Annex II

Annotated outline for the second world ocean assessment

Note by the Joint Coordinators

1. At its tenth meeting, held on 28 February and 1 March 2018, the Ad Hoc Working Group of the Whole on the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, following discussions on the revised draft outline presented by the Joint Coordinators of the Group of Experts of the Regular Process, approved the outline for the second world ocean assessment and requested the Group of Experts to prepare an annotated outline for the second world ocean assessment for the eleventh meeting of the Working Group, to be held on 23 and 24 August 2018.[12]

2. A proper annotated outline for the second world ocean assessment can only be prepared when the writing teams for the various chapters and sections are in place and can consider how they wish to develop the various chapters within the structure of the approved outline. It would also require an opportunity for the Group of Experts to have a thorough discussion in person (similar to that which took place to develop the draft outline). Given that the preparation of an annotated outline was not foreseen beforehand, no specific meeting was included in the timetable and implementation plan for the assessment (provided to the Working Group and approved at its tenth meeting) to provide such an opportunity.

3. For the reasons explained in the report of the Joint Coordinators on the preliminary timetable and implementation plan, the assembling of writing teams is still under way for most of the chapters (there are some that have been finalized, in particular for some of the sections within chapters 6 and 7 where individual writing teams are needed). In setting up writing teams, it is important to ensure a good distribution of experts from around the world so that the situation in each ocean basin is properly covered in each chapter. Regard must also be given to gender balance.

4. Given the above need for writing team involvement, a comprehensive annotated outline therefore cannot be provided at this stage. The Group of Experts is not in a position to anticipate how the conveners and members of the writing teams will propose to develop the themes specified in the approved outline.

5. With the agreement and input of the other members of the Group of Experts, the Joint Coordinators have therefore agreed to submit the present note setting out their views as on the likely development of the outline so as to provide a basis for discussion at the eleventh meeting of the Working Group on the future development of the outline. The note is set out under the chapter and section headings specified in bold type in the approved outline, since the outline provides that these would form part of the structure of the second world ocean assessment. Not all section headings from chapters have been reproduced in the present note for brevity. The chapters, however, will definitely cover all of the fields specified in such headings, although the structure of the headings will not necessarily be followed.

6. In addition, the Group of Experts has developed a template for the chapters of the second world ocean assessment, expanding the guidance given in the initial background to the outline for the second world ocean assessment. This is contained in enclosure I. It will be revised from time to time in the light of experience gained. Moreover, the list of the lead and co-lead members for the chapters of the outline for

[12] See A/73/74.

the second world ocean assessment, also developed by the Group of Experts, is contained in enclosure II.

7. As stated in the approved outline, each chapter (or each section of each chapter), other than chapters 1–4, would include:

(a) A one-paragraph abstract of the chapter or section;

(b) A very short summary of the situation recorded in World Ocean Assessment I;

(c) A description of environmental changes between 2010 and 2020;

(d) A description of the economic and social consequences and/or of the other economic or social changes (including, where appropriate, changes in global distribution of benefits and disbenefits and issues related to concepts of natural capital);

(e) A description of the main information gaps in relation to the subject matter;

(f) A description of the main capacity-building gaps in the field.

8. Again, as set out in the approved outline, where appropriate, each chapter or section would review separately the situation in the various ocean regions (Arctic, North Atlantic, South Atlantic, Indian Ocean, North Pacific, South Pacific and Southern Ocean).

9. Finally, as set out in the approved outline, where appropriate, each chapter will contain an explicit evaluation of how the developments described in the chapter are contributing to the achievement of relevant Sustainable Development Goals. The writing team for each chapter will be asked to consider the Goals thus identified that are relevant to its chapter, and whether any further Goals need to be considered in that chapter. Chapter 1 (overall summary) will include an overview of those evaluations for all relevant Goals.

Part 1: Summary

Chapter 1: Overall summary

This chapter will be developed by the Group of Experts collectively, under the leadership of the Joint Coordinators. In particular, it will focus on issues relevant to the 2030 Agenda for Sustainable Development, including those highlighted in the technical abstract of World Ocean Assessment I relating to the 2030 Agenda.

Part 2: Introduction

Chapter 2: Approach to the assessment

Sections (a) (purpose of the assessment) and (b) (approach of the assessment) of this chapter are largely sketched out in the approved outline, some of it with full text. It will be developed to fill out the full text of the remaining parts specified in the outline.

Section (c) (further detail on the drivers-pressures-state-impact-response approach and ecosystem services) will provide an overview of the drivers-pressures-state-impact-response framework and the latest developments in the use of the framework. It will also provide an update on the understanding of ecosystem services

provided by the marine environment, building on the baselines provided in chapters 4–9 of the first assessment.

Chapter 3: Scientific understanding of the ocean

This chapter covers the fundamental basis for the rest of the assessment. In developing the chapter, consideration will be given to the first *Global Ocean Science Report*, published by the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization in 2017, and the decision of the General Assembly in December 2017 to proclaim the United Nations Decade of Ocean Science for Sustainable Development for the period 2021–2030 (resolution 72/73). The outline specifies that it should cover recent step-change improvements in understanding the ocean, including: physical and chemical properties of the ocean; ocean bathymetry; ocean circulation; effects on biota of anthropogenic noise; and sources of marine debris. In the light of the remit of the Regular Process, it will also need to consider whether there has been comparable progress in understanding economic and social aspects of the ocean.

Part 3: Drivers of changes in the marine environment

Chapter 4: Drivers

A substantial amount of work has been done on issues relating to how to define "drivers" and what is driving environmental, economic and social changes in the world's environment in the global assessment under the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. This chapter will need to take account of this work as well as other work detailing the planetary socioeconomic changes that are driving change in the marine environment. The sections included in this chapter (as approved) include:

(a) Developments in human population (especially populations in coastal areas);

(b) Development aspirations:

(i) Food security and food safety;

(ii) Resource use (including demand for metals and hydrocarbons and the use of marine genetic resources);

(iii) Energy;

(iv) Transport;

(v) Leisure and recreation;

(c) Drive to sustainability (including the Sustainable Development Goals);

(d) Cultural needs and aspirations;

(e) Contributions from improved technologies.

Part 4: Current state of the marine environment and its trends

The structure of the approved outline for the second world ocean assessment is significantly different from that of World Ocean Assessment I. This is to meet the

wishes, expressed in the first round of regional workshops, that the second assessment follow more closely the drivers-pressures-state-impact-response approach, and to provide an update on any changes to the baselines set out in the first assessment. Part 4 therefore concentrates on changes to the **state** of various aspects of the ocean, while part 5 looks at changes to key **pressures** that are leading to the changed states of those aspects.

Chapter 5: Trends in the physical and chemical state of the ocean

The sections within this chapter are well-recognized specialisms within the general discipline of oceanography, and the relevant writing teams will need to evaluate which developments in the state of these disciplines can be regarded as the "step-changes" from the baseline set out in World Ocean Assessment I, to which the approved outline refers. The potential overlaps in describing change in the physical and chemical state of the ocean with chapter 9, on the pressures from changes in the climate and associated changes since the first assessment, will need to be considered.

(a) **Sea temperature**;

(b) **Sea levels**;

(c) **Salinity**;

(d) **Ocean circulation**;

(e) **Sea ice**;

(f) **Ocean chemistry, including ocean acidification**;

(g) **Dissolved oxygen**.

Together with chapter 9, this chapter will be an appropriate place to update information on issues identified in the technical abstract of World Ocean Assessment I on the impacts of climate change and related changes in the atmosphere on the ocean.

Chapter 6: Trends in the biodiversity of main taxa of marine biota

As the approved outline provides, the biodiversity of taxa will be described in terms of abundance, distribution, productivity and diversity within the taxon. Separate writing teams will be needed for many of the sections of this chapter and it is likely that in order to consider the vast diversity of species within each taxon, each section of the chapter will need to be further subdivided on the basis of major taxonomic groups. In addition to the specific chapters on species of concern in World Ocean Assessment I, many of these taxa were described in the regional chapters of that assessment, on the seven ocean basins and the open ocean deep sea. The descriptions in the second assessment will bring together the global description with regional observations, as appropriate, in fulfilment of the guidance on regional aspects in the approved outline.

(a) **Plankton**: as in chapter 6 of World Ocean Assessment I, this section will need to consider net primary production in the ocean as well as other components of the plankton community and the various factors that are driving any changes observed from the baseline identified in the first assessment and the implications of those changes for society.

It will be for consideration whether issues such as the impact on primary production and plankton of microparticles and nanoparticles of plastic and other substances (such as titanium dioxide) are better considered here or in the chapters on

the inputs of hazardous substances and solid waste. In World Ocean Assessment I, they were considered in conjunction with primary production.

The section will also consider the state of microbes and viruses in the ocean; it is to be noted that the absence of a thorough consideration of microbes and viruses was a point of criticism of World Ocean Assessment I. It is therefore likely to be necessary to provide material on those taxa in order to give the baseline, which was missing from World Ocean Assessment I. In the regional workshop for the North Pacific, held in Palau on 8 and 9 August 2018, it was proposed that the description of "microbes and viruses" would be better as "bacteria and viruses".

(b) **Marine invertebrates**: these taxa were considered in World Ocean Assessment I in the eight regional chapters (36A-36H). This section of chapter 6 will therefore bring together the information on regional aspects of the current state of marine invertebrates in the one place. Any potential overlaps in describing change in the state of marine invertebrates in relation to the factors driving those changes to be described in chapter 15 (capture fisheries and harvesting of wild marine invertebrates) will be considered along with that chapter.

(c) **Fish**: as with marine invertebrates, this section will bring together information that was covered across the regional chapters in the first assessment. It will also be necessary for this section to include the developments in respect of sharks, other elasmobranchs, tuna and billfish, which were covered by separate chapters (chaps. 40 and 41). Again, the potential overlaps in describing change in the biodiversity of fish, particularly in relation to the factors driving those changes, with chapter 15, on the pressures from changes in capture fisheries, will need to be considered.

(d) **Marine mammals**: this section will provide an update on changes from the baselines provided in chapter 37 of the first assessment.

(e) **Marine reptiles**: this section will provide an update on changes from the baselines provided in chapter 39 of the first assessment.

(f) **Seabirds**: this section will provide an update on changes from the baselines provided in chapter 38 of World Ocean Assessment I.

(g) **Marine plants**: the state of biodiversity of marine plants was considered in chapters 47–49 and to a lesser extent in the regional chapters of World Ocean Assessment I. This section will therefore bring together the information on regional aspects of the current state of marine plants in the one chapter. The potential overlaps in describing change in the state of marine plant biodiversity with chapter 7, which contains sections on changes in the state of seagrass meadows, mangroves and salt marshes since the first assessment, will need to be considered.

(h) **Macroalgae**: in World Ocean Assessment I, the state of macroalgae was considered mainly in chapter 47, which included baselines for kelp forests and seagrass meadows. It is now intended that the broader taxa of macroalgae be included in a section of chapter 6 that is separate from other marine plants, recognizing the broader taxonomic diversity of macroalgae. The state of the floating species of *Sargassum* macroalgae will be considered with the habitat of the Sargasso Sea, given the integral contribution the species makes to that habitat.

Chapter 7: Trends in the state of biodiversity in marine habitats

As the approved outline provides, changes in the state of biodiversity in marine habitats will be described in terms of diversity, abundance, distribution and productivity and what the implications of change might mean for habitat functioning and the provision of ecosystem services. Baselines for the first four sections of this chapter were described in the eight regional chapters of World Ocean Assessment I. In the second assessment, the sections of chapter 7 will allow for changes in each of the habitats to be clearly articulated in distinct sections and, where global baselines were not provided in the first assessment, for these to be provided.

(a) **Sand and mud substrates (soft bottom)**: the potential overlaps in describing change in the state of sand and mud substrate biodiversity with other habitat sections, in particular those on island lagoons, estuaries and deltas and seagrass meadows, will need to be considered.

(b) **Rocky substrates and reefs**: the potential overlaps in describing change in the state of rocky substrate and reef biodiversity with other habitat sections, in particular the two sections on corals and the section on intertidal zones, will need to be considered.

(c) **Intertidal zone**: the potential overlaps in describing change in the state of intertidal zone biodiversity with other habitat sections, in particular that on rocky substrates, will need to be considered.

(d) **Atoll and island lagoons**: the potential overlaps in describing change in the state of atoll and island lagoon biodiversity with other habitat sections, in particular those on sand and mud substrates and tropical coral reefs, will need to be considered.

(e) **Tropical and subtropical coral reefs**: the recognized and well-reported rapid change in these habitats will need to be related to the baseline provided in chapter 43 of World Ocean Assessment I.

(f) **Cold-water corals**: this section will need to describe the developments from the baselines described in chapter 42 of World Ocean Assessment I.

The following eight sections represent an attempt to develop a more rational structure for describing coastal habitats than that provided in the first assessment. They will largely build on the baselines provided in chapters 44 and 47–49, together with part of chapter 51 (in which submarine features were described) of World Ocean Assessment I. Habitats associated with algal species have been separated from seagrass meadows and the diversity of communities associated recognized by expanding the discussion of changes in biodiversity to include algal beds as well as kelp forests. The unique communities associated with submarine canyons have also been recognized as a distinct point of discussion. The regional workshop for the North Pacific, held in Palau on 8 and 9 August 2018, suggested that the section on submarine canyons should also include continental slopes. Particular considerations for overlaps with other sections of the chapter are detailed individually.

(g) **Estuaries and deltas**: the potential overlaps in describing change in the state of estuary and delta biodiversity with sand and mud substrate and mangrove biodiversity will need to be considered.

(h) **Kelp forests and algal beds**: the potential overlaps in describing change in the state of kelp forest and algal bed biodiversity with rocky substrate and reef biodiversity will need to be considered.

(i) **Seagrass meadows**: the potential overlaps in describing change in the state of seagrass meadow biodiversity with sand and mud substrate and estuary and delta biodiversity will need to be considered.

(j) **Mangroves**: the potential overlaps in describing change in the state of mangrove biodiversity with estuary and delta biodiversity will need to be considered.

(k) **Salt marshes**: the potential overlaps in describing change in the state of salt marsh biodiversity with the intertidal zone will need to be considered.

(l) **Submarine canyons**: as noted above, the regional workshop held in Palau has proposed that this should be extended to cover the continental slopes as well.

(m) **High-latitude ice (including that over areas of open ocean)**: this section will build on the baseline provided in chapter 46 of World Ocean Assessment I. It will also need to build on the baselines provided in chapters 36G and 36H (Arctic and Southern Oceans). Outputs from the monitoring programmes of the Arctic Council and the Commission for the Conservation of Antarctic Marine Living Resources and the research programmes Integrating Climate and Ecosystem Dynamics in the Southern Ocean, Ecosystem Studies of Subarctic and Arctic Seas and that of the Scientific Committee on Antarctic Research will provide important inputs to this section.

(n) **Seamounts and pinnacles**: this section will build on the baselines provided in chapter 51 of the first assessment, as well as information provided in the regional chapters.

The following five sections represent an attempt to develop a better structure for dealing with the features of the ocean beyond the geophysical continental shelf. This revised structure is necessary to avoid the unsatisfactory situation whereby some aspects were dealt with in both chapter 36F and chapter 51 of the first assessment by different writing teams. These sections will be an appropriate place to build on the baselines and issues identified in the technical abstract of World Ocean Assessment I on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

(o) **Abyssal plains**;

(p) **Open ocean**;

(q) **Ridges, plateaus and trenches**;

(r) **Hydrothermal vents and cold seeps**: this section will build on the baselines provided in chapter 45 of the first assessment, as well as information provided in the regional chapters.

(s) **Sargasso Sea**: the Sargasso Sea is a unique ecosystem which is best studied and described as a unit. This will probably also be the best place to consider the problems of the floating mats of *Sargassum* that have been affecting both Caribbean islands and West African States.

Chapter 8: Trends in the state of human society in relation to the ocean

In World Ocean Assessment I, the aspects of human society related to the ocean were described in relation to the human activities that have an impact on the marine environment. In contrast to this, the approved outline requires a survey of the state of human society under four headings. These will build on the baselines provided across a number of themes that are described in various chapters of World Ocean Assessment

I. Identifying the changes in states associated with the four sections of this chapter will provide a more coherent picture of the socioeconomic and cultural aspects of the marine environment. Overlaps and synergies with other chapters of the second assessment (for example, those dealing with pollution and hazardous substances, shipping and fisheries) will need to be considered. Currently, the Pool of Experts contains experts identified as having expertise across the four sections of this chapter, but may not yet contain a sufficient range of experts to deal with this chapter.

(a) **Coastal communities**, including the coastal population, the size of coastal communities, their wealth or income and their vulnerability and adaptability to and dependency on the ocean (including dependence on, and engagement with, marine resources).

This section would bring together important aspects of the way in which human communities relate to the ocean. In World Ocean Assessment I, these aspects are scattered across a number of chapters and therefore do not present a coherent picture.

(b) **Human health as affected by the ocean**, including the health of coastal communities relative to inland communities, the effects of exposure to contaminated seawater, the scale of beach closures for health reasons and the extent to which food resources available from the sea create health problems through the content of hazardous substances (including metals, microplastics and nanoparticles) and pathogens in them.

This section would largely update various sections of chapter 20 (land-based inputs) of World Ocean Assessment I but would also expand some of the material in chapter 6 of that assessment (primary production).

(c) **Maritime industries**, including their economic performance, the role of freight transport in international trade, the role of ferries and coastwise shipping in internal transport, recruitment of workers, the proportion of their workers who are women, the rates of death of, and injury to, their workers, the protection of their working conditions, their levels of pay, maritime security, human trafficking, forced labour, which has also been referred to as “modern slavery”, smuggling, access to markets and handling facilities for fisheries produce and the proportion of fisheries that are artisanal, culture-related or conducted by indigenous peoples.

This section will describe developments in relation to a number of issues related to maritime industries discussed in various chapters of World Ocean Assessment I, including the social aspects of fisheries (chap. 15), fishing vessels (chap. 17), maritime transport (chap. 17) and the coastal infrastructure and social aspects of tourism industries (chap. 27).

(d) **Maritime cultural services**, including the extent to which marine cultural resources are conserved, support for cultural activities linked to the sea, and the scale of use of objects from the sea that are valued for cultural reasons.

This section would update most of the material in chapter 8 of World Ocean Assessment I (aesthetic, cultural, religious and spiritual ecosystem services derived from the marine environment).

Part 5: Trends in pressures on the marine environment

The approved outline provides that each chapter or section in this part should include discussion of: (a) the impacts both on marine biota and habitats and on humans; (b) management measures (both adaptive and mitigatory) taken in response; and (c) the interplay between all terrestrial ecosystems (including mountain, hill, lowland and coastal ecosystems) and the ocean.

Chapter 9: Pressures from changes in climate and atmosphere

This chapter has clear linkages with chapter 5, where the state of the physical and chemical aspects of the ocean will be detailed. The potential overlaps and synergies between the two chapters will need to be considered as a result. While pressures that have an impact on the physical and chemical state of the ocean were not dealt with in a specific chapter in the first assessment, some aspects were detailed in chapters 4 and 5 of that assessment. The special report of the Intergovernmental Panel on Climate Change on the oceans and cryosphere will be prepared in parallel to the second world ocean assessment (it is due to be completed in September 2019). The next regular report of the Panel (sixth assessment report) will not be completed until the first half of 2022. This chapter will therefore need to follow the Panel's material as it is produced, relying on the relevant literature rather than directly on reports of the Panel. In addition, the outputs from the eighteenth meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, held in 2017, which focused its discussions on the topic "Effects of climate change on the oceans", will be informative for this chapter. This chapter will also be an appropriate place in which to update information on issues identified in the technical abstract of World Ocean Assessment I on the impacts of climate change and related changes in the atmosphere on the ocean. This chapter will comprise the following sections:

(a) **Physical properties of the ocean**, including changes in circulation and factors driving circulation, such as heat and stratification;

(b) **Ocean chemistry**, including salinity, carbon and nutrient cycling and ocean acidification;

(c) **Extreme climate events**, including changes in the interplay between climate change and natural climate phenomena.

Chapter 10: Changes in inputs to the marine environment of nutrients

This chapter will build on the baselines provided in chapter 20 of World Ocean Assessment I, which included a regional survey of what was known at the time about nutrient inputs and their effects. This may include outputs from new regional assessments reportedly being conducted by regional seas organizations in the eastern Indian Ocean and the South-East Pacific, as well as from regions with established monitoring systems.

Chapter 11: Changes in liquid and atmospheric inputs to the marine environment from land (including through groundwater), ships and offshore installations

This chapter will provide an update on the baselines provided in chapter 20 of World Ocean Assessment I. It also brings together updates on baselines relating to offshore installations (which were detailed in chapter 21) and shipping (which were detailed in chapter 17) into the one chapter, in order to provide a more comprehensive overview of changes in liquid and atmospheric inputs. Given the specificities associated with each of the sections within this chapter (listed below), separate writing teams may be needed to provide an update on each section.

(a) **Persistent organic pollutants**;

(b) **Metals**;

(c) **Radioactive substances (including naturally occurring radioactive material)**;

(d) **Personal care products, pharmaceuticals and nutraceuticals**;

(e) **Atmospheric pollutants**;

(f) **Hydrocarbons**;

(g) **Other substances used on, and discharged from, offshore installations**;

(h) **Distribution of, and trends in, contaminant concentrations**.

Chapter 12: Changes in inputs and distribution of solid waste in the marine environment (other than dredged material)

This chapter will provide an update to the baselines provided in chapter 24 of World Ocean Assessment I, dealing with the regular use of the ocean as a place for the disposal of solid waste. However, there is a partial and declining fulfilment of reporting obligations under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, and the 1996 Protocol thereto. Without better reporting, the second world ocean assessment will have difficulty in dealing with this aspect of this chapter.

This chapter will also provide an update to the baseline provided in chapter 25 (marine debris) of World Ocean Assessment I. The input of plastics (including microplastics and nanoplastics) into the marine environment has become a much more high-profile issue than it had been when that chapter was written. The chapter will cover activities resulting in marine debris, including plastics, abandoned fishing gear, microparticles and nanoparticles, and estimates of the sources from land, ships and offshore installations. It will draw on associated research on developing regional and global baselines. The outputs from the seventeenth meeting of the Informal Consultative Process, held in 2016, which focused its discussions on the topic "Marine debris, plastics and microplastics", will be informative for this chapter.

Chapter 13: Changes in erosion and sedimentation

This chapter will provide an update to baselines provided in chapter 26 (land/sea interaction) of World Ocean Assessment I. It has become increasingly clear that the management of inland areas (particularly in relation to forest clearance and the creation of dams) can have a significant impact on the marine environment through the increase or reduction in the sediment carried by watercourses to the sea. The absence of, or the increase in, the replenishment of sediment can significantly affect the coastal zone and its environment. Overlaps and synergies with chapter 9, particularly in association with changes in sea level and the intensity of storm events, will need to be considered.

Chapter 14: Changes in coastal and marine infrastructure

This chapter will provide an update to baselines provided across several chapters of World Ocean Assessment I, including chapter 18 (ports), chapter 19 (submarine cables and pipelines), chapter 26 (land/sea interaction) and chapter 27 (tourism and recreation). Bringing together content dispersed across these chapters in the first assessment will provide a coherent and comprehensive picture of the pressure

that developments in marine infrastructure are exerting on the marine environment. Specifically (as approved), the chapter will cover:

- Amounts of land reclaimed from the sea
- Extent of new land defences against the sea, and extent of sea defences abandoned
- Extent of coastal development, including development for tourism
- Other adaptations affecting coastal populations as a result of sea level rise
- Changes in port installations and their management, including dredging
- Changes in submarine cables and submarine pipelines.

Chapter 15: Changes in capture fisheries and harvesting of wild marine invertebrates

This chapter will build on the baselines provided in part IV of World Ocean Assessment I, which gave an overview of the situation with regard to food security and food safety in relation to food from the sea. This chapter is intended to update that overview in relation to levels of catches of fish, shellfish and other invertebrates, both within and beyond areas of national jurisdiction, and through commercial fisheries, artisanal (otherwise called small-scale) and subsistence fisheries. The Joint Coordinators consider that this should include more detail on the situation in the different ocean basins; part IV of the first assessment concentrated mainly on the global picture, and there is a need to update information on fisheries and harvesting included in the regional chapters of the first assessment in order to capture regional specificities.

This chapter will also need to consider the levels of by-catch and other impacts on vulnerable marine ecosystems and benthic ecosystems, the levels of post-harvest loss, the levels of fish-stock propagation and the use of marine protein in agriculture and aquaculture. It will also need to review estimated levels of illegal, unregulated and unreported fisheries and the levels of non-food harvesting (for example, for feedstocks for terrestrial stock-rearing). Given the broad range of fisheries and harvesting practices, a number of writing teams dealing with specific components of the chapter may be needed.

Chapter 16: Changes in aquaculture

Aquaculture (including mariculture) is a fast-growing activity within the marine environment. This chapter will need to update the baseline information in chapter 12 of World Ocean Assessment I.

Chapter 17: Changes in seaweed harvesting and use

This chapter will need to update the information in chapter 14 (seaweeds) of World Ocean Assessment I. The overview of the state of marine macroalgae will be dealt with in chapter 6H, as explained above. This chapter will therefore need to focus specifically on human uses of seaweed.

Chapter 18: Changes in desalinization and in the production of sea salt

Chapter 28 of World Ocean Assessment I reviewed the use of the desalinization of seawater to provide freshwater and showed the importance of this process for the Gulf States and some islands such as Malta, Okinawa, Japan, and Singapore. No experts in this field have yet been appointed to the Pool of Experts. This chapter will also need to update the material in chapter 8 of World Ocean Assessment I on marine salt production.

Chapter 19: Changes in seabed mining

This chapter will update chapter 23 (offshore mining) of World Ocean Assessment I. It will be important for the writing team for the chapter to consider updates in information from countries where mining within areas of national jurisdiction is significant, particularly in the "tin belt" in South-East Asia and where mining in areas beyond national jurisdiction is starting.

Chapter 20: Changes in hydrocarbon exploration and extraction

This chapter will provide an update to chapter 21 of World Ocean Assessment I. Issues relating to discharges and noise from this sector will now be dealt with in the chapters relating to those issues. It will be necessary for the decommissioning of offshore installations that have reached the end of their useful life to be considered in more detail in this chapter, since this issue will become more significant as more offshore oilfields and gas fields reach the end of their productive lives.

Chapter 21: Trends in inputs of anthropogenic noise to the marine environment

Inputs of anthropogenic noise into the marine environment were only considered in the first assessment under the chapters dealing with shipping and offshore hydrocarbon industries. Noise inputs are derived from many more sources than those two sectors. There has been an explosion in information on the measurement of inputs and their associated impacts over the past two decades, together with improved understanding of effects across all species (see chap. 3). This chapter will therefore provide the opportunity to give a more comprehensive and coherent treatment of this pressure. Global baselines will be provided for those aspects for which they were not provided in the first assessment. The outputs from the nineteenth meeting of the Informal Consultative Process, which focused its discussions on the topic "Anthropogenic underwater noise", will be informative for this chapter.

Chapter 22: Developments in renewable energy sources

This chapter will provide an update to material dealing with renewable energy sources in chapter 22 (other marine-based energy industries) of World Ocean Assessment I. Currently, the Pool of Experts, although containing a number of experts with expertise in renewable energy sources, does not cover the whole spectrum of renewable energy technologies and their environmental and economic impacts.

Chapter 23: Developments in marine transportation

This chapter will provide an update to the baselines provided in chapter 17 (shipping) of World Ocean Assessment I. Some of the baselines provided in that chapter (for pollution, noise, and economic and social aspects) will be included in chapter 8C (maritime industries), chapter 10 (nutrient inputs from ships' sewage), chapter 11 (land-based inputs other than nutrients), chapter 21 (noise) and chapter 25 (invasive species).

Chapter 24: Developments in tourism and recreation activities

This chapter will provide an update to the baselines provided in chapter 27 (tourism and recreation) of World Ocean Assessment I. Some aspects of that chapter will be considered elsewhere in the second world ocean assessment, especially the employment aspects in chapter 8 and tourist infrastructure in chapter 14.

Chapter 25: Invasive species

Invasive species were only dealt with in chapter 17 (shipping) of World Ocean Assessment I, in which they were discussed in relation to their transport by shipping and the resulting distribution of invasive species. This chapter will allow for a more comprehensive discussion of current understanding on marine invasive species, including transport in ballast water and on ships' hulls, the drivers of their distribution and establishment and their impacts on ecosystems.

Chapter 26: Developments in exploration and use of marine genetic resources

Chapter 29 (use of marine genetic resources) in World Ocean Assessment I explained the background to the exploration and research into the use of marine genetic resources, but noted that (the considerable potential in this field notwithstanding) there was only limited success in applying them to practical uses. This chapter will update the baseline provided in that chapter and will consider the current discussions on aspects of the use of marine genetic resources in the negotiations on an international instrument on biodiversity in areas beyond national jurisdiction.

Chapter 27: Marine hydrates — a potentially emerging issue

Investigations have shown that there are large amounts of marine hydrates (compounds of methane and water) forming in the marine environment, and that they have the potential to provide new energy sources. However, their decomposition and release can lead to a decrease in the stability of the seabed and significant increases in methane contributions to greenhouse gases. At present, the constraints of pressure and temperature prevent them both from being released and from being an economically viable prospect for extraction. Changes in ocean temperatures associated with climate change have the potential to relax those constraints. This chapter will cover this topic for the first time and therefore will need to provide a baseline on current understanding of and outlooks for their potential release and use.

Chapter 28: Cumulative impacts

It is increasingly being acknowledged that the management of marine environments needs to be integrated in such a way as to quantify and manage the cumulative nature of impacts from the multiple sectors utilizing marine environments (economic, social and cultural). Coverage of this topic in the first assessment was limited and dispersed across some of the regional chapters and some of the summary chapters (for example, chapter 54). Much research has been conducted on this theme in the past decade. This chapter therefore needs to summarize this research and provide a comprehensive baseline on current understanding, particularly of approaches to quantifying impacts across sectors and jurisdictions and outputs of those assessments.

Part 6: Trends in management approaches to the marine environment

World Ocean Assessment I did not contain a discussion of management approaches in general to the marine environment, partly because of the instruction not to carry out any policy analysis. However, it is clear that many of the frameworks and approaches that have been developed for the management of human activities in the ocean are relevant to the ocean assessment and there is merit in identifying these and ongoing developments in the science associated with the varying approaches. It is therefore appropriate to consider current understanding associated with the various management approaches aimed at limiting or mitigating pressures from human activities on the ocean.

Chapter 29: Developments in marine spatial planning

The techniques of marine spatial planning are increasingly being applied by many countries within their national jurisdiction. This chapter will provide a baseline of current approaches in the spatial planning of human activities. The outputs from the marine spatial planning programme of the Intergovernmental Oceanographic Commission, as well as the various regional programmes (for example, under the International Council for the Exploration of the Sea) will inform this chapter. This chapter will need to review the various techniques that are being used for this purpose in the context of the various national legal structures in order to demonstrate the crucial questions that need to be considered if marine spatial planning is to be applied.

Chapter 30: Developments in management approaches

In addition to marine spatial planning, which is important in reconciling potential conflicts between different sectors, a range of management approaches is being applied within and across sectors in the marine environment, aimed at ensuring that uses of the marine environment are sustainable. This chapter will provide a baseline of management approaches and frameworks, current research associated with the development of particularly integrated approaches to management and their regional application. Specifically (as approved), the chapter will cover:

- Ecosystem-based management approaches
- Culturally-based management approaches
- Community-based management approaches

- Area-based management tools, including marine protected areas and special areas (such as special areas under the International Convention for the Prevention of Pollution from Ships and Particularly Sensitive Sea Areas)
- Adaptation to climate change and resilience-building.

Chapter 31: Developments in the understanding of overall benefits from the ocean to humans

This chapter will provide an update to the baselines provided in chapter 55 (overall value of the ocean to humans) of World Ocean Assessment I, including the distribution of those benefits and the role in safeguarding those benefits of improved implementation of international law as reflected in the United Nations Convention on the Law of the Sea. In particular, the chapter will provide an update on current understanding of the services provided by the ocean, economic valuation of those services and any developments associated with preserving and enhancing those benefits, including implementation of international law as reflected in the Convention.