



SBSTTA 18 Recommendation XVIII/4

XVIII/4. Marine and coastal biodiversity: other matters

The Subsidiary Body on Scientific, Technical and Technological Advice

1. *Requests* the Executive Secretary to transmit the updated synthesis of the impacts of the ocean acidification on marine biodiversity⁴⁴ to the Joint Liaison Group of the three Rio Conventions;
2. *Recommends* that the Conference of the Parties at its twelfth meeting adopt a decision along the following lines:

The Conference of the Parties

Impacts of anthropogenic underwater noise on marine and coastal biodiversity

1. *Expresses its gratitude* to the European Commission for providing financial resources for, the Government of the United Kingdom of Great Britain and Northern Ireland for hosting, and to the International Maritime Organization for collaborating in the organization of the Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity (IMO Headquarters, London, 25-27 February 2014);

2. *Welcomes* the report of the workshop ⁴³ and notes that there has already been a significant amount of research into the impacts of underwater noise on aquatic life over the past few decades, but there remain significant questions that require further study, with the largest gaps in knowledge relating to fishes, invertebrates, turtles and birds, and additional knowledge gaps on characteristics of major sound sources, trends in the prevalence and magnitude, as well as the intensity and spatial distribution, of underwater noise and on the potential impacts of underwater noise on ecosystems and animal populations, including implications of cumulative and synergistic impacts of multiple sources of noise and other stressors;

3. *Urges Parties and invites* other Governments and competent organizations, including the International Maritime Organization, the Convention on the Conservation of Migratory Species of Wild Animals, and the International Whaling Commission, as well as indigenous and local communities and other relevant stakeholders, to take appropriate measures within their mandates to avoid, minimize and mitigate the potential significant adverse impacts of anthropogenic underwater noise on marine and coastal biodiversity, including through, *inter alia*:

- (a) Defining and differentiating types or intensities of underwater noise where there are adverse impacts, and characterizing noise by source;
- (b) Conducting further research on the remaining significant knowledge gaps noted in paragraph 2 above;
- (c) Developing and transferring quieter technologies, including for airguns, pile-driving and ship quieting, and applying the best available practice in all relevant activities;
- (d) Including areas that are affected at different levels of sound when mapping the spatial and temporal distribution of sound;
- (e) Combining acoustic mapping with habitat mapping of sound-sensitive species with regard to spatial risk assessments in order to identify areas where those species may be exposed to noise impacts;
- (f) Mitigating and managing anthropogenic underwater noise through the use of spatio-temporal management of activities, relying on sufficiently detailed temporal and spatial knowledge of species or population distribution patterns combined with the ability to avoid generating noise in the area at those times;
- (g) Conducting appropriate impact assessments before carrying out activities that may have adverse impacts on noise-sensitive species, and carrying out appropriate monitoring;
- (h) Including noise considerations in the establishment and development of management plans for marine protected areas (MPAs) and other relevant plans, as appropriate;
- (i) Considering thresholds as a tool to protect sound-sensitive species, taking into account their locations during critical life cycle stages as well as relevant results of research and additional information;

- (j) Standardizing metrics and sound measurements so that there are similar measures and approaches for all sounds and in all places;
- (k) Building capacity in developing regions where the awareness and scientific capacity to address this issue has yet to be strengthened;
- (l) Engaging industry and other relevant sectors, including navy, when developing guidelines in order to increase their ownership and participation in the implementation of the guidelines;
- (m) Encouraging collaboration and communication among relevant international bodies for synergies in addressing this issue;
- (n) Linking relevant information on the adverse impacts of underwater noise on sound-sensitive species when harmonizing different processes related to marine spatial planning and area-based management.

4. *Requests* the Executive Secretary:

- (a) To further facilitate collaboration among Parties, other Governments and relevant organizations, on the elements referred to in paragraph 3 above;
- (b) To compile and synthesize relevant scientific and technical information concerning the elements specified in paragraph 3 above, as well as information on related measures taken and best practice examples, provided by Parties, other Governments and competent organizations, and to make this compilation available as information for a future meeting of the Subsidiary Body on Scientific, Technical and Technological Advice to be held prior to the thirteenth meeting of the Conference of the Parties, with a view to disseminating the results of the synthesis, including successful experiences, through the clearing-house mechanism or other means;

Impacts of ocean acidification on marine and coastal biodiversity

Recalling paragraphs 63 to 67 of [decision X/29](#) and paragraph 23 of [decision XI/18 A](#),

5. *Expresses its gratitude* to the Government of the United Kingdom of Great Britain and Northern Ireland for supporting the scientific compilation, coordination and synthesis work for, and international experts for contributing to, the preparation of a systematic review document on the impacts of ocean acidification on biodiversity and ecosystem functions, ⁴⁴ which provides a targeted synthesis of the biodiversity implications of ocean acidification for marine and coastal systems, including information on the less-reported paleo-oceanographic research, and welcomes this updated synthesis of the impacts of ocean acidification on marine biodiversity;

6. *Notes* and expresses its concern that, in waters where pH is already naturally comparatively low (for example, in high latitudes, coastal upwelling regions on the shelf slope and brackish water areas with low alkalinity, such as the Baltic Sea), widespread under-saturation of both aragonite and calcite is expected to develop during the twenty-first century, and that benthic and planktonic calcifiers among the organisms likely to be affected, as well as cold-water corals and the structural integrity of their habitats;

7. *Urges* Parties and *invites* other Governments, the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, relevant scientific groups, and other relevant organizations, to further enhance their international collaboration to improve the monitoring of ocean acidification, closely linked to other global ocean observing systems, noting that a well-integrated global monitoring network for ocean acidification is crucial to improve understanding of current variability and to develop models that provide projections of future conditions;

8. *Requests* the Executive Secretary to forward the updated synthesis of the impacts of ocean acidification on marine biodiversity ⁴⁴ to Parties, other Governments and relevant organizations and to transmit it to the Secretariat of the United Nations Framework Convention on Climate Change, and to continue to collaborate with the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, relevant scientific groups, other relevant organizations, and indigenous and local communities in order to raise awareness of the key findings of the updated synthesis and facilitate incorporating these findings into relevant national strategies and action plans concerning conservation and sustainable use of marine and coastal biodiversity as well as developing relevant research and monitoring programmes at the global, regional and national levels;

9. *Recalling* paragraph 2 of [decision XI/21](#), *invites* Parties, other Governments, relevant organizations, and indigenous and local communities to consider the information contained in the updated synthesis of the impacts of the ocean acidification on marine biodiversity ⁴⁴ for their work under relevant processes, including those within the framework of the United Nations Framework Convention on Climate Change; ⁴⁵

Priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems

10. *Recalling* paragraph 9 of [decision XI/18 A](#), *adopts* the priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems as contained in annex to this decision, as an addendum to the programme of work on marine and coastal biodiversity, in order to update the specific workplan on coral bleaching ⁴⁶ of the programme of work, and *urges* Parties and *invites* other Governments and relevant organizations, to implement the activities contained therein, where applicable and in accordance with national capacity and circumstances, for enhanced implementation toward achieving Aichi Biodiversity

Target 10;

11. *Recalls* the findings of Working Group II of the Intergovernmental Panel on Climate Change in its *Fifth Assessment Report* ⁴⁷ which states that many species and systems with limited adaptive capacity are subject to very high risks with additional warming of 2°C, particularly Arctic, sea ice and coral reef systems and notes the relevance of Aichi Biodiversity Target 10 in this regard;

12. *Recognizing* that increased sea temperature also increases risks to coral reefs from pathogens and that there are additional interactions, often synergistic, among all these stressors, *urges* Parties and *invites* other Governments and relevant organizations to consolidate and further strengthen current efforts at the local, national, regional and global levels to manage coral reefs as socio-ecological systems undergoing change due to the interactive effects of multiple stressors, including both global stressors (for example, rising sea temperature, the effects of tropical storms and rising sea levels, as well as ocean acidification,) and local stressors (for example, overfishing, destructive fishing practices, land-based and sea-based pollution, coastal development, tourism and recreational use, etc.), focusing on actions that address, in particular:

(a) Reducing the impacts of multiple stressors, in particular by addressing those stressors that are more tractable at the regional, national and local levels, noting that this would have multiple benefits;

(b) Enhancing the resilience of coral reefs and closely associated ecosystems through ecosystem-based adaptation to enable the continued provisioning of goods and services;

(c) Maintaining sustainable livelihoods and food security in reef-dependent coastal communities and providing for viable alternative livelihoods, where appropriate;

(d) Increasing the capability of local and national managers to forecast and plan proactively for climate risks and associated secondary effects, applying ecosystem-based adaptation measures;

(e) Enhancing international and regional cooperation in support of national implementation of priority actions, building upon existing international and regional initiatives and creating synergies with various relevant areas of work within the Convention;

13. *Recalling* paragraph 14 of *decision XI/18 A*, *requests* the Executive Secretary, in collaboration with Parties, other Governments and relevant organizations, to facilitate the implementation of the priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems, as contained in annex to this decision, by organizing capacity-building workshops and developing information-sharing mechanisms on experiences and lessons learned from various implementation activities;

14. *Noting* that deep-water corals and many other cold-water organisms are also vulnerable to the impacts of ocean acidification but are impacted by additional stressors that are different from those affecting warm-water coral reefs, and *recognizing* the need for further work to identify the location and condition of deep-water corals and to understand the impacts of human activities on these corals, *requests* the Executive Secretary to prepare, in collaboration with Parties, other Governments and relevant organizations, a draft specific workplan on biodiversity and acidification in cold-water areas, building upon the elements of a workplan on physical degradation and destruction of coral reefs, including cold-water corals ⁴⁸ and in close linkage with the relevant work under the Convention, such as the description of areas meeting the scientific criteria for ecologically or biologically significant marine areas, and relevant competent organizations, such as the Food and Agriculture Organization of the United Nations for its work on vulnerable marine ecosystems (VMEs), and to submit the draft specific workplan on biodiversity and acidification in cold-water areas to a future meeting of the Subsidiary Body on Scientific, Technical and Technological Advice for consideration prior to the thirteenth meeting of the Conference of the Parties;

Marine spatial planning and training initiatives

15. *Welcomes* the work of the United Nations Environment Programme, including through the contributions from regional seas organizations and other competent regional initiatives, and the Scientific and Technical Advisory Panel of the Global Environment Facility, as well as a range of contributing partners, towards strengthening the practical use of marine spatial planning, and *requests* the Executive Secretary to further expand collaboration with these organizations and other relevant initiatives, in particular the Food and Agriculture Organization of the United Nations for its work on vulnerable marine ecosystems, the International Maritime Organization for its work on particularly sensitive sea areas (PSSA), and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization for its work on tools for marine spatial planning;

16. *Recognizing* that marine spatial planning is a useful tool for applying the ecosystem approach to marine and coastal management, and *considering* the challenges associated with its implementation, *requests* the Executive Secretary and *invites* relevant organizations to advance their work on enhancing methods and tools, including monitoring measures, for marine spatial planning;

17. *Requests* the Executive Secretary to facilitate, through technical training and the information-sharing mechanism on ecologically or biologically significant marine areas, the use of scientific information compiled for the description of areas meeting the scientific criteria for ecologically or biologically significant marine areas to support efforts, at the regional or national level, on the use of marine spatial planning by Parties and competent intergovernmental organizations;

18. *Expresses its gratitude* to the Government of Japan, through the Japan Biodiversity Fund, for

providing financial resources for, the Governments of Senegal and China for hosting, the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the Abidjan Convention Secretariat, Partnerships in Environmental Management for the Seas of East Asia, the Commonwealth Scientific and Industrial Research Organisation (Australia), and various other partner organizations for collaborating and providing scientific and technical contributions for, the organization of Sustainable Ocean Initiative capacity-building workshops for West Africa (4 to 8 February 2013) and East, South and South-East Asia (9 to 13 December 2013), and *welcomes* the capacity-building initiatives being facilitated by the Executive Secretary through the Sustainable Ocean Initiative in collaboration with Parties and relevant organizations;

19. *Recalling* paragraph 20 of [decision X/29](#), *invites* the Global Environment Facility, donors and funding agencies, as appropriate, to continue to extend support for capacity-building to developing countries, in particular the least developed countries and small island developing States, as well as countries with economies in transition, in order to further accelerate existing efforts towards achieving Aichi Biodiversity Targets in marine and coastal areas;

20. *Requests* the Executive Secretary to organize, in collaboration with Parties and relevant organizations, additional capacity-building workshops and partnership activities within the framework of the Sustainable Ocean Initiative, to address priority issues identified for respective regions concerning the achievement of Aichi Biodiversity Targets in marine and coastal areas;

Annex

PRIORITY ACTIONS TO ACHIEVE AICHI BIODIVERSITY TARGET 10 FOR CORAL REEFS AND CLOSELY ASSOCIATED ECOSYSTEMS ⁴⁹

1. Pursuant to paragraph 13 of [decision XI/18 A](#), this proposal on the following action items was prepared to update the specific workplan on coral bleaching (appendix 1 of annex I to [decision VII/5](#)) through an addendum to the workplan, taking into account the submissions ⁵⁰ made by Parties, other Governments and relevant organizations in response to notification 2013-108. ⁵¹

2. As such, it builds on the existing specific workplan (appendix 1 of annex I to [decision VII/5](#)) and is in line with operational objective 2.3 of the elaborated programme of work on marine and coastal biological diversity (annex I to [decision VII/5](#)) as well as the elements of a workplan on physical degradation and destruction of coral reefs, including cold-water corals (appendix 2 of annex I to [decision VII/5](#)).

3. It will contribute to the achievement 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.* It will also facilitate achieving Aichi Biodiversity Targets 6 and 11.

4. This proposal aims to address the urgent need to consolidate and further strengthen current efforts at local, national, regional and global levels to manage coral reefs as socio-ecological systems undergoing change due to the interactive effects of multiple stressors, including both global stressors (e.g., rising sea temperature, the effects of tropical storms and rising sea levels, as well as ocean acidification,) and local stressors (e.g., overfishing, destructive fishing practices, land-based and sea-based pollution, coastal development, tourism and recreational use, etc). The proposal recognizes that increased sea temperature also increases risks to coral reefs from pathogens and that there are additional interactions, often synergistic, among all these stressors.

5. In particular, the proposal focuses on actions that will help:

(a) Reduce the impacts of multiple stressors, in particular by addressing those stressors that are more tractable at the regional, national and local levels, noting this would have multiple benefits and where benefits can be expected regardless of the impacts of ocean acidification ;

(b) Enhance the resilience of coral reefs and closely associated ecosystems through ecosystem-based adaptation to enable the continued provisioning of goods and services;

(c) Maintain sustainable livelihoods and food security in reef-dependent coastal communities and provide for viable alternative livelihoods, where appropriate;

(d) Increase the capability of local and national managers to forecast and plan proactively for climate risks and associated secondary effects, applying ecosystem-based adaptation measures; and

(e) Enhance international and regional cooperation in support of national implementation of priority actions, building upon existing international and regional initiatives and creating synergies with various relevant areas of work within the Convention.

6. To this end, Parties should develop national coral reef action strategies, or equivalent policies, strategies, plans or programmes, consolidating existing national initiatives, as platforms to mobilize inter-agency and cross-sectoral partnerships, as well as close coordination among national and subnational governments and local communities. National strategies should be complemented by regional strategies to address common stressors. National and regional strategies could include elements discussed in this proposal.

7. *Recalling* paragraph 4 of [decision XI/20](#), Parties are also urged to advocate and contribute to effective carbon dioxide emission reductions, by reducing anthropogenic emissions by sources and by increasing removals by sinks

of greenhouse gases under the United Nations Framework Convention on Climate Change, noting also the relevance of the Convention on Biological Diversity and other instruments. ⁵²

Parties are encouraged to undertake the following actions:

8. Strengthen existing sectoral and cross-sectoral management to address local stressors, such as overfishing, destructive fishing practices, land- and sea-based pollution, coastal development, tourism and recreational use:

8.1. Sustainably manage fisheries for coral reefs and closely associated ecosystems

- a. Conduct comprehensive national assessments, including retrospective analyses, of fisheries, including commercial fisheries as well as small-scale fisheries, to determine the level of unsustainable fishing practices;
- b. Promote community-based measures to manage fisheries sustainably;
- c. Introduce new, or strengthen existing, national regulations and management measures, including the application of the ecosystem approach to fisheries (EAF), to address unsustainable fishing practices, including overfishing, illegal, unreported and unregulated (IUU) fishing and destructive fishing practices, and ensure effective enforcement, using relevant guidelines of the Food and Agriculture Organization of the United Nations;
- d. Identify and implement management measures for multispecies reef fisheries to reduce unsustainable fishing practices;
- e. Sustainably manage populations of key reef fish and invertebrate species targeted by export-driven fisheries or by the aquarium and curio trades, through measures including the setting of targets, identifying indicators for sustainable fishery operations, and establishing monitoring programmes to track fishery condition and management outcomes, and by the proper implementation for species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora of non-detriment findings as required by that Convention and for which guidance is provided in CITES Resolution Conf. 16.7;
- f. Prioritize the recovery and sustainable management of herbivorous reef fish populations, in particular species with key ecological functions.

8.2. Manage land-based and sea-based sources of pollution:

- a. Identify all sources of significant land-based and sea-based pollutants affecting coral reefs and set up comprehensive national/local water quality monitoring programmes;
- b. Implement comprehensive watershed and coastal water quality management plans that reduce all major types of pollution, especially those causing eutrophication, sublethal effects on corals, lower seawater pH or other negative impacts;
- c. Implement watershed management policies that address reforestation; erosion control; runoff reduction; sustainable agriculture and mining; reduction of pesticides, herbicides, fertilizer and other agrochemical use, and wastewater management and treatment;
- d. Prioritize the reduction of nutrient and sediment pollution from watersheds, and the management of pollution "hotspots" (areas that produce the highest pollution loads);
- e. Implement best practice standards for marinas, docks, mariculture, tourism or recreational operations conducted in coral reefs or adjacent environments;

8.3. Increase spatial coverage and effectiveness of marine and coastal protected and managed areas in coral reefs and closely associated ecosystems:

- a. Improve the management of existing areas protecting coral reefs and related ecosystems, including mangrove and seagrass habitats, so that they meet their management and broader ecological objectives;
- b. Prioritize the full protection of existing healthy, resilient and resistant coral reefs through the development and effective management of marine and coastal protected areas or as part of locally managed marine areas (LMMAs);
- c. Integrate ecological and social resilience factors of coral reefs and closely associated ecosystems into design and management of marine protected area networks;
- d. Prioritize the enhancement of conservation and management measures for coral reefs and closely associated ecosystems in areas described to meet the scientific criteria for ecologically or biologically significant marine areas;
- e. Improve the design of coral reef related marine protected area networks to improve the ability of coral reefs to cope with future climate and ocean change effects;
- f. Develop adaptation plans for marine protected areas to help improve the resilience of ecosystems, giving priority to coral reefs and related ecosystems;
- g. Encourage and support community-based marine managed areas, in line with national policies for

marine and coastal management, national or legislative frameworks or other measures;

8.4. Manage coastal development to ensure that the health and resilience of coral reef ecosystems are not adversely impacted:

- a. Prioritize the protection of coral reef ecosystems in coastal development and land-use and sea-use management in coastal areas, through the application of area-based management measures, such as marine and coastal protected areas and/or marine spatial planning;
- b. Ensure that consideration of long-term climate related impacts are integrated into coastal development and land-use and sea-use planning;
- c. Manage impacts from large-scale tourism development and its consequent habitat loss and alteration in coral reefs and closely associated ecosystems, and support sustainable tourism by providing socioeconomic incentives and empowering coastal community for eco-tourism operation.

9. Identify and apply measures to improve the adaptive capacity of coral reef-based socio-ecological systems within the local context, which will ensure sustainable livelihoods of reef-dependent local communities and provide for viable alternative livelihoods:

- a. Develop and apply socio-ecological vulnerability monitoring and assessment protocols in coral reef regions, including socio-ecological vulnerability maps and identify highly vulnerable areas for prioritizing management actions and to inform planning and management as part of a resilience- and ecosystem-based approach;
- b. Prioritize poverty-reduction programmes for reef-dependent communities, to promote livelihood strategies that are socially and ecologically resilient and to reduce poverty-induced overexploitation of reef ecosystems;
- c. Develop and implement socioeconomic incentives to encourage coastal communities to play a central role in conservation and sustainable use of coral reefs and closely associated ecosystems, including through, *inter alia*, the use of tax benefits or other economic incentives for sustainable fishing, conservation agreements that rewards users who forego unsustainable activities, and community-based conservation trust funds supported by fees from ecotourism and fines for unsustainable use;
- d. Apply ecosystem-based adaptation (EbA) tools and indicators for use in coral reef regions and incorporate EbA principles and practices into coral reef management;
- e. Incorporate social drivers of coral reef degradation, such as projected human population increase and food security needs, into forecasts of multiple stressor impacts.

10. Establish or further enhance integrated management and coordination mechanisms to effectively address multiple stressors to coral reefs, including through the implementation of national coral reef action strategies/plans, as described above:

- a. Integrate ecosystem-based approaches for management and adaptation, into development planning and legislative frameworks at the local, subnational and national level, and identify and remove barriers to implementation;
- b. Apply cross-sectoral, inter-agency area-based management tools, including watershed and marine spatial planning approaches, to effectively reduce local stressors from multiple sources and mitigate their impacts to coral reefs and closely associated ecosystems;
- c. Incorporate watershed-based management approaches into reef management through the application of an integrated land-sea planning approach;
- d. Integrate national coral reef action strategies/plans into existing national mechanisms and broader national priorities such as poverty reduction and sustainable development strategies (including those for population and health, coastal development and food security);
- e. Set in place an inter-agency steering committee at national and/or subnational levels, as appropriate, to coordinate, support and monitor the implementation of national coral reef action strategies/plans;
- f. Empower local communities in reef-management, particularly in remote regions or where capacity is low, by providing necessary resources and capacity building, and devolution of management responsibilities in line with national/subnational management guidelines.

11. The Executive Secretary of the Convention, in collaboration with existing global (e.g., the International Coral Reef Initiative, ICRI) and regional initiatives, should facilitate strengthening of international and regional cooperation in support of national implementation of priority actions, as described above, with regard to information exchange, knowledge sharing, awareness building, capacity-building, sustainable financing, and research and monitoring:

11.1. Education, awareness and capacity-building:

- a. Develop or expand national and regional networks of coral reef managers of all types to promote the exchange of information, knowledge and best practices;

- b. Develop a global coral reef portal linked to the website of the Convention on Biological Diversity and existing global and regional initiatives to facilitate technical collaboration and voluntary information sharing on all aspects of sustainable management of coral reefs and related ecosystems;
 - c. Facilitate wide implementation of existing training programmes on priority tools and approaches for coral reef management and develop additional training materials in support of implementing priority actions;
 - d. Integrate information about coral reefs, environmental conservation and ecosystem-based management into existing curricula at all levels of national education systems;
 - e. Develop and implement targeted education and awareness campaigns for diverse stakeholders on how communities and stakeholders can increase coral reef resilience by reducing the direct threats facing coral reefs;
 - f. Provide training and other capacity development opportunities in support of community based management initiatives that increase socio-ecological resilience at the local or subnational level.
- 11.2. Sustainable financing:
- a. Secure, through national sectoral budget systems (e.g., fisheries, environment, climate change adaptation fund, coastal development, tourism, etc.), the necessary financial resources to implement national coral reef action strategies;
 - b. Apply comprehensive and diverse financing schemes for coral reef management, and explore opportunities for innovative financing to support local implementation;
 - c. Remove key bottlenecks and improve access to funding through capacity building and streamlining of funding processes;
 - d. Demonstrate and increase awareness of the socioeconomic importance of coral reefs and associated ecosystems to local and national economies.
- 11.3. Research and monitoring programmes:
- a. Research on multiple stressor interactions and effects on coral reefs at the species, population and ecosystem level to identify the most damaging local stressors affecting coral reefs ecosystems at the site-based level;
 - b. Research to support a resilience-based approach to coral reef management that is embedded within an integrated ecosystem-based management framework;
 - c. Develop and implement early warning systems for major reef health incidents such as bleaching or disease events, tropical storms and flood plumes;
 - d. Develop water chemistry monitoring programmes for coastal and inshore waters to determine the natural spatial and temporal variability of ocean carbon chemistry, and detect trends;
 - e. Research on the sensitivity of species, habitats and communities within coral reefs to changes in ocean carbon chemistry and whether there is a potential for adaptation to ocean acidification in reef organisms;
 - f. Incorporate into the framework of management actions a set of broadly applicable and robust indicators for resilience and stressor assessment, and use these indicators to support regular assessments of management effectiveness;
 - g. Further develop ecological and socio-economic criteria and variables for use in vulnerability assessments in coral reef regions, building on existing work; and
 - h. Develop mapping tools that combine data on the current status of coral reefs, management efforts and their effectiveness with predictive modelling of stressor effects to generate future scenarios of reef condition and ecosystem service provision.

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43 UNEP/CBD/MCB/EM/2014/1/2.

44 UNEP/CBD/SBSTTA/18/INF/6.

45 United Nations, Treaty Series, vol. 1771, No. 30822.

46 Decision VII/5, annex I, Appendix 1.

47 Intergovernmental Panel on Climate Change, Climate Change 2014: Impacts, Adaptation and Vulnerability (available at <https://www.ipcc.ch/report/ar5/wg2>).

48 Decision VII/5, annex I, appendix 2.

49 Draft addendum to update the specific workplan on coral bleaching in the programme of work on marine and coastal biodiversity (appendix 1 of annex I to decision VII/5).

50 Compilation of submissions is provided in the background document ([UNEP/CBD/SBSTTA/18/INF/7](#)).

51 Ref No. SCBD/SAM/DC/JL/JG/82124, issued on 26 November 2013.

52 <http://www.cbd.int/doc/decisions/cop-11/cop-11-dec-20-en.pdf>.