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Item 6.2 of the provisional agenda*

REPORT OF THE EXPERT MEETING TO DEVELOP A SERIES OF JOINT EXPERT REVIEW PROCESSES TO MONITOR AND ASSESS THE IMPACTS OF OCEAN ACIDIFICATION ON MARINE AND COASTAL BIODIVERSITY

INTRODUCTION

1. At its tenth meeting, the Conference of the Parties to the Convention on Biological Diversity expressed its serious concern that increasing ocean acidification, as a direct consequence of increased carbon dioxide concentration in the atmosphere, reduces the availability of carbonate minerals in seawater, important building blocks for marine plants and animals (decision X/29). The Conference of the Parties also took note that many concerns exist regarding the biological and biogeochemical consequences of ocean acidification for marine and coastal biodiversity and ecosystems, and the impacts of these changes on oceanic ecosystems and the services they provide, for example, in fisheries, coastal protection, tourism, carbon sequestration and climate regulation, and that the ecological effects of ocean acidification must be considered in conjunction with the impacts of global climate change.

2. In paragraph 2 of decision X/13 on new and emerging issues, the Conference of the Parties also recognized that the issue of ocean acidification meets the criteria set out by the Conference of the Parties for consideration as a new and emerging issue, and requested the Subsidiary Body on Scientific, Technical and Technological Advice to consider the impacts of ocean acidification on marine biodiversity and habitats as part of the ongoing activities under the programme of work on marine and coastal biological diversity.

3. The Conference of the Parties adopted, in decision X/2, the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets, including target 10: *By 2015, the multiple anthropogenic pressure on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.*

4. In decision X/29, the Conference of the Parties requested the Executive Secretary to develop, in collaboration with the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC–UNESCO), the Food and Agriculture Organization of the United Nations (FAO), the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), the World Conservation Monitoring Centre of the United Nations Environment Programme (UNEP-WCMC), the International Coral Reef Initiative (ICRI), Ramsar Convention, Antarctic Treaty, the

* UNEP/CBD/SBSTTA/16/1.

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Arctic Council, and other relevant organizations and scientific groups, subject to the availability of financial resources, a series of joint expert review processes to monitor and assess the impacts of ocean acidification on marine and coastal biodiversity and widely disseminate the results of this assessment in order to raise awareness of Parties, other Governments and organizations, and also requested the Executive Secretary, given the relationship between atmospheric carbon dioxide concentration and ocean acidification, to transmit the results of these assessments to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC).

5. Pursuant to the above request and with financial support from the Government of Spain, the Executive Secretary convened an Expert Meeting to Develop a Series of Joint Expert Review Processes to Monitor and Assess the Impacts of Ocean Acidification on Marine and Coastal Biodiversity, from 19 to 20 October 2011. The meeting was held at the office of the Secretariat of the Convention on Biological Diversity (SCBD), in Montreal.

6. The meeting was attended by experts from Australia, Canada, Cuba, Fiji, France, Japan, Mozambique, Norway, the United Kingdom of Great Britain and Northern Ireland, the Arctic Institute of North America (AINA) and the Coastal and Marine Union (EUCC), the Belgian Federal Science Policy Office (BELSPO), the Centre de Recherches Insulaires et Observatoire de l'Environnement–Institut des Récifs Coralliens du Pacifique (CRIOBE-IRCP), the European Project on Ocean Acidification (EPOCA), the Intergovernmental Oceanographic Commission of UNESCO (IOC–UNESCO), the National Oceanic and Atmospheric Administration (NOAA), and SeaWeb. A SBSTTA Bureau member also attended the meeting, upon the request of the SBSTTA Bureau. The full list of participants is attached as annex I below.

ITEM 1. OPENING OF THE MEETING

7. On behalf of the Executive Secretary of the Convention on Biological Diversity, Mr. David Cooper opened the meeting at 9 a.m. on Wednesday, 19 October 2011. He welcomed the meeting participants and thanked the Government of Spain for contributing the resources needed to convene this expert meeting and to undertake a background study on ocean acidification, submitted as an official document to the meeting (UNEP/CBD/EM-OAMCB/1/2, available at http://www.cbd.int/doc/meetings/mar/emioamcb-01/official/emioamcb-01-02-en.pdf). He also thanked IOC–UNESCO and its Executive Director, Ms. Wendy Watson-Wright, for their collaboration in the meeting preparation. Mr. Cooper highlighted the Aichi Biodiversity Targets as set out in the Strategic Plan for Biological Diversity 2011-2020, including target 10, cited in paragraph 3 above. He highlighted the challenges faced in empowering countries to effectively address the threats of ocean acidification, recognized the expertise of the participants and expressed his expectation of a positive outcome of this meeting.

8. The representative of IOC–UNESCO, Ms. Kathy Tedesco, also welcomed the participants and expressed her gratitude for having been invited to contribute to this important process. She acknowledged the ongoing cooperation between IOC–UNESCO and the Secretariat of the Convention on Biological Diversity, including on marine spatial planning and marine protected areas. She provided technical information pertaining to ocean acidification and discussed the dissemination of relevant information to policymakers. She also informed participants about the outcomes of the Monaco Symposium, and of a UN-Oceans side-event on ocean acidification to be held during the seventeenth meeting of the Conference of the Parties to the UNFCCC. She concluded by saying that IOC–UNESCO was dedicated to the issue of ocean acidification and was looking forward to a successful workshop.

ITEM 2. ELECTION OF THE CO-CHAIRS, ADOPTION OF THE AGENDA AND ORGANIZATION OF WORK

9. After a brief self-introduction, Mr. Yukihiro Nojiri (Japan) and Mr. Stephen Widdicombe (United Kingdom) were elected as meeting Co-Chairs based on proposals from Mr. Jean-Pierre Gattuso (France), which were seconded by Ms. Sophia Johannessen (Canada).

10. The meeting Co-Chairs nominated Ms. Sophia Johannessen, Mr. Kristian Teleki and Ms. Nicola Barnard as rapporteurs for the plenary session, taking into consideration their expertise and experience, in consultation with the Secretariat of the Convention on Biological Diversity.

11. On behalf of the Secretariat, Ms. Jihyun Lee provided the background to the meeting, highlighting relevant decisions of the Conference of the Parties on the issue of ocean acidification and its impacts on marine and coastal biodiversity, including decisions IX/20, X/2, X/13 and X/29, and described the objectives and the expected outputs of the meeting.

12. Participants were then invited to consider the provisional agenda as contained in document UNEP/CBD/EM-IOAMCB/1/1 and the proposed organization of work as contained in annex II of document UNEP/CBD/EM-IOAMCB/1/1/Add.1, and adopted them without any amendments.

13. All of the agenda items were discussed in plenary sessions.

ITEM 3. IDENTIFY GAPS AND BARRIERS IN EXISTING MONITORING AND SCIENTIFIC ASSESSMENT OF THE IMPACTS OF OCEAN ACIDIFICATION ON MARINE AND COASTAL BIODIVERSITY IN TERMS OF THEIR LINKAGES TO RELEVANT GLOBAL POLICY PROCESSES

14. The meeting participants shared, through the theme presentation and open discussion, their global, regional and national experiences on existing monitoring and scientific assessment of the impacts of ocean acidification on marine and coastal biodiversity.

15. Mr. Kristian Teleki and Ms. Nicola Barnard provided a theme presentation on this agenda item based on the background study undertaken, as contained in UNEP/CBD/EM-IOAMCB/1/2. A summary of their presentation is provided in annex II below.

16. Participants then discussed and identified gaps and barriers in existing monitoring and assessments in terms of their linkages to relevant global policy processes. The results of this plenary discussion are contained in annex III.

ITEM 4. DEVELOP OPTIONS FOR ADDRESSING IDENTIFIED GAPS AND BARRIERS, INCLUDING A PROPOSAL FOR THE DEVELOPMENT OF A SERIES OF JOINT EXPERT REVIEW PROCESSES

17. The participants shared, through the theme presentation and open discussion, their views and suggestions on developing options for addressing identified gaps and barriers in existing monitoring and assessments in terms of their linkages to relevant global policy processes.

18. Mr. Jean-Pierre Gattuso provided a theme presentation on this agenda item. A summary of his presentation is provided in annex II.

19. Ms. Kathy Tedesco provided a presentation on the perspectives of IOC–UNESCO on this agenda item. The summary of her presentation is provided in annex II.

20. Ms. Jihyun Lee provided a presentation on the perspectives of the Secretariat of the Convention on Biological Diversity on this agenda item. The summary of her presentation is provided in annex II.

21. The participants considered a proposal for the development of a series of joint expert review processes, as called for by the Conference of the Parties in paragraph 66 of decision X/29, taking into account its relevance to the work of relevant organizations and scientific groups. The results of the plenary discussion on this agenda item are contained in annex IV.

ITEM 5. IDENTIFY NECESSARY COLLABORATION ACTIVITIES TO IMPLEMENT POSSIBLE OPTIONS FOR ADDRESSING IDENTIFIED GAPS AND BARRIERS

22. The participants identified, through the theme presentation and open discussion, necessary collaboration activities to implement options for addressing identified gaps and barriers in existing monitoring and assessments in terms of their linkages to relevant global policy processes, taking into account its relevance to the work of relevant organizations and scientific groups.

23. Mr. Yukihiro Nojiri provided a theme presentation on this agenda item. The summary of his presentation is provided in annex II.

24. Mr. Kristian Teleki also provided a presentation, highlighting possible ways to facilitate international collaboration on addressing the issue of ocean acidification. The summary of his presentation is provided in annex II.

25. The results of the plenary discussion are contained in annex V.

ITEM 6. OTHER MATTERS

26. Under this item, the participants articulated possible elements for guidance to Parties on practical responses and solutions to ocean acidification.

27. The results of the plenary discussion are contained in annex VI.

ITEM 7. ADOPTION OF THE REPORT

28. Participants considered and adopted the report of the meeting on the basis of a draft report prepared and presented by the Co-Chairs.

ITEM 8. CLOSURE OF THE MEETING

29. The Co-Chairs thanked all participants for their valuable contributions, rapporteurs for their excellent support in preparing the draft report, and the Secretariat staff for their hard work in servicing the meeting.

30. The meeting was closed at 5 p.m. on Thursday, 20 October 2011.

Annex I

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Annex II

SUMMARY OF THEME PRESENTATIONS

Agenda item 3

Kristian Teleki and Nicola Barnard (Resource Persons)

Kristian Teleki and Nicola Barnard gave a presentation on "Linking Ocean Acidification to Global Policy: Gaps and Barriers". They indicated that ocean acidification research was a rapidly advancing field of study, with most work having been conducted since 2004. They pointed out that their discussion would be based mainly on the areas requiring further research. These areas included high-latitude regions, which were particularly susceptible naturally and had been the subject of limited research; deep-sea environments, about which little was known but where profound changes were expected—cold-water corals had been the earliest casualties; upwelling regions; estuaries, which were prone to the effects of acidification because they were shallow and had naturally low levels of salinity and alkalinity, and because they were important for ecosystem services; and coral reef ecosystems, which, given their calcareous structure, were particularly susceptible. They also highlighted some compounding factors, including the variable and complex responses of marine organisms and the fact that best practices for monitoring, although developed, had not yet been widely adopted. They indicated that a key challenge was that given the rapid rates of change, the scientific community had had limited resources and time to develop solutions and that there had been limited uptake in policy and stakeholder groups, despite the need.

They pointed to future priorities for ocean acidification research such as the need for long-term experiments, as opposed to the short-term nature of most research thus far; multi-stressor experiments; understanding life history stages; moving from species-specific experiments to looking at community responses; making a link to social sciences and socio-economic impacts, such as the consequences for human societies and the imperative to develop adaptation responses; a coordinated global monitoring effort, such as an international ocean acidification observation network (as proposed by Richard Feely of NOAA); improving access to common resources and facilities and reducing redundancy; training scientists to recognize and respond to threats posed by ocean acidification; the need to strengthen research, scientific and oceanographic capacities as well as policy and socio-economic institutions; and more effective communication of ocean acidification science.

As they moved to the subject of responses and "solutions", they pointed out that reduction of carbon emissions was at the top of the list and went on to look at ways to "buy time", or to manage for resilience and adaptation, such as the establishment of marine protected areas and other ways to reduce stresses and improve resilience of marine organisms. They went on to discuss policy integration at the global and regional levels and noted that the Convention on Biological Diversity was the only entity making this connection. They pointed out that the issue of ocean acidification was not adequately addressed under current discussion on climate change within the framework of UNFCCC. Nor was the issue being discussed thoroughly by the United Nations General Assembly, the United Nations Convention on the Law of the Sea (UNCLOS) and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), though OSPAR was encouraging its states to take more of an interest.

They observed that at the national level, key channels were not always accessed. They noted that national biodiversity strategies and action plans, produced by Parties to the Convention on Biological Diversity, could tie into issues of resiliency; some countries had integrated ocean acidification into their national climate change adaptation strategies. Some national legal mechanisms and strategies were making great advances, and there were a number of precursors to national strategies in the United Kingdom, Australia, Germany and Japan.

Finally, they identified some barriers to mainstreaming, such as the fact that mechanisms to consider new scientific knowledge on ocean acidification were not yet well developed. They pointed to indications that there was a great thirst for this knowledge and a need for clear conduits from scientists to policymakers. They also noted that the impacts of ocean acidification had not been adequately communicated to the sectors likely to be the most affected and that the heterogeneity of effects needed to be better communicated—for example, most stakeholder groups, such as fishers, were interested in the impacts of changes in ocean chemistry, even more than that of ocean temperature. They noted that good work had been done in North America and Europe but not in the developing world—areas that would be severely impacted—and that local work on ocean acidification was not necessarily being recorded.

They noted that the Convention on Biological Diversity could act as a much-needed bridge between the scientific community and society, and pointed to the great many briefing documents on the subject—indicating a great duplication of efforts and the need for better coordination and linkages to policy fora. They raised the question of whether the issue should be linked to climate change or whether it should be an issue discussed on its own—a point that was taken up in subsequent discussions.

Agenda item 4

Jean-Pierre Gattuso (Laboratoire d'Océanographie, CNRS-UPMC, France)

To help address the gaps and barriers, Mr. Jean-Pierre Gattuso delivered a presentation entitled "Ocean Acidification: Knowns, Unknowns and Perspectives". He indicated that 15 declarative statements on ocean acidification had been developed and evaluated by an expert group using guidance notes for Intergovernmental Panel on Climate Change (IPCC) report authors on dealing with uncertainties.[1] There were two metrics that the expert group used to evaluate these statements: the level of evidence (from limited to robust) and the level of confidence (from very low to very high). These statements were categorized into three main areas: chemical aspects, biological and biogeochemical responses, and policy and socio-economic aspects. Mr. Gattuso proceeded to provide details on and context for each of the three areas.

a. ***Chemical aspects*****:** Five areas relating to the chemical aspects of ocean acidification were thought to have a robust level of evidence and high confidence associated with them: that (1) ocean acidification had occurred in the past; (2) ocean acidification was in progress; (3) ocean acidification would continue at a rate never encountered in the past 55 million years; (4) future ocean acidification rates and impacts depended on emission pathways; and (5) the legacy of historical fossil fuel emissions on ocean acidification would be felt for centuries.

b. ***Biological and biogeochemical responses:*** Ocean acidification would adversely affect calcification (medium evidence as some calcifying organisms did not respond to ocean acidification, and the level of confidence was high); ocean acidification would stimulate photosynthetic carbon fixation (medium evidence and high confidence levels); ocean acidification would stimulate nitrogen fixation (medium evidence and confidence level); some species or strains were tolerant to ocean acidification (robust evidence and very high confidence); some taxonomic groups would be able to adapt to ocean acidification (evidence is low); ocean acidification would change the composition of communities (robust evidence and high confidence); ocean acidification would impact on food webs and high trophic levels (evidence was low especially as this was a difficult issue to assess with complex implications on food web structure which were largely unknown); and ocean acidification would have biogeochemical consequences at the global scale (medium evidence and confidence).

c. ***Policy and socio-economic aspects*****:** "there will be socio-economic consequences" and "an ocean acidification threshold that must not be exceeded can be defined" both had low to no evidence, which precluded any confidence being associated with them.

[1] www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf.

d. ***Summary*:**

- Chemical effects: there was robust evidence and high degree of certainty;
- Biological and ecological effects: overall much less certain;
  - Calcification, primary production, nitrogen fixation and biodiversity would be altered but with an unknown magnitude;
  - Some biological and ecological effects would not be able to be assessed;
- Biogeochemistry, society and the economy might change—whether this would be significant or not was also unknown.

Mr. Gattuso further highlighted and underscored that there were particular systems that were at risk from ocean acidification, including polar areas, deep-sea environments, coral reefs and near-shore marine ecosystems. He noted that when ocean acidification was added to existing local stressors in these systems, the interactions and potential impacts became extremely complex. To communicate the ocean acidification science and the issues previously mentioned, he noted that there had been considerable efforts through a number of statements, summaries and declarations made by a range of organizations and initiatives that had been aimed at policymakers, such as the Royal Society report on ocean acidification (2005). In response to addressing policy gaps and mainstreaming the ocean acidification science, EPOCA established the Reference Users Group (RUG), which represented various international representatives of stakeholder groups and had been integral in providing briefing documents and in advancing ocean acidification at various international fora.

Kathy Tedesco (IOC–UNESCO)

Ms. Kathy Tedesco informed the meeting of ocean acidification–relevant activities in which IOC-UNESCO was directly involved. She noted that as part of UN-Oceans' coordination mechanism, IOC-UNESCO would facilitate the organization of an ocean acidification side-event at the seventeenth session of the Conference of the Parties to UNFCCC (COP 17) in Durban, South Africa on 6 December 2011. The event format would be a moderated panel conveying an understanding of ocean acidification, its economic implications, its impacts on small island developing States, and the perception and communication of ocean acidification to the general public. IOC (with the International Maritime Organization, the Food and Agriculture Organization of the United Nations, and United Nations Development Programme) was preparing an inter-agency paper, towards the preparation of the United Nations Conference on Sustainable Development, entitled "A Blueprint for Ocean and Coastal Sustainability", which contained proposals for ten areas or themes considered to be critical, including ocean acidification.

Ms. Tedesco concluded by announcing the Third International Symposium on the Ocean in a High-CO_2 World, being held in Monterey, United States of America, from 24 to 27 September 2012. The international organizing committee was planning three days of scientific meetings and a fourth day focused on policy matters, which would be attended by policymakers. Details were on the meeting website (http://www.ocean-acidification.net/).

Jihyun Lee (Secretariat of the Convention on Biological Diversity)

Ms. Jihyun Lee delivered a presentation on developing a series of joint expert review processes to address the gaps and barriers identified in agenda item 3. She indicated that the final chapter of the background document provided for this meeting highlighted key elements to be considered under this agenda item, namely the effective transmission of emerging scientific information to Parties and the coordinated improvement of global understanding and knowledge-sharing on ocean acidification. She highlighted the need to develop indicators and clear guidance on how Parties could achieve mainstreaming and integration of scientific knowledge on ocean acidification in their own national biodiversity strategies and action plans (NBSAPs), as well as in strategies for local integrated coastal management and for marine protected areas. She explained the role of the Secretariat of the Convention on Biological Diversity as a potential collaborator to increase synergies among international policymaking processes and scientific groups, including through the Convention national focal points and partners at global, national and regional levels. She then gave explanations to participants on the process of the Convention and its

linkages with global partners. She concluded by outlining the aspects in which the Secretariat required guidance from the expert meeting regarding the joint expert review process: (1) who would participate (nominations through the Convention/IOC, terms of reference, Co-Chairs); (2) how often the experts would meet (aligning with the regular meeting cycle of SBSTTA and the Conference of the Parties, inter-sessional activities); and (3) what kind of outputs were required to report to SBSTTA and the Conference of the Parties.

Agenda item 5

Yukihiro Nojiri (Japan)

Mr. Yukihiro Nojiri, principal senior researcher for the Center for Global Environmental Research at the National Institute for Environmental Studies in Japan, delivered a comprehensive presentation concerning the identification of collaboration activities to implement possible options for addressing identified gaps and barriers in the context of ocean acidification. He stressed that the aggregate impact of ocean acidification for coasts and open ocean systems could be large in terms of globally integrated impact, for which research work was not sufficient.

During his presentation, Mr. Nojiri presented four representative concentration pathways (RCPs) prepared for the IPCC fifth assessment report, going from a lowest RCP scenario, peaking at 490 ppm (parts per million CO_2 equivalent) before 2100 and then declining, to an extreme future RCP scenario, exceeding 1370 ppm. He then presented more conceptual thoughts about the impact of temperature increase and presented evidence for detection of ocean acidification of some sensitive species, such as bivalve larvae. The detection level of ocean acidification was presently felt at the species level but could have profound impacts on marine ecosystems in the future. He stressed that the impacts of climate change could affect major sectors of global systems like water, ecosystem, food, coasts and health, but noted that the comparison with the impact of ocean acidification had not been well evaluated. Finally, he commented that reducing emissions of greenhouse gases would be the best solution for tackling both climate change and ocean acidification problems; however, alteration of marine ecosystem would be unavoidable even in the most successful mitigation scenarios, and evaluation of the altered ecosystem would be needed.

Mr. Nojiri argued the difficulty in proposing stabilization targets from an ocean acidification point of view, saying that "we cannot propose CO_2 target but we have to show predictions of ocean acidification stress, and that the global aggregate is important". While ecosystem model studies were already in progress, Mr. Nojiri stressed the need for involving social scientists to assess the impacts in other sectors. Mr. Nojiri went on to present more conceptual thoughts about the combined impact of temperature increase and ocean acidification for marine biology, taking into account various scales of CO_2 levels, approximate temperatures, and the sectors impacted by climate change. The difficulty in proposing the stabilization target of atmospheric CO_2 from the perspectives of ocean acidification required the following:

- The ocean acidification community had to show future predictions of marine ecosystems under ocean acidification stress;
- The combined stress of ocean acidification and warming (with hypoxia) should be targeted;
- The global aggregate impact of ocean acidification was important; whether ocean acidification could be one of the significant factors to constrain the future CO_2 stabilization target; and
- Regional impact studies had to include human impacts such as eutrophication, pollution, coastal alteration, overfishing.

Mr. Nojiri then commented on some of the technical issues of climate regulation via CO_2 sinks, namely:

- The natural oceanic CO_2 sink of ~2 Gt/y was actually the mitigation with the lowest cost. A typical carbon cost of ~100 $/t CO_2 was the additional cost to reduce CO_2 emission into the atmosphere, not considering the mitigation cost for ocean acidification caused by the ocean CO_2 sink;

- Even a moderate target of atmospheric CO_2 stabilization level would have an appreciable impact on marine ecosystems;
- The conservation of ocean biological diversity could be a counter-force for reducing the stabilization target; however, quantitative evaluation for loss of valuable and vulnerable ecosystems and also for aggregate loss of the universal impact was needed; and
- The Convention on Biological Diversity and research community might collaborate for reasonable evaluation of CO_2 reduction targets in terms of marine ecosystems; however, too strict a target could prove too costly for reduction of CO_2 emissions.

Mr. Nojiri expressed that "conservation is the counter-force for reducing the stabilization target". In terms of collaboration, Mr. Nojiri expressed the important role of the Convention on Biological Diversity, particularly referring to paragraph 66 of decision X/29, concerning the importance of transmitting the information to the UNFCCC Secretariat and holding regular joint expert reviews. Finally, Mr. Nojiri informed the participants about the important task of the IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) and SOLAS (Surface Ocean - Lower Atmosphere Study) working group on ocean acidification and made further reference to the implementation of an international coordination office (ICO) including a Reference User Group (RUG). To underline the importance of ocean acidification, a presentation was given of the work of the IPCC joint WG II/I Workshop on Impacts of Ocean Acidification on Marine Biology and Ecosystems held in Okinawa (Japan) in January 2011.

Kristian Teleki (Resource Person)

Mr. Kristian Teleki presented on the issue of linking policy gaps and barriers in ocean acidification and on possible options to address them. He highlighted that a number of organizations had participated in the EPOCA RUG (Reference User Group), including the Secretariat of the Convention on Biological Diversity, and mentioned other entities which could also play an active role within it (e.g., FAO, IOC-UNESCO, UNFCCC, ICRI, the Ramsar Convention, Antarctic Treaty and the Arctic Council). He then showed a diagram taken from Jean-Pierre Gattuso's recently published book on ocean acidification, illustrating a strategy for the information flow to policymakers, to show that the message often was degraded as it moved up the chain towards policymakers. He suggested that the RUG could ensure the clarity of the message as it fed into policy, and that using existing mechanisms like the RUG to link research with policy should be favoured. He highlighted the issue of resourcing and funds mobilization, which prevented organizations from attending relevant policy and RUG meetings. A value proposition should therefore be promoted to engage different organizations and attract them to contributing to the RUG. Ways to achieve this could be to establish a RUG or international coordination office policy subcommittee, to meet once a year to discuss these issues, or to convene a RUG ocean acidification policy summit, to create an opportunity for relevant policy bodies and scientific organizations to meet and address the needs of policymakers, in order to ensure that the message was properly received and translated into policy actions. Key platforms for dialogue could also be established, such as mentoring programmes. He concluded by highlighting the importance of seeking unique opportunities to disseminate a more powerful ocean acidification message to policymakers, by targeting various sectors such as industry, economy and finance, as well as the public.

Annex III

SUMMARY OF DISCUSSION ON GAPS AND BARRIERS IN EXISTING MONITORING AND SCIENTIFIC ASSESSMENT OF THE IMPACTS OF OCEAN ACIDIFICATION ON MARINE AND COASTAL BIODIVERSITY IN TERMS OF THEIR LINKAGES TO RELEVANT GLOBAL POLICY PROCESSES

Summary

1. Areas that require further research:
- The effects of carbon sequestration on ocean acidification;
- Interactions among multiple stressors;
- Trophic and ecological interactions, for generalization to models of effects of ocean acidification;
- Broad-scale effects on ecosystems and biodiversity;
- Linkages with freshwater systems and the hydrological cycle;
- Acclimation and adaptation;
- Socio-economic consequences, including food and national security;
- Total aggregated global impacts of ocean acidification on biodiversity and ecosystem at global scale.

2. Monitoring:
- Increase temporal resolution;
- Increase spatial coverage; large areas of the ocean that are currently left out of monitoring programmes;
- Increase international cooperation;
- Inclusion of measures of biodiversity along geochemical monitoring.

3. Barriers to communication:
- The message is complex, and there is a lot of uncertainty in biological and ecological response;
- Direct communication is needed with local communities and policymakers;
- People are interested in issues that affect them directly. Need additional effective communication mechanism and sharing of information between scientists, policymakers and communities.

4. Coastal communities, developing nations and indigenous people need to be included in monitoring programmes and in the design and implementation of adaptation programmes.

5. National barriers exist in funding which limit international collaboration on issues such as the impacts on deep-water ecosystems and high-seas biodiversity; barriers can lead to duplication of effort.

6. Data management should be improved to provide global coverage and open access and to add biological and experimental data to observational databases.

7. Expand existing standard measurement protocols to include moored and profiling electronic sensors and how to measure pH reliably in turbid coastal water over a wide range of salinity.

8. The science of ocean acidification should be linked with socio-economics to estimate the economic risk that is posed by the impacts of ocean acidification.

9. Research and monitoring should be concentrated on areas identified as particularly vulnerable, e.g., polar regions.

Detailed discussion of these points

Participants noted the following:[2]

1. Barriers to communication

It is difficult to communicate with policymakers and other non-scientists on ocean acidification, because it is presented in terms of a change in pH, which is expressed on a log scale, making the level of increase appear lower than it actually is. For example, a change of 0.3 pH units doubles the hydrogen ion concentration (acidity); a change of 0.5 units corresponds to a three-fold increase; an increase of three times the pCO_2 increase gives one third the carbonate ion concentration. Calcification is affected by carbonate concentration and all ocean surface biology will be affected due to change in atmospheric concentration. There are examples of vulnerable ecosystems, but the global effect integrated over the whole world may be very large. The whole surface ecosystem will be unavoidably affected. We have to communicate to policymakers that acidification is universal, not just local.

We need to communicate to local communities and users directly, through interactive dialogue and feedback, not just through United Nations bodies. Regional efforts are also important such as the European Union and circum-Arctic. It was noted that Arctic Council is active on ocean acidification through an assessment being undertaken by the Arctic Monitoring and Assessment Programme (AMAP) Working Group.

Antarctica is sometimes forgotten; it is important to refer to "polar regions" rather than just the Arctic. Reference was made to the International Polar Year of 2007/2008 for the polar regions, and the final IPY 2012 conference that will be held in Montreal in April 2012, and which could be a possible forum for discussion of ocean acidification.

It is not just how and what we communicate but when. Face-to-face communication between scientists and policymakers is effective, as demonstrated in HERMIONE and RUG, and should occur at local and national levels.

When acidification is covered in the media, its real impacts, which are not always straightforward, are not always accurately conveyed. We should be consistent about messages and base them on scientific knowledge.

Scaring people about climate change could have a negative effect. For example, an increased frequency of intense hurricanes is predicted for small island developing States, but since the Copenhagen climate change meeting (December 2009), there have been no major hurricanes. People take scientific messages literally and get scared, but when predictions don't come true immediately, people stop believing. With ocean acidification there is not the same uncertainty, but the message is going to the same people. We must be mindful of what is already in people's minds. It is important to communicate that there is less uncertainty about acidification than about the effects of climate change. People want to know how the change is going to affect them. At the community level people are not interested in the message if it does not show a direct effect on their lives.

The message should be simple, targeting three points: 1. Climate change is real; 2. Ocean acidification is already happening; 3. This is how it will affect you. People living at a subsistence level understand that well when it affects their livelihood. For example, Fiji is currently working on a climate change policy that does not address ocean acidification. Efforts are needed to enhance our communication efforts on ocean acidification at a local level, together with our current efforts on addressing climate change impacts.

It is important to incorporate social science and economics. At present, there is no effective mechanism to support interdisciplinary interaction because of different funding channels for undertaking the social and

[2] This section of detailed discussion compiled the views and comments made by individual meeting participants, but does not necessarily reflect the view of the meeting participants as a whole.

natural sciences. There are cultural barriers, too. In the United States of America, few proposals are submitted in response to requests for proposals for socio-economic analysis. Linking the issue to fisheries raises the priority.

A recent oyster fishery crash on the west coast of the United States of America elevated ocean acidification within the policy area, because it was specific and affected stakeholders. A field visit to the site by Senators, during which they met an oyster farmer whose family had been involved in oyster culture for 100 years, led to the Federal Ocean Acidification Research and Monitoring (FOARAM) Act. Commercial fishers are now wondering how they can get involved, because they can see that ocean acidification will affect them. There is a gap between the global view of acidification and the local implications. The example of Pacific coast oyster farms illustrates both the gap and possibly an opportunity for future communication.

A survey of a cross-section of society in Europe shows that the public there believes that ocean acidification is real, that there will be real consequences to society, and that future impacts will be severe enough that we should act now.

What are the available mechanisms to facilitate communication between scientists and policymakers? Often scientists are willing to share results but don't know how their work can be used. The scientific community has produced many outreach documents. More efforts are needed to clarify the specific needs of policymakers with regard to enhancing the contribution of scientific outputs. In Norway, policymakers have reacted quickly by producing reports and arranging meetings. But for the time being there is not much concrete (or practical) advice from the experts, except for an urgent need for more research. Managers need practical advice. In the United Kingdom the National Academy has arranged an ongoing dialogue among scientists and policymakers: at the beginning of every Parliament in the United Kingdom, each Member of Parliament is matched with a scientist in a mentoring programme.

What do different media outlets need? What will allow them to tell this story to their readers? Reporters may not be interested in the scientific papers immediately, but if scientists were to discuss ocean acidification with them they would be able to operate from a more informed position.

Thresholds are useful to policymakers. Water quality guidelines, for example, have been adopted immediately once a threshold was established. Perhaps scientists should we try to predict thresholds for ocean acidification.

If we can communicate the impacts of ocean acidification in terms of economic loss, the message will be conveyed easily to policymakers, but it is difficult to quantify how much will be lost, because of uncertainty in ecosystem responses. Also, in discussing risk, it would be helpful to communicate with economists who have some experience in calculating the monetary value of ecosystem goods and services. However, there is more at stake than economic loss.

The message is complex; there is a lot of uncertainty, which makes the message difficult for policymakers to use.

Climate change vs. acidification

Participants discussed the need to address ocean acidification in relation to climate change. The research on the combined impact is still in the early research stage, so we cannot say clearly how they will interact.

When dealing with the effects of CO_2 rise, it might not be wise to split them up.

Ocean acidification is too important and too severe to be swamped by the climate change/temperature discussion. In view of some scepticism about climate change, it would be more effective in terms of communication to keep the ocean acidification issue separate from climate change—in Australia a separation is important for this reason. For scientific research the two issues must be connected, but not necessarily so for communication. It is challenging to communicate complexity to stakeholders; it is easier to describe impacts separately.

In the ocean, it is important to understand the linkages of ocean acidification with climate change, increasing hypoxia and local environmental stresses. It is useful for local governments to know that the activities over which they have control (i.e., contaminants, fishing, habitat destruction) interact with the global stressors and that reducing those may increase resilience of organisms and ecosystems.

If we talk about interactive effects from the beginning, we may lose the political audience—we should start by talking about the main effects of ocean acidification and climate change separately. It is easier for people to understand climate change when there are practical examples. For example, coastal communities in Mozambique are strongly dependent on natural resources. When people can see a shift in the timing of the rainy season, a change in sedimentation, or mangroves dying, they can believe in climate change. For these people ocean acidification would be more easily understood if it were linked to climate change.

2. Gaps in knowledge about the effects of carbon sequestration on ocean acidification

In terms of gaps in science and research, it is important to know more about the interactions between ocean acidification and carbon sequestration in the oceans. Will carbon continue to be absorbed and sequestered in warmer more acidic oceans, or might carbon increasingly not be absorbed or released? For example, it appears that marine organisms that play a crucial role in the sequestration of carbon into deep seas may be affected by ocean acidification, such that the carbon cycle or the sequestration of carbon into the deep seas might be affected or reduced. There are also national and industry proposals to sequester greenhouse gases in geological formations underneath the ocean, or in deep layers of the sea, both measures that could directly or accidentally result in the release of greenhouse gases in the oceans and increase ocean acidification. Last, as the ocean warms, there are marine methane hydrates which might release methane, a very potent greenhouse gas, into the oceans or atmosphere.

3. Inclusion of coastal communities, developing nations and indigenous people

Impacts will be universal. Who will determine the regions to be studied? We need but lack involvement at the local community level. Indigenous and local communities (e.g., Arctic region) will be disproportionately affected by ocean acidification. Developing countries and small island developing States cannot afford to add too many layers of organization. It will be important to include ocean acidification in existing climate change adaptation programmes, and to engage indigenous and local communities.

4. Interactions among global and local stressors

More research is required on the effects of multiple stressors.

Research into understanding the interaction of local activities with universal issues demonstrates that tackling acidification requires both the reduction of emissions and the reduction of additional stressors. Solutions that incorporate both are necessary to maintain resilience.

Both temperature rise and acidification are universal, but marine organisms can migrate to escape warming; the combined effect is inescapable. Species that migrate northward to escape warm water may be damaged by acidification.

There is almost no uncertainty about ocean acidification, given a particular CO_2 emission scenario; it is just a matter of thermodynamics. At the local level, the changes are not so easy to predict. There is uncertainty related to local oceanographic and biological processes.

Norway has analyzed collapsed fish stocks. The collapses in Norwegian spring-spawning herring and Canadian cod were due to the combination of overfishing and environmental conditions unfavourable for recruitment. Ocean acidification represents a change in the environment that may have negative consequences for recruitment, at least for some species. This leads to management advice—don't overfish now and don't fish out local stocks, because we may need genetic diversity in the future.

5. Monitoring strategies

Are we monitoring at the right resolution? Very fine-scale temporal resolution research at reefs provides more information about what corals are actually exposed to. Technological advances are coming along: ocean gliders have developed great capacity. The new national glider capability in the United Kingdom will transform how we do oceanography; ocean observatories are extremely expensive and rare. Priority should be given to research in the deep sea, for example, to investigate the effects of shoaling of the aragonite saturation horizon. This work is expensive, so it will be important to share resources.

The United State of America is exploring monitoring schemes for coral reefs, mostly within the NOAA but including academics as well. They are beginning wide-scale spatial monitoring in the Pacific using settling panels and automatic reef monitoring. In the Atlantic, work is on a local scale using intensive metabolism-photosynthesis-respiration experiments, which rotate through sites at about 18-month intervals. Ideally, they would take both approaches in both oceans, but they are limited by resources.

Deep, cold-water corals are not yet widely studied, although some work is beginning in Alaska. It would be useful to concentrate research into understanding processes affecting seawater chemistry and metabolic responses before moving on to full-scale monitoring.

While there has been much ocean acidification research on corals, less had been done on reefs. It is easier to study effects on calcification of an individual species, but harder to work out effects on reefs—that will be an important next step. Considering how ecosystems are likely to change is different from simply aggregating individual species effects. How can we make that leap? The only way is to look at natural settings like CO_2 seeps to see how organisms have adapted to a high-CO_2 environment. This work should expand beyond seeps to include other regions, such as the Galapagos. Another approach is to manipulate CO_2 concentration on-site. There are programs in Australia, Europe and the Southern Ocean to undertake on-site experiments without enclosing the communities.

6. How to generalize to model parameterizations

Modelling, for instance using EcoSim software to simulate ecosystems, is a good approach. To use models it is necessary to understand the trophic organization of organisms. Multiple tools to address the situation will be useful.

7. International coordination of research

Constraints in securing necessary funding can limit international scientific collaboration on issues such as effects on deep-water corals, which can lead to duplication of effort.

Many Strong Voices—a consortium linking peoples of the Arctic and small island developing States, coordinated by UNEP/Grid-Arendal—will be active on the ocean acidification issue at the next meeting of the Conference of the Parties to the Convention on Biological Diversity and at Rio+20 (as they have been at two previous meetings of the Conference of the Parties). This kind of linkage and others, such as links among highly urbanized coastlines, could be helpful.

There will be a workshop in June 2012 to discuss development of an international observation network led by the United States of America but with the hope of broad participation. Southern-hemisphere monitoring is limited, even where there are strong upwelling areas. The ocean acidification issue will be also discussed at the upcoming GEOS meeting, where NOAA would seek to collaboration with scientists from the Latin American region. Reference was made to the Organization of American States and their activities on climate for the Caribbean and Latin America. There is a high need to facilitate international collaboration in the Antarctic on ocean acidification issues, which is just beginning.

8. Data management

How can we make data available for meta-analysis and modelling? Are we seeing a publishing bias in which only the high-impact cases are published while there are other data out there that are more variable? Are we following guidelines and best practices, given limited resources? Experimental data are

often not included in national databases. Australia has developed a national observing system. The data are freely available.

There are major issues related to data, including the incorporation of experimental and biological observation data. Large programmes often set out to do this, but how do we get global coverage and communication among programme-based data stewards? How do data from places with small-scale programmes feed into these databases? The Carbon Dioxide Information Analysis Center (CDIAC) is doing this for inorganic carbon, but it is harder with biological data because there are more parameters. EPOCA is doing this for global biological impact data—members scan new papers, contact authors and ask whether they would like to include their data, with relatively high success. Some 30 to 40 per cent of data sets are missing for various reasons. It should be a high priority for researchers to make their data openly available.

9. Effects on biodiversity

Ocean acidification is universal but will likely have more significant effects on calcifying than on non-calcifying organisms. There are not enough data to state this with confidence, but the ratio of calcifying to non-calcifying organisms will probably change. To help manage for resilience, given that a future atmospheric pCO_2 of 450 to 500 ppm seems unavoidable, we should make predictions about shifts in ecosystems, perhaps for pCO_2 as high as 600 to 800 ppm. Some vulnerable species may go extinct. There are some papers about extinctions—pteropods in the southern and Arctic Oceans are threatened. The ecosystem may change, including in terms of the ratio of calcifying to non-calcifying organisms. It will be important for Parties to the Convention on Biological Diversity to have an indication of how the ecosystem will change.

10. Standard measurement techniques

Recently developed standard operating procedures and guides to best practices give good guidance on how to measure pH, but technical difficulties remain with moored and profiling electronic sensors and how to measure pH reliably in turbid coastal water over a wide range of salinity. Both to empower local communities and to expand coverage of pH monitoring, it would be useful to develop a simple, relatively cheap, reliable method that could be used by non-scientists to monitor acidification bay-by-bay. It may be best at present for local groups to collect samples of seawater for dissolved inorganic carbon and alkalinity and send them to central labs for analysis until a more practical method for local measurement of pH is developed.

11. Linking science with socio-economics

We need to draw in the expertise of communication specialists, economists, lawyers and social scientists. Policymakers will find it helpful to view predicted changes in economic terms. Social scientists are already assessing the economic value of natural ecosystems. Linking science with socio-economics will be important in the future. There is a real scientific difficulty in linking ocean acidification and fisheries; e.g., experiments tell us that pteropods may disappear in the Southern and Arctic Oceans. Pteropods in the North Pacific comprise a large part of the diet of pink salmon (80% in some seasons). If pteropods disappear, will pink salmon collapse or will pteropods be replaced by some other prey?

12. Linkages with freshwater systems and the hydrological cycle and how those affect global and local ocean acidification

This is an important, though largely neglected, issue for estuaries, coastal and marine waters.

13. Geographic gaps in ocean acidification assessment and monitoring

Large marine ecosystems (LMEs) have been defined all over the world (e.g., Arctic Ocean, North Sea, Iceland Shelf). We could consider all the LMEs to see whether they are or can be covered in terms of ocean acidification research and monitoring. There is a lot of knowledge connected with these LMEs.

Important food webs that lead to fish have been identified and considered as management areas. These could be considered for regional implementation of monitoring. At the tenth meeting of the Parties to the Convention on Biological Diversity, Parties provided guidance on identifying ecologically and biologically significant areas (EBSAs)—those with need for enhanced conservation and management measures—through regional processes.

Annex IV

SUMMARY OF DISCUSSION ON OPTIONS FOR ADDRESSING IDENTIFIED GAPS AND BARRIERS, INCLUDING A PROPOSAL FOR THE DEVELOPMENT OF A SERIES OF JOINT EXPERT REVIEW PROCESSES

Participants concluded that a phased expert review process should be implemented, including the following steps:

For the current biennium for SBSTTA 16 (May 2012) and the eleventh meeting of the Conference of the Parties (October 2012):

1) **Preparation of a simple scientific update summary document:** This document will capture key advances in scientific understanding and assessment made since the preparation of CBD Technical Series No. 46, "Scientific Synthesis of the Impacts of Ocean Acidification on Marine Biodiversity" (2009) in a short document, and will list other important syntheses that have been recently prepared. The document will focus on key changes in knowledge that have occurred since 2009.
2) **Preparation of guidance, as suggested in annex VI, for Parties to the Convention on Biological Diversity on practical responses to ocean acidification:** This guidance will draw on existing science to indicate potential response mechanisms and actions that may be taken by individual countries to address impacts of ocean acidification on marine and coastal biodiversity.

It was considered that these actions could inform a SBSTTA recommendation (and eventually decision of the eleventh meeting of the Conference of the Parties), in follow-up to paragraph 66 of decision X/29, which could also promote some of the conclusions of this meeting on monitoring, observation and research (described below).

For the next biennium or SBSTTA in mid-2013 and the twelfth meeting of the Conference of the Parties (2014)

3) **Preparation of a systematic review of ocean acidification impacts on biodiversity and ecosystem functions:** This document will provide a targeted synthesis of the implications of ocean acidification for the biodiversity of marine and coastal systems, to include information on the less-reported paleo-oceanographic research. It will update the impacts on biodiversity documented in CBD Technical Series No. 46. A reduced emphasis on contextual and introductory information is proposed to streamline this document. It is anticipated that this process would lead to, or could provide opportunities for, the preparation of a peer-reviewed scientific publication.

As needed, this could inform a SBSTTA recommendation (and eventually decision of the twelfth meeting of the Conference of the Parties).

Meeting participants explored mechanisms by which the Convention on Biological Diversity might support the advancement of key scientific needs and limitations. The following needs emerged from the discussion:

- Enable collaboration among ocean acidification research scientists across basin-scales to more effectively capture the interconnected nature of ecosystems. It was considered that such "internationalization" would be transformative not only for ocean acidification research, but also for MPAs and other science issues related to marine biodiversity;
- Raise awareness among Parties of new technologies that can drive down the cost of effective ocean acidification monitoring and assessment (e.g., automated monitoring equipment) and encourage strategic investment in technology and the application of these technologies in developing countries;
- Advocate the importance of establishing and maintaining long-term data sets for ocean acidification monitoring and assessment that examine changes in community structure through space and time;

- Ensure that biological observations are included alongside geochemical observations in global data-sharing mechanisms and collaborations. The framework and variables in preparation on this issue following the Ocean Observations meeting in 2009 were highlighted, and participants were encouraged to provide input on biological observations into the ongoing effort to establish a coordinated ocean acidification monitoring network;
- Support capacity-building for research in developing countries and ensure that these countries are able to manipulate the available tools to better understand local ocean acidification implications. The use of exchange programmes to translate effective actions from other areas was encouraged;
- Facilitate the involvement of indigenous and local communities;
- Support the engagement of developing country Parties in ocean acidification research and monitoring activities through the effective mobilization of CBD and UNEP Regional Seas focal points to identify appropriate national-level experts. It was noted that limited connections exist in the Caribbean, Africa and Latin America; participants suggested a number of research institutions.

Participants acknowledged that despite the ocean's integral role in the climate system and the potentially wide-ranging impacts on marine life and humans, ocean acidification is largely absent from most policy discussions pertaining to CO_2 emissions.

Participants questioned why the issue of ocean acidification has received little attention from policymakers and suggested that this may stem from the considerable level of caveats and uncertainties presented regarding its wide-ranging effects. It was noted that this may be both because the ocean acidification community has been ineffective in conveying the message and because policymakers may already have enough issues to consider. Participants noted the need to match uncertainty with messages about how realistic the wide-ranging effects will be.

The time lag between the emergence of an issue and reaction by politicians was discussed, as were the collective expectations of policymakers, which are perhaps too high and ambitious. There may be a need to allow more time for uptake, and to repeat positive efforts (such as those of the EPOCA RUG) on multiple platforms in order to encourage broader dissemination of the message. Participants shared experiences with policy uptake, which generally ranged from one to two years depending on the process.

Participants noted that the Convention on Biological Diversity may be able to play a role in helping to address this policy gap and identify what can be done better to reach out in a more efficient way to policymakers. The ocean acidification message is very complex, and perhaps there is just too much uncertainty in the message.

In the context of broader stakeholder engagement, participants expressed interest in incorporating indigenous and local communities in this process, as many of these groups represent those that are most vulnerable to changes in ocean chemistry. It was noted that the Convention on Biological Diversity already has some degree of experience in this area in a similar process, which focused on marine protected area prioritization using traditional knowledge.

While there is considerable scientific research on ocean acidification in North America and Europe, participants acknowledged that there are considerable gaps and that an inventory should be undertaken to identify where ocean acidification monitoring is occurring, the resources available, and mechanisms to feed into international networks.

It was noted that over the last few years there has been an ever-increasing number of expert meetings on ocean acidification, and that while their focus varies, the core issues remain the same. Participants wondered whether there is a way to coordinate responses and do the necessary groundwork in a uniform and harmonized manner. It was noted that the proposed international coordination office (ICO) for ocean acidification may be able to play a key role in addressing this and other issues facing the ocean acidification community at large.

The proposed ICO, which would be supported by the RUG, has three main elements: outreach, science and capacity-building through communication, promotion and facilitation of ocean acidification activities.

The IMBER SOLAS working group on ocean acidification was originally tasked with the synthesis and coordination of international ocean acidification efforts. Since many groups had already done the former, this working group concentrated its efforts on coordination and thus the creation of the ICO.

It was noted that further impetus to establish the ICO is provided by the need to avoid overlapping of numerous underfunded activities and the need for enhanced coordination of efforts to improve resource sharing and avoid duplication of effort. The notion of the ICO has been endorsed by a wide range of organizations, including the Secretariat of the Convention on Biological Diversity, ICRI, IOC-UNESCO and UNEP-WCMC.

Participants noted that the potential role of the Secretariat of the Convention on Biological Diversity in the ICO would be to promote its activities at the meetings of the Convention of the Parties, to assist in mobilizing resources to support the ICO and to enhance outreach efforts by capitalizing on the Convention on Biological Diversity's convening power and policy linkages.

Participants requested the Secretariat of the Convention on Biological Diversity to help raise the profile of ocean acidification amongst the Parties and to help organize capacity-building and training activities (especially in small island developing States) for scientists, as well as to support the outreach component of the ICO to ensure a direct linkage to policymakers.

It was noted that there are other countries that are in the process of trying to establish national ocean acidification programmes (e.g., South Africa) and that there should be a place for the well-established efforts in Europe, North America, Australia and Japan to share lessons learned and experiences in establishing national-level ocean acidification programmes. While participants viewed this as a valuable area, they raised concerns about finding the resources to undertake this activity.

Participants recommended that the Secretariat of the Convention on Biological Diversity collaborate with the Chair of the International RUG, who is producing an ocean acidification briefing document specifically for Rio+20.

Participants noted significant demands on the time of the scientific community as a result of an increasing number of meetings and synthesis tasks. To align these demands and avoid redundancy, participants requested that the knowledge about scientific status produced through the IPCC Fifth Assessment Report process be considered by the relevant processes of the Convention on Biological Diversity. The IPCC report will be publicly available in 2014.

Process for preparation of simple scientific update summary document:

Resource persons would need to be identified to support the collation of information, and participants proposed that the Secretariat of the Convention on Biological Diversity invite participants, in consultation with lead authors, to advance this process. Participants suggested that a workshop be held to gather experts to agree on content and to consider the latest science. A number of existing meetings were identified that will gather a quorum of ocean acidification researchers and could provide an opportune venue for a linked CBD event to advance this work, which could be organized, including:

- UK Ocean Acidification (UKOA) project coordination meeting in Exeter, United Kingdom (16-18 April 2012);
- A meeting hosted by IOC–UNESCO in Paris (dates to be determined);
- The Third International Symposium on the Ocean in a High-CO_2 World (Monterey, United States of America, 24-27 September 2012).

Participants emphasized that efforts should be made to engage developing country Parties in this process. In particular, opportunities to raise awareness within small island developing States were noted. The Secretariat of the Convention on Biological Diversity can continue to collaborate with UNEP Regional Seas Programmes to this end.

It was also noted that consideration of biodiversity impacts among functional groups may enable more effective presentation of complex results (e.g., dose-response relationships), and can start to move the

community towards an improved understanding of thresholds (known to be of particular interest to policy stakeholders). A synthesis focused on biodiversity impacts was considered by participants to be a good complement to the IPCC report (which will cover the suite of issues and contexts), and would provide an opportunity to address inconsistencies in the conclusions from previous meta-analysis of information on ocean acidification impacts on marine biodiversity.

Annex V

SUMMARY OF DISCUSSION ON NECESSARY COLLABORATION ACTIVITIES TO IMPLEMENT POSSIBLE OPTIONS FOR ADDRESSING IDENTIFIED GAPS AND BARRIERS

The meeting participants expressed their strong support for the establishment of an international coordination office (ICO), which will facilitate the implementation of CBD decisions on ocean acidification.

Participants discussed the interoperability of the ICO and IOC–UNESCO in terms of engaging scientists in ocean acidification activities. It was considered that the established links between the Secretariat of the Convention on Biological Diversity and IOC–UNESCO, under the umbrella of the UN-Oceans coordination mechanism, should be maintained.

Participants discussed the value of unique platforms to engage a more diverse audience and encourage understanding of ocean acidification across a wider range of sectors so that the messages feed up to policymakers from a range of sources. Making arguments that connect ocean acidification to different issues faced by policymakers, such as economics and food security, were also considered as a mechanism to improve the traction of the message.

Participants highlighted the importance of engaging regional-level policy mechanisms, such as the regional seas organizations/regional fisheries management organizations, and other related regional initiatives (e.g., CARICOM, Coral Triangle, OECS, etc.) as a way to disseminate current scientific knowledge and raise awareness. Training in science and communication is a key to ensuring that regional-level champions can convey the message in a way sensitive to local nuances.

In particular, participants noted a need to increase understanding of the significance of the threats posed by ocean acidification to productive sectors (e.g., tourism, fisheries). Also mentioned were potential implications of ocean acidification for natural defences against coastal erosion, storms and national security. Establishing linkages between ocean acidification and ecosystem services may enhance the resonance and visibility amongst diverse stakeholders and audiences.

In the context of the climate change debate, those countries that stand to be most affected by the likely changes, such as small island developing States, have been strong advocates for necessary policy and management actions. Presently, small island developing States do not recognize the importance of ocean acidification and the threats it poses to ecosystems and societies.

In countries where policymakers are engaged in publicly funded ocean acidification research programmes, it may be possible to make direct contact with these individuals to help advance the dialogue and build on the existing activities that are already in place to engage policymakers. These individuals may not be directly involved in high-level MEA discussions, but may be influential in terms of national advisory chains/delegations to the international conventions.

Participants noted that consideration of adaptation responses to ocean acidification presents an opportunity to engage with a more diverse set of policymaking bodies. The participants recognized a need to encourage the spread of science to underrepresented audiences, geographies and sectors.

Participants explored the role of the Convention on Biological Diversity in offering solutions to ocean acidification, which included identifying and engaging key partners who are working actively to reduce emissions, and establish policy and improved practices to influence resilience and adaptation. The existing linkages of the Convention on Biological Diversity with such entities as the World Tourism Organization and the World Business Council for Sustainable Development were noted through cross-cutting programmes (e.g., biodiversity and development, climate change, sustainable tourism and biodiversity). However, the limitations of the Secretariat of the Convention on Biological Diversity, in terms of staff time and resources, in engaging multiple partners were highlighted, and a need to prioritize engagement was noted.

Participants highlighted the opportunity of the Third International Symposium on the Ocean in a High-CO_2 World in Monterey (24-27 September 2012) as a possible venue to engage policymakers. They noted the value of an ocean acidification "policy summit" to gather the key United Nations/international organizations (as identified in decision X/29 of the Conference of the Parties to the Convention on Biological Diversity) in order to link these groups with the existing science and improve understanding of information needs and limitations to uptake.

The UN-Oceans mechanism was noted as a possible route to raise awareness of critical marine issues among United Nations organizations and their partners (e.g., through the use of task forces). The Secretariat of the Convention on Biological Diversity and IOC–UNESCO may wish to consider establishing an ocean acidification–specific task force through this process.

In terms of mobilizing international resources to support ocean acidification, the importance of building bridges between research platforms in developed and developing countries was noted. Participants learned that the decision of the Conference of the Parties to the Convention on Biological Diversity is one mechanism by which requests can be made to international funding agencies to allocate resources to priority issues of the Convention—such as for management, targeted research, outreach and capacity-building.

Participants noted recent discussion at the European Union to establish a coordinated mechanism for international scientific research. This would comprise a call for funding and a mechanism to enable cross basin-scale collaborations focused on research into ocean science and climate change.

Annex VI

POSSIBLE ELEMENTS FOR GUIDANCE TO PARTIES TO THE CONVENTION ON BIOLOGICAL DIVERSITY ON PRACTICAL RESPONSES TO OCEAN ACIDIFICATION

Participants suggested the following elements be developed, with possible refinement, as guidance to support Parties to the Convention on Biological Diversity in the realization of practical responses to ocean acidification impacts on marine and coastal biodiversity. These suggested elements are in recognition of Aichi Biodiversity Target 10: *By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.*

CO_2 emission reductions

Chemical changes associated with anthropogenic ocean acidification are irreversible on time frames of at least hundreds of years; biological changes could last even longer. Substantial damage to ocean ecosystems can only be avoided through urgent and rapid reductions in global emissions of CO_2. Parties to the Convention on Biological Diversity are encouraged to:

- Work towards CO_2 emission reductions; and
- Participate in UNFCCC, IPCC and other related processes.

Maintaining and restoring ecosystem resilience

Multiple stressors affect marine biodiversity, often through additive impacts. In addition to significant reductions in emissions, adaptation-based measures will be required to respond to acidification. While mitigation involves a global commitment, adaptation actions can be adopted at the local, national and international levels as part of broader efforts to preserve and maintain marine ecosystems, and support the communities and peoples who depend on those ecosystems and the services they provide. Decreasing the impacts of other stressors is critical to maintain ecosystem resilience. Local, subnational or national laws in many countries may already be in place to address many stressors that drive or exacerbate acidification conditions. Parties to the Convention on Biological Diversity are encouraged to:

- Adopt and enforce national-level policies to facilitate ecosystem resilience, such as:
    - Effective watershed and coastal management to reduce runoff with associated organic matter and pollutants (including stormwater surge prevention, maintaining intact wetlands, improved water treatment facilities) to limit the exacerbating impacts of eutrophication on localised acidification;
    - Control of coastal erosion to reduce nutrient and sediment loading of water and protect physical integrity of habitats (including increasing vegetation cover, coordination among local and municipal governments for watershed-scale action);
    - Land-use management through local and regional planning, zoning and permitting to reduce direct and indirect CO_2 emissions, runoff and other threats;
    - Reduction of local pollutants through source control of persistent pollutants and enforcement of existing emissions limits for non-persistent pollutants;
    - Identify and protect resilient ecosystems through effectively and actively managed marine and coastal protected areas;
    - Prevent the further loss and degradation of coastal ecosystems and catalyse their recovery through restoration and management;
    - Implement ecosystem-based fisheries management to limit the impacts of destructive fishing practices (e.g., bottom-trawling) and other physical pressures and disturbances to ecosystems, and avoid overfishing;
    - Recognize the roles of indigenous and local communities in maintaining and restoring ecosystem resilience, and provide resources and tools to support adaptation that maintains essential ecosystem services upon which societies depend;

- Incorporate emerging scientific knowledge on ocean acidification into national biodiversity and climate change strategies and action plans, national and local plans on integrated marine and coastal area management, and the design and management of marine and coastal protected areas:
    - Develop specific national action plans and strategies to deal with ocean acidification;
    - Communicate capacity development needs to the Secretariat of the Convention on Biological Diversity.

Communications and outreach

Effective communication is one important tool to encourage the formation of plausible solutions to ocean acidification. To date—outside of the ocean acidification scientific community—the issue has not been adequately communicated in a manner to spur significant action by affected sectors and stakeholders. Parties to the Convention on Biological Diversity are encouraged to:

- Facilitate communication of ocean acidification issues at the local, national, and international levels;
- Coordinate at regional levels for information and knowledge sharing and convene relevant stakeholders to consider this issue;
- Support capacity-building and training for communication of ocean acidification across key sectors;
- Share case-studies of where ocean acidification impacts are already observed and can be confidently attributed (natural and anthropogenically induced acidification).

Contributing to scientific knowledge generation

The global scale of ocean acidification means that concerned Parties need to work together to address knowledge gaps. Careful coordination of knowledge requirements with the future national research plans will help reduce redundancy and improve coverage of underrepresented ecosystems. Important networks already exist which seek to coordinate international research efforts, synthesize available knowledge, and enable intercomparison of scientific data. Parties to the Convention on Biological Diversity are encouraged to:

- Engage actively in existing networks and platforms to share data and observations related to ocean acidification;
- Apply global best practices in the monitoring and assessment of ocean acidification;
- Inform the Secretariat of the Convention on Biological Diversity of existing ocean acidification activities and research to support improved understanding of capacities, resources and underrepresented geographies.
