to the skills in marine geology needed.

- In taking decisions on submarine cables and pipelines, States need to have the capacities to address possible competing uses of the seabed on which the cables and pipeline are laid.

3.3.4 Coastal, riverine and atmospheric inputs from land

Shortfalls were found the skills and capacities for several important disciplines, including:

- Skills and infrastructure to monitor wastes and waste

3.3.7 *Offshore mining industries*

- As in oil and gas, the major gap for this activity is the ability to undertake EIAs and monitor compliance, especially because of their remoteness; this is mainly so in developing countries.
- The offshore mining technology

- Research is insufficient to qualify and evaluate the presence of floating debris which can similarly undermine the quality of pelagic habitats; as is information on the impacts of marine debris in benthic habitats which are comparatively well studied.
- Scientific evidence and assessment efforts have not been adequate to evaluate the impacts of microplastics in the water column of the ocean.
- To date, the introduction of an alien species via marine debris has yet to be documented and there are important shortfalls in the scientific evidence of the role of marine debris in introducing alien species, especially in developing countries.
- Research, assessment, and monitoring are not sufficient to evaluate impacts of marine debris on coastal and marine species, habitats, economic health, human health and safety, and social values. Research and monitoring are insufficient to understand and in many parts of the sea, to qualify

3.3.11 *Desalinization*

- Many areas suffering from shortages of freshwater could be helped by the creation of installations for desalinization and the skills needed to maintain and manage them. This is likely to become increasingly important with changes in rainfall as a result of climate change.

3.3.12 *Use of marine genetic resources*

- Marine biodiversity is best known in areas within national jurisdiction, and it is

UNGA (2012b). *Final Report of the workshop held under the auspices of the United*