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Protection of coral reefs for sustainable livelihoods and development

Report of the Secretary-General

Summary

Often referred to as the "rainforests of the sea", tropical coral reefs, which rank among the most biologically rich and productive global ecosystems, provide social, economic and environmental benefits for millions of people. Yet, despite their importance, coral reefs are facing numerous local and global threats caused by human activity and climate change. Unsustainable fishing practices, coastal development, pollution, ocean warming and ocean acidification have already damaged one fifth of the coral reefs beyond repair and predictions of what could arise should no change occur are alarming. Concerted global, national, regional and local efforts are therefore urgently required.

Protection, resilience-building, recovery, conservation and adaptation measures need to be implemented in an integrated and coherent manner and tailored to regional, national and local community needs, while involving all stakeholders. The United Nations Conference on Sustainable Development will offer the opportunity to review progress made to date as well as the remaining gaps in the implementation of the principles of the Rio Declaration on Environment and Development, Agenda 21, the marine-related goals and targets set out in the Johannesburg Plan of Implementation, and other ocean-related international agreements. In addition, the Conference could serve to secure renewed political commitment by formulating concrete ocean and coral reef-related measures and actions.

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Contents

I. Introduction

1. The General Assembly adopted resolution 65/150, entitled “Protection of coral reefs for sustainable livelihoods and development”, at its sixty-fifth session in which it, inter alia, urged States to take all practical steps at all levels to protect coral reefs and related ecosystems for sustainable livelihoods and development, including immediate and concerted global, regional and local action to respond to the challenges and to address the adverse impact of climate change, as well as of ocean acidification, on coral reefs and related ecosystems; and also urged them to formulate, adopt and implement integrated and comprehensive approaches for the management of coral reefs and related ecosystems.

2. In paragraph 3 of the same resolution, the General Assembly requested the Secretary-General to prepare a comprehensive report on the protection of coral reefs for sustainable livelihoods and development by the Assembly, for consideration at its sixty-sixth session. Pursuant to that request, the present report highlights the importance of protecting coral reefs and conducts an analysis of the economic, social and development benefits of coral-reef protection in the context of the themes and objectives of the United Nations Conference on Sustainable Development, to be held in 2012. The report also identifies needed actions with the potential to protect coral reefs and related ecosystems.

3. The report draws on substantive inputs and information provided by Governments and United Nations programmes and organizations, in particular the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).[1] The International Maritime Organization (IMO), and the International Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO); the Intergovernmental Panel on Climate Change (IPCC); IUCN, International Union for Conservation of Nature; the World Resources Institute; the International Coral Reef Initiative (ICRI); the Western Indian Ocean Coastal Challenge; and Conservation International also contributed inputs.[2]

II. Coral reefs and sustainable development

4. In the context of the well-established importance of oceans and coral reefs in achieving sustainable development goals,[3] this report enumerates a number of international, national, regional and local efforts that have been designed to protect and manage coral reefs as part of an overall effort to enhance the sustainable development of marine and coastal areas.

A. The United Nations

5. Member States meeting at the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, adopted the Rio Declaration on

[1] See UNEP Coral Reefs website (http://coral.unep.ch/).

[2] See http://www.un.org/esa/dsd/.

[3] Some coral reefs are even declared UNESCO World Heritage Sites (for example, the Belize Barrier Reef, in 1996).

Environment and Development[4] and Agenda 21.[5] Chapter 17 of Agenda 21 specifically addresses the protection and sustainable development of the marine and coastal environment within the context of the United Nations Convention on the Law of the Sea,[6] which has established the basis for ocean governance and provided the overall legal framework for dealing with ocean matters, including economic activities in maritime areas, protection and preservation of the marine environment, and marine science and technology.

6. The Convention on Biological Diversity[7] entered into force in 1993. At their second meeting, held in Jakarta in November 1995, the Conference of the Parties to the Convention adopted the Jakarta Mandate on Marine and Coastal Biological Diversity.[8] Since 1998, the Convention has addressed issues such as integrated marine and coastal area management, marine protected areas, coral bleaching, and physical degradation and destruction of coral reefs.

7. The tenth meeting of the Conference of the Parties to the Convention, held in Nagoya, Japan, in October 2010, resulted in the adoption by the Conference of the Parties of decision X/2 regarding the establishment of the Strategic Plan for Biodiversity 2011-2020 which aims, inter alia, to minimize the multiple threats to coral reefs, and other vulnerable ecosystems by 2015 (target 10).[9] In the same context, decision X/29[10] emphasized the need for data collection and analysis, environmental (impact) assessments and the establishment of measures to ensure conservation and sustainable use of marine and coastal living resources. In addition, it suggested the drafting of a report on the progress made in the implementation of the specific workplan on coral bleaching.

8. The United Nations Framework Convention on Climate Change,[11] which came into force in 1994, provides the framework for establishing protocols to stabilize greenhouse gas concentrations in the atmosphere and for undertaking intergovernmental efforts to tackle the challenges posed by climate change.

9. Other conventions that are relevant for the protection of coral reefs include the International Convention for the Prevention of Pollution from Ships, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Convention)[12] and the Protocol thereto (London Protocol), the Convention on International Trade in Endangered Species of Wild Fauna and Flora,[13] the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention),[14] the Convention on the Conservation of Migratory Species of Wild Animals,[15] and the Convention for the Protection, Management and

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[4] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex I.

[5] Ibid., annex II.

[6] United Nations, *Treaty Series*, vol. 1833, No. 31363.

[7] Ibid., vol. 1760, No. 30619.

[8] UNEP/CBD/COP/2/19, annex, decision II/10.

[9] See UNEP/CBD/COP/10/27, annex.

[10] Ibid.

[11] United Nations, *Treaty Series*, vol. 1771, No. 30822.

[12] Ibid., vol. 1046, No. 15749.

[13] Ibid., vol. 993, No. 14537.

[14] Ibid., vol. 996, No. 14583.

[15] Ibid., vol. 1651, No. 28395.

Development of the Marine and Coastal Environment of the Eastern African Region.[16]

10. In 1994, the Global Conference on the Sustainable Development of Small Island Developing States adopted the Barbados Programme of Action for the Sustainable Development of Small Island Developing States,[17] which explicitly identified coastal and marine resources as an area requiring urgent action. Its implementation was reviewed at the fourth session (1996) and the sixth session (1998) of the Commission on Sustainable Development and it was reaffirmed by the Mauritius Declaration[18] and the Mauritius Strategy for the Further Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States[19] in 2005.

11. At the seventh session of the Commission on Sustainable Development in 1999, a call for action was launched to eliminate overfishing and wasteful fishing practices. Commission decision 7/1[20] emphasized that "oceans and seas constitute the major part of the planet that supports life, drive the climate and hydrological cycle, and provide the vital resources to be used to ensure well-being for present and future generations and economic prosperity, to eradicate poverty, to ensure food security and to conserve marine biological diversity and its intrinsic value for maintaining the conditions that support life on earth" (para. 1).

12. Other General Assembly resolutions relating to coral reefs include resolution 61/105 (8 December 2006) on sustainable fisheries, resolution 63/214 on the sustainable development of the Caribbean Sea for present and future generations (19 December 2008) and resolution 64/73 (7 December 2009) on the protection of global climate for present and future generations of humankind.

13. In 2000, the United Nations Millennium Declaration[21] re-emphasized the need to protect the environment and to manage all living species and natural resources in a sustainable manner, while reaffirming support for the principles of sustainable development, including those set out in Agenda 21.

14. Paragraphs 30 to 36 of the Plan of Implementation of the World Summit on Sustainable Development ("Johannesburg Plan of Implementation"),[22] adopted at the World Summit on Sustainable Development in 2002, focus on oceans, seas, islands and coastal areas. The Johannesburg Plan of Implementation promotes the establishment of inter-agency coordination mechanisms within the United Nations

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[16] Available from www.unep.org.

[17] *Report of the Global Conference on the Sustainable Development of Small Island Developing States, Bridgetown, Barbados, 25 April-6 May 1994* (United Nations publication, Sales No. E.94.I.18 and corrigenda), chap. I, resolution 1, annex II.

[18] *Report of the International Meeting to Review the Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States, Port Louis, Mauritius, 10-14 January 2005* (United Nations publication, Sales No. E.05.II.A.4 and corrigendum), chap. I, resolution 1, annex I.

[19] Ibid., annex II.

[20] See E/1999/29, chap. I.C.

[21] See General Assembly resolution 55/2.

[22] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex.

system and encourages regional cooperation among relevant regional organizations and programmes.

15. The Intergovernmental Oceanographic Commission of UNESCO facilitates and coordinates sustained observations, modelling and analysis of marine and ocean variables and processes to support decision-making process worldwide. In this context, the Global Ocean Observing System (GOOS) has been developed to provide accurate descriptions of the present state of the ocean, including living resources, continuous forecasts of the future conditions of the sea, and the basis for forecasts of climate change, including those needed to monitor and protect coral reefs.

16. In 2003, UN-Oceans[23] was created as an inter-agency coordination mechanism on ocean and coastal issues, including coral reefs, building on the work of the former Subcommittee on Oceans and Coastal Areas of the Administrative Committee on Coordination. Its role is to promote the coherence of United Nations system activities on oceans and coastal areas with the mandates of the General Assembly, the priorities contained in the Millennium Development Goals and the Johannesburg Plan of Implementation and the mandates of governing bodies of all members of UN-Oceans, and to support the integrated management of oceans at the international level.

B. International and regional networks and non-governmental organizations

17. The International Coral Reef Initiative, a partnership among Governments, international organizations and non-governmental organizations, was launched in 1994 as the only global entity devoted solely to coral reef conservation. Its aim is to preserve coral reefs and related ecosystems by implementing chapter 17 of Agenda 21, and other relevant international conventions and agreements. At the same time, the Global Coral Reef Monitoring Network (GCRMN) was established as an operating unit of the Initiative, to assist in the development of coral reef monitoring and data management, with equal emphasis on ecological and socio-economic information, and to compile reports on the global status of coral reefs.

18. In 1995, the International Coral Reef Initiative called on member States to commit themselves to engaging in more research on and monitoring of coral reefs so as to provide data for effective management (under its Call to Action and Framework for Action).

19. In 2007, the Government of Seychelles initiated the Western Indian Ocean Coastal Challenge (WIO-CC), which invited countries of the region to collaborate

[23] Current members include: the Convention on Biological Diversity, the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA), the International Labour Organization (ILO), IOC-UNESCO, IMO, the International Seabed Authority, the Department of Economic and Social Affairs of the United Nations Secretariat, the Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the United Nations Secretariat, UNDP, UNEP, the United Nations Industrial Development Organization (UNIDO), the World Meteorological Organization (WMO), the World Bank and the World Tourism Organization.

on reducing the adverse impacts of climate change, while promoting resilient ecosystems, sustainable livelihoods and human security.

20. In 2009, the World Ocean Conference, a global forum on oceans, assembled ministers and heads of delegations, experts, scientists, and intergovernmental and non-governmental organizations to discuss threats to the ocean, effects of climate change on the ocean, and the role of ocean in climate change. The result was the adoption of the Manado Ocean Declaration, which stressed the need for national strategies for the sustainable management of coastal and marine ecosystems.

21. In 2010, the Pacific Oceanscape framework was adopted by the Pacific Leaders Forum as a call for united action against ocean threats across the Pacific. This framework was part of a broader movement entitled the “Pacific Ocean 2020 Challenge”, an intergovernmental initiative encouraging leaders to cooperate in responding to the major threats to the Pacific.

22. Other important regional initiatives relevant to coral reefs include the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security, the Micronesia Challenge, the Caribbean Challenge, the Eastern Tropical Pacific Seascape project, the West Indian Ocean Partnership, the West African Conservation Challenge, and the Regional Initiative for the Conservation and Wise Use of Mangroves and Coral Reefs in the Americas.

23. Finally, numerous non-governmental organizations and foundations are implementing programmes and initiatives whose aim is to protect and conserve coral reefs.

C. Opportunities for further cooperation

24. The United Nations Conference on Sustainable Development (Rio+20), which will be held in Rio de Janeiro, from 4 to 6 June 2012, offers a unique opportunity to bring together government representatives, civil society, academia, the scientific community and the private sector to discuss sustainable development issues, including the sustainable management and protection of coral reefs.

25. The Conference will provide the opportunity to review progress made to date as well as the remaining gaps in the implementation of the principles contained in the Rio Declaration, of Agenda 21, of the marine-related goals and targets set out in the Johannesburg Plan of Implementation, and of other ocean-related international agreements.

26. In addition, the Conference could serve as an opportunity to secure renewed political commitment through the formulation of concrete ocean and coral reef-related measures and actions. New and emerging challenges, such as the recent severe impacts of climate change and the opportunities (and possible drawbacks) associated with new technologies (for example, geo-engineering), could also be addressed.

27. The Commission on Sustainable Development is scheduled to undertake a two-year review of oceans, marine life and small island developing States in 2015-2016.

III. The importance of protecting coral reefs and related ecosystems for sustainable livelihoods and development (including current status and adverse impacts)

28. Large reef-building areas can be found in the Atlantic, the Indian Ocean, the Middle East, the Pacific, South-East Asia and Australia, with its Great Barrier Reef, which represents the world's largest coral reef system. Grounded by the seabed, coral reefs are built up over very long periods of time (centuries or more) through the accumulation of calcium carbonate skeletons, which have been discarded by reef-building corals (mainly stony corals).

29. Most coral reefs exist in tropical waters. The corals that build tropical coral reefs are small marine organisms called polyps which live in compact colonies and depend upon a symbiotic relationship with the algae that live within their tissue and give them their colouration.

30. Rivalling the tropical coral reefs in species diversity, cold-water coral communities are now known to exist around the world, generally in waters deeper than 40 metres (m) and also at depths that can be well over 1,000 m. While only a few species form actual reefs, cold-water coral mounds and banks provide a habitat and reproductive grounds for a range of species, including commercially important fish and shellfish. Discovered in 2002, the Røst Reef in northern Norway is regarded as the largest cold-water reef. To date, knowledge of cold-water coral ecology, of the extent and status of communities, and of their socio-economic value remains limited.

31. Often referred to as "rainforests of the sea", tropical coral reefs are among the most biodiverse systems on the planet. They are also highly productive, and sustain human society through a range of provisioning and supporting services. Tropical coral reefs cover about 250,000 square kilometres (km^2) of ocean and while constituting only less than one tenth of 1 per cent of the marine environment, they offer habitat to 25 per cent of all known marine species.

32. One of the main functions of global coral reefs is to protect about 150,000 km of shoreline in more than 100 countries and territories as they dissolve wave energy and reduce damages from erosion, floods and storms, thereby protecting human settlements, infrastructure and coastal ecosystems.

33. Apart from environmental benefits, coral reefs also offer important social and economic ones. Of all natural ecosystems on the planet, coral reefs, along with mangroves and seagrass beds, have been estimated to deliver the highest annual value in terms of ecosystem services. Approximately 850 million people (one eighth of the global population) live within 100 km of reefs and derive some benefits from coral reefs, while over 275 million, mostly in developing countries and island nations, depend directly on reefs for livelihoods and sustenance.

34. Coral-reef fish species represent an important source of protein and contribute about one quarter of the total fish catch on average in developing countries, while at the same time creating job opportunities. A healthy and effectively managed coral reef can produce 5 to 15 tons of fish and seafood per km per year.

35. Coral reefs support the tourism industry of more than 100 countries, as they attract divers, snorkellers and recreational fishers and provide sand for beaches. In

addition, some reef-related marine species have even been analysed and tested for pharmaceutical use, mainly in the area of cancer, HIV and malaria treatment. Further information on economic, social and environmental benefits can be found in section IV below.

36. Despite their importance, coral reefs are facing numerous local and global threats, which generally occur in combination.

37. The main local threats are unsustainable fishing practices, coastal development and watershed- and marine-based pollution. These threats reduce the ability of coral reefs, associated ecosystems and human populations to withstand and adapt to increasing climate change (see table 1).

38. From a regional perspective, South-East Asia has been the most affected by local threats, resulting in endangerment of almost 95 per cent of its coral reefs. The coral reefs in Australia are the least threatened, with only about 14 per cent at risk.[24]

Table 1
Overview of local threats and their impacts

Local threat	*Details*	*Percentage of affected coral reefs*	*Impacts*	*Trends*
Overfishing and destructive fishing	• Unsustainable harvesting of fish or invertebrates • Damaging fishing practices (use of explosives or poisons) • Illegal, unreported and unregulated fishing • Destructive fish gear (for example, gill nets, discarded/lost nets) • “Fishing down the food chain”	**More than 55 per cent** (of which 30 per cent face a high threat)	• Reduced areas of living corals • Reduced species diversity • Lower fish abundance	**Will continue to increase owing to:** • Population growth • Excess fishing capacity • Poor fisheries governance and management practices • International demand for fish • Lack of alternative income

[24] L. Burke, and others, *Reefs at Risk Revisited* (Washington, D.C., World Resources Institute, 2011), pp. 1-14.

Local threat	*Details*	*Percentage of affected coral reefs*	*Impacts*	*Trends*
Coastal development (for example, human settlements, industry, aquaculture, infrastructure)	• Coastal engineering • Run-off from land construction and clearing (sediment) • Dredging or land filling • Pollution: sewage discharge and toxic chemicals • Direct construction on reef expanses (airports, etc.) • Unsustainable tourism	**Approximately 25 per cent** (of which 10 per cent face a high threat)	• Increased algal cover/ overgrowth • Reduced coral growth	**Will continue to increase:** • As population growth in coastal areas continues to outpace overall population growth
Watershed-based pollution (for example, crop cultivation, intensive livestock farming, deforestation, mining)	• Erosion (sediment) • Nutrient fertilizer • Pesticides • Chemical toxins Run-off delivered by rivers to coastal waters	**More than 25 per cent** (of which 10 per cent face a high threat)	• Corals more susceptible to storms, diseases, infestations • Coral bleaching • “Dead zones”/ ecosystem collapse	**Will continue to increase owing to:** • Deforestation • Climate change-induced increase in precipitation • Increased fertilizer use (especially in Africa and South Asia) due to increased food demand of increasing global population
Marine-based pollution and damage from ships (for example, commercial, recreational and passenger vessels)	• Solid waste (including plastics), nutrients and toxins from oil and gas installations and shipping (for example, contaminated bilge water, fuel leakages) • Accidental transport of invasive species in ships’ ballast water • Physical damage from ship groundings, anchors and oil spills	**Approximately 10 per cent** (of which 1 per cent face a high threat)	• Collapses and closures of fisheries	**Will continue to increase owing to:** • Increase in global oil demand • Increase in maritime shipping and cruise tourism • Increased threat by invasive species

Source: L. Burke and others, *Reefs at Risk Revisited* (Washington, D.C., World Resources Institute, 2011).

39. Apart from these local threats, serious global threats induced by climate change are endangering coral reefs (see table 2).

Table 2
Overview of main global threats and their impacts

Global threat	*Details*	*Percentage of affected coral reefs*	*Impacts*	*Trends/projections 2030-2050*
Ocean acidification	• Increased carbon dioxide (CO_2) emissions cause change in chemistry of ocean surface waters: build-up of carbonic acid	**More than 75 per cent** (in combination with local threats)	• Reduction of coral growth rates	**By 2030: less than 50 per cent** of global coral reefs expected to be in areas favourable for coral growth
			• Weakening of coral skeletons	**By 2050: only approximately 15 per cent** expected to be in areas favourable for coral growth
			• Support of coral bleaching	
			• Halt of coral growth	
			• Slow dissolution of coral reefs	
Ocean warming	• Rising sea temperatures	**More than 75 per cent** (in combination with local threats)	• (Mass) coral bleaching	**By 2030: 50 per cent** of global coral reefs expected to experience thermal stress and coral bleaching
			• Coral death	**By 2050: more than 95 per cent** expected to experience thermal stress and coral bleaching

Source: L. Burke and others, *Reefs at Risk Revisited* (Washington, D.C., World Resources Institute, 2011).

40. One severe global threat is ocean warming, which leads to “coral bleaching”, a phenomenon whereby corals lose their symbiotic algae and, as a result, their colouration. If continued algae loss occurs, the corals eventually die. The most severe coral bleaching to date, which occurred in 1998, was caused by extreme El Niño-related weather events and resulted in the killing of about 16 per cent of global corals.[25] Since then, repeated coral bleaching has been recorded in most regions. In

[25] Ibid., pp. 21-37.

2010, a mass coral bleaching event affected the Greater Coral Triangle region. Recent studies predict the dominance of algae on the Great Barrier Reef and Caribbean reefs by 2030-2050, as they often colonize dead corals after coral bleaching events, thereby preventing the settlement of new corals.[26]

41. The other important global threat is ocean acidification caused by increasing carbon dioxide (CO_2) emissions. About 30 per cent of global CO_2 emissions are absorbed by oceans and form carbonic acid in reaction with water, which leads to reduced coral growth and calcification, weakened coral skeletons and even the slow dissolution of existing coral reefs.[27]

42. Since the beginning of the industrial revolution, oceans have become 30 per cent more acidic and predictions show that by 2050, ocean acidity could even increase by 150 per cent. This would give marine ecosystems a very small period of time for adaptation, as it would represent a rate of increase that is 100 times faster than that of any ocean acidity change experienced over the last 20 million years.[28]

43. The reduction of global CO_2 emissions is crucial and first steps have already been taken, inter alia, through the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the United Nations Framework Convention on Climate Change.[29] In July 2011, mandatory measures to reduce emissions of greenhouse gases from international shipping were adopted at the sixty-second session of the Marine Environment Protection Committee of the International Maritime Organization. The regulations apply to all ships of 400 gross tonnage and above and are expected to enter into force on 1 January 2013.

44. Other potential threats are: (a) sea-level rise (mostly affecting Pacific small island developing States and atolls), which increases erosion, inundation and pollution of freshwater below islands; (b) increased frequency of high-intensity tropical storms (for example, hurricanes); (c) diseases (mainly in the Caribbean); and (d) plagues and infestations of crown-of-thorns starfish (natural predators of corals).

45. Slow-growing and fragile, cold-water coral reefs are also extremely vulnerable to physical damage caused by human activity. Bottom-fishing and deep-sea trolling have already caused and continue to cause severe impacts; and prospecting constitutes another potentially significant direct threat. In addition, the placement of underwater pipelines and cables endangers cold-water coral reefs.

46. Globally, 27 countries and territories are highly vulnerable to coral reef loss, of which 19 are small island developing States. Nine countries showed the lowest adaptive capacity, that is, the lowest ability to cope with the effects of coral reef degradation, and will need particular attention (see also figure).

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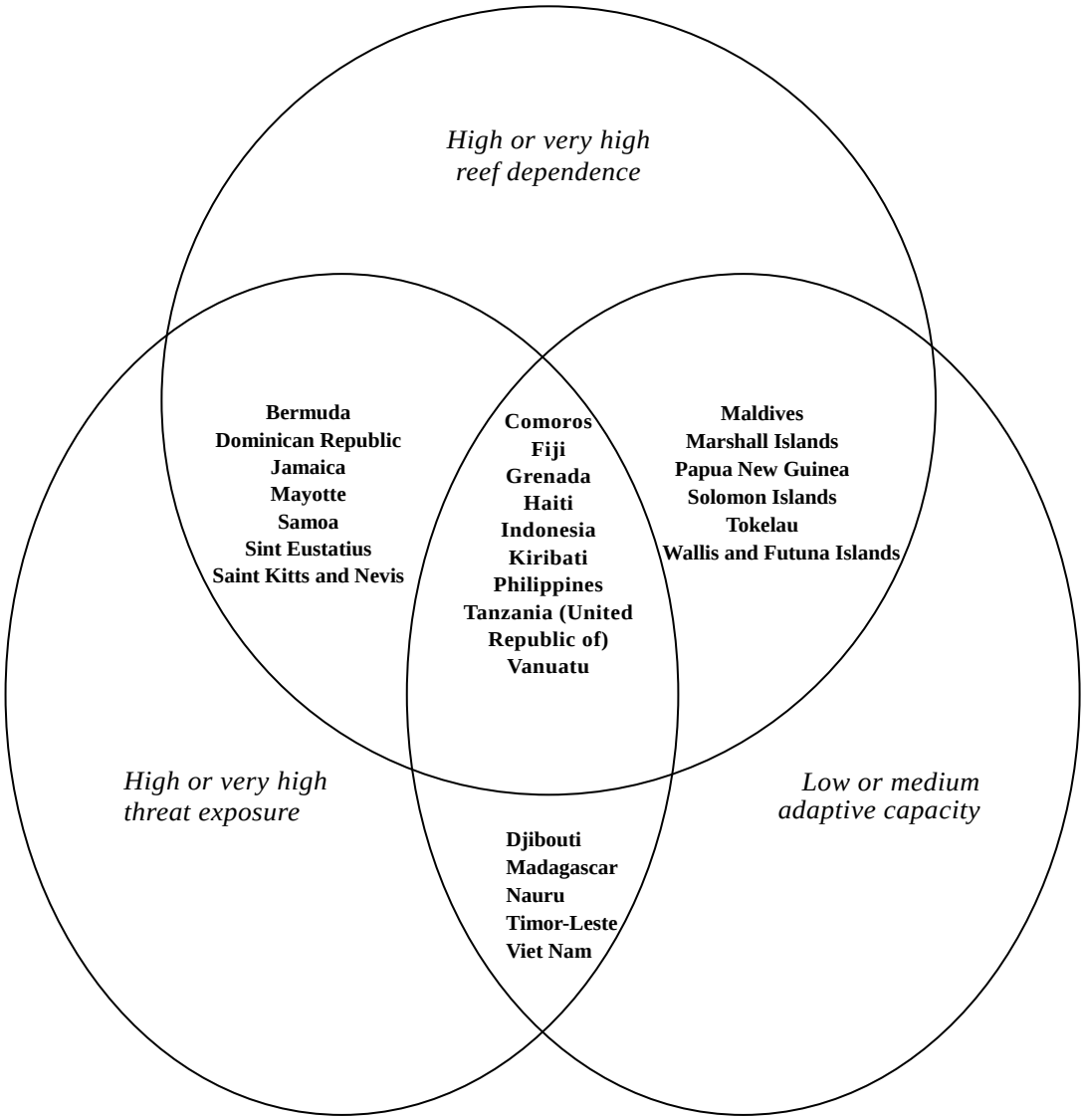
[26] S. Wooldridge and others, “Precursors for resilience in coral communities in a warming climate: a belief network approach” in *Marine Ecology Progress Series*, vol. 295 (2005), pp. 157-169.

[27] Burke and others, *Reefs at Risk Revisited*, pp. 21-37.

[28] Secretariat of the Convention on Biological Diversity, *Scientific Synthesis of the Impacts of Ocean Acidification on Marine Biodiversity*, Technical Series, No. 46 (Montreal, 2009), p. 9.

[29] United Nations, *Treaty Series*, vol. 2303, No. 30822.

Vulnerability drivers in 27 very highly vulnerable nations and areas



Source: Burke and others, *Reefs at Risk Revisited*.

47. Despite these threats, only about 27 per cent of global coral reefs are located inside marine protected areas, more than half of which are in Australia. In addition, according to a recent study of the World Resources Institute, only 6 per cent of global coral reefs are located in effectively managed marine protected areas.[30]

48. As a result, the negative impacts on coral reefs, mangroves and seagrass beds have been considerable. Global coverage of seagrass beds has declined by almost one third in 100 years and at least one quarter of the historical mangrove cover has been lost.

[30] Burke and others, *Reefs at Risk Revisited*, pp. 79-84.

49. According to ICRI, about one fifth of the global coral reefs have already been damaged beyond repair and it is predicted that 35 per cent will be lost within the next 20 to 40 years if no change occurs. The recent World Resources Institute report entitled *Reefs at Risk Revisited* notes that some 341 coral-reef species, including 200 reef-building corals, are currently threatened and predicts that, through the combined impacts of local and global threats, 90 per cent of coral reefs will be threatened by 2030 and all coral reefs will be threatened by 2050, if no protective measures are taken.

50. The protection of coral reefs, mangroves and seagrass beds is therefore crucial[31] and should be understood as requiring a broad range of actions directed towards sustainable management that directly and tangibly protect coral reefs as well as the rights and interests of reef-dependent populations and sectors.

IV. Economic, social and environmental benefits of protecting coral reefs, in the context of the themes and objectives of the United Nations Conference on Sustainable Development, to be held in 2012

51. At the second session of the Preparatory Committee for the United Nations Conference on Sustainable Development, held on 7 and 8 March 2011, many small island developing States called specifically for the Conference to provide support for sustainable ocean management and the protection of marine resources. Therefore, the topic of oceans, including coral reefs, is expected to figure prominently at the Conference. Furthermore, numerous preparatory meetings are expected to cover the topic of ocean management and protection.[32]

52. The Conference will focus on two themes: (a) a green economy in the context of sustainable development and poverty eradication; and (b) the institutional framework for sustainable development.

53. Although a precise definition has yet to be formulated, the concept of a green economy can be perceived as a lens focused primarily on the intersection between environment and economy and on seizing opportunities to advance economic and environmental goals simultaneously. The development of this green economy will rely heavily on the sustainable management of oceans and the conservation of marine resources, including coral reefs.

54. Many member States are now replacing the concept of a green economy with that of a “blue economy”, which implies that development of a green economy needs to include a focus on benefits for coastal communities, especially in small island developing States and developing countries, which depend on the ocean and its marine resources for their existence.[33] This also highlights the importance of healthy oceans in the context of the three pillars of sustainable development, as they can generate significant economic, social, environmental benefits. The identification of coral reef-related benefits is therefore crucial.

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[31] See also the Action Plan to Conserve the Coral Reef Ecosystem, established in 2010 in Japan.

[32] See http://www.uncsd2012.org; and A/CONF.216/PC/9.

[33] Australia/Pew Environment Group, “Keeping the green economy blue”, concept paper (2011).

55. Coral reefs offer employment opportunities in fisheries and are an important nutrition source. No less than 30 million people in global coastal communities are entirely dependent on coral reefs as their primary sources of food production, income and livelihood.[34]

56. On average, people in coral-reef countries consume 29 kilograms (kg) of fish and seafood per year, with the consumption in Maldives being the highest. Main fish consumer countries are the Pacific small island developing States, with average fish consumption twice or four times higher than the global average. Nevertheless, a potential shortage of fish resources has been predicted for 2030 in the Pacific area.

57. In 2010, coral-reef fisheries generated global annual net benefits of US$ 6.8 billion. Effectively managed and environmentally sound fisheries can play an important role in supporting sustainable development and poverty eradication by providing food and employment opportunities. Fisheries are, in general, small-scale and artisanal enterprises and, as such, represent an attractive business option owing to low entry costs. The greatest number of coral-reef fisheries can be found in Asian countries (for example, Indonesia, Viet Nam and China), each of which has between 100,000 and more than 1 million coral-reef fishers.

58. According to the World Resources Institute, global annual net benefits from all coral reef-related goods and services totalled approximately US$ 29 billion in 2010, but the economic revenues derived from coral reefs vary considerably by site, depending, inter alia, on: (a) size of tourism markets, (b) importance and productivity of fisheries, (c) level of coastal development and (d) distance to major urban centres. In general, economic revenues originate mainly from coral-reef exports and tourism.

59. The export of coral-reef species and products represents an important source of income for many countries and includes, inter alia, live reef food fish, aquarium fish and tourist souvenirs. The greatest relative value of coral reef exports (mainly black pearls) can be found in French Polynesia,[35] where they constitute 62 per cent of the gross domestic product (GDP).

60. Coral-reef tourism provides considerable income for both developing and developed countries and generated global annual net benefits of US$ 11.5 billion in 2010. More than 96 coral-reef countries benefit from coral-reef tourism, which in 23 accounts for 15 per cent of their GDP. Revenue associated with coral-reef tourism comes from divers, snorkellers, recreational fishers and beach visitors, who pay for diving and fishing activities, hotels, restaurants and transportation and, in some cases, have to pay a “visitor fee” as well.

61. In addition, coral reefs offer shoreline protection, provide habitation for marine species and contribute to the formation of (tourist) beaches. In some small island developing States, coral reefs protect more than 80 per cent of the coastline. The global annual net benefits of shoreline protection amounted to US$ 10.7 billion in 2010. Apart from providing shoreline protection, coral reefs offer a habitat for 25 per cent of all marine species and create favourable conditions for other ecosystems (for example, mangroves and seagrass beds).[36]

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[34] C. Wilkinson, ed., “Status of coral reefs of the world: 2008” (Townsville, Australia, Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, 2008), pp. 5-19.

[35] See also, French Initiative for Coral Reefs (L’IFRECOR) website (http://www.ifrecor.fr/).

[36] Burke and others, *Reefs at Risk Revisited*, pp. 66-78.

62. Finally, coral reefs possess a significant cultural and spiritual value for many indigenous and other coastal communities.

63. While the dependence on coral reefs is high in many countries, with one half billion people greatly depending on coral reefs for food, livelihood and tourism,[37] small island developing States and coastal communities in developing countries are the most reef-dependent and their particular needs and concerns need to be given particular attention.

64. According to the World Resources Institute, coral-reef degradation caused by human activity and climate change could lead to significant economic losses in the Caribbean by 2015, namely US$ 95 million-US$ 140 million in diminished net revenues from fisheries and US$ 100 million-US$ 300 million in reduced income from tourism. In addition, annual losses of US$ 140 million-US$ 420 million from reduced coastal protection are predicted in the region within the next 50 years.

65. According to other studies, the climate change-induced deterioration of the Great Barrier Reef could cost Australia US$ 2.2 billion-US$ 5.3 billion over the next 19 years, while Indonesia could experience losses in the amount of US$ 1.9 billion over 20 years owing to the practice of overfishing.[38]

66. The second objective of the United Nations Conference on Sustainable Development is to strengthen the institutional framework for sustainable development. There are numerous local, regional, national and international targets, initiatives and processes relevant to coral reefs and dependent communities and sectors, many of which have firm anchoring in international agreements.

67. There is a need to reinforce political commitment with regard to existing international agreements and conventions such as the United Nations Convention on the Law of the Sea, which should include necessary actions for the protection and preservation of rare and fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other forms of marine life, including coral reefs.

68. The establishment, monitoring and enforcement of sustainable national marine managed and marine protected areas, and the building of (regional) networks, are important actions.[39]

69. Increasingly, countries are creating marine protected areas, even if coral reefs and their resources are associated with only a minor segment of their national economy, owing to their fundamental importance for those countries' coastal communities. One example is the Sudan, which participates in the activities of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) geared towards the conservation of all aquatic resources, including coral reefs.

70. Effectively managed areas — for example, the Bonaire National Marine Park (box I) and the Gulf of Mannar Biosphere Reserve (box II) — attest to the fact that adequate measures can significantly reduce threats and generate important economic, social and environmental benefits.

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[37] Wilkinson, "Status of coral reefs of the world: 2008", pp. 5-19.

[38] Burke and others, *Reefs at Risk Revisited*, pp. 66-78.

[39] See, also, the ICRI East Asia Initiative on MPAs Networks (including Thailand).

Box I
Benefits of the Bonaire Natural Marine Park

Background

Bonaire is located approximately 100 kilometres (km) north of the Bolivarian Republic of Venezuela in the Caribbean. The goal of the 2,700 hectare Bonaire National Marine Park, created in 1979, is "to protect and manage the island's natural, cultural and historical resources, while allowing ecologically sustainable use, for the benefit of future generations". Since 1991, the non-governmental organization Stichting Nationale Parken Bonaire (STINAPA Bonaire) has been managing the Park and is responsible for covering all its direct costs (including law enforcement, maintenance, education, research and monitoring).

Tourism, especially diving, provides the primary economic revenue to Bonaire. In 1994, 25,000 divers visited Bonaire, generating gross revenues of US$ 34 million. Currently, more than 28,000 divers visit Bonaire annually.

Measures: introduction of an admission fee ("nature fee")

In collaboration with all relevant stakeholders, a successful fee system was introduced, which entails the payment of an admission fee ("nature fee") for visitor entry into the Bonaire National Marine Park. In 1992, the imposed visitor fees yielded a total of over US$ 170,000, which was used to cover management costs, and coral reef protection and conservation measures.

Today, the Bonaire National Marine Park charged a one calendar year fee of $25 for scuba divers and $10 for non-scuba divers. Passes are also available at a cost of $10 for one day of scuba diving. Residents of Bonaire pay a reduced fee. Further revenues are generated from the renting of moorings, and the sale of tourist souvenirs, as well as from grants and donations.

Results

The Bonaire National Marine Park is financially self-sufficient.

Sources: STINAPA Bonaire, Bonaire National Marine Park Management Plan 2006; and http://www.stinapa.org.

71. According to Conservation International, incomes within marine protected areas are twice as high as those outside of marine protected areas; and marine protected areas can significantly improve livelihood opportunities, food security and environmental awareness.

72. Another successful approach in the area of coral reef protection and conservation entails the designation of particularly sensitive sea areas (PSSAs) by the International Maritime Organization (IMO). In order for an area to be designated a particularly sensitive sea area, it must demonstrate vulnerability to damage by international shipping activities, while possessing certain attributes from an

ecological, socio-economic and scientific perspective. Since 1990, IMO has designated 13 such areas, of which 8 are designed to protect coral reefs from the impacts of international shipping.[40]

Box II
Benefits of the Gulf of Mannar Biosphere Reserve project

Background

The Gulf of Mannar lies between the southern tip of India, the south-east coast of Tamil Nadu State and the north-west coast of Sri Lanka. In 1986, 21 inshore coral sand islands and their surrounding coral reefs, seagrass beds and mangrove habitats were designated as constituting the Gulf of Mannar National Park. In 1989, the entire Gulf of Mannar was designated a biosphere reserve, thereby representing the first marine conservation area of this kind in India and the South Asia region.

The Gulf of Mannar Biosphere Reserve project was first implemented in 2002 as a partnership between the Governments of India and Tamil Nadu, the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF). It aims to demonstrate the modalities for integrating biodiversity conservation, sustainable coastal zone management and the livelihoods of local communities, including indigenous and tribal populations. Its overall objective is to use a multisectoral and integrated systems approach to conserving the coastal biodiversity of the Gulf of Mannar.

Measures

Measures encompassed empowering local communities to manage the coastal ecosystems in a sustainable manner through strengthening of conservation efforts, support for alternative livelihood and implementation of awareness programmes.

Results

The Biosphere Reserve project has helped to transform the behaviours of local communities and fishermen. In turn, threats to marine resources have been significantly reduced, as evidenced by a 7.5 per cent increase in coral cover in the project area in the period from 2006 to 2010.

Sources: UNDP-GEF; and http://www.gombrt.org.

73. A wide range of actors from governmental and non-governmental organizations, initiatives, civil society and the private sector are involved in coral-reef protection and conservation. It is therefore crucial to ensure among their activities so as to avert duplication and optimize protection, recovery, conservation and adaptation measures.

[40] See, also, http://www.imo.org/OurWork/Environment/PollutionPrevention/PSSAs.

74. To engage all stakeholders, including the private sector, in the effective management and protection of coral reefs, economic incentives (for example, buyouts, conservation agreements and alternative livelihoods incentives) can be utilized as an attractive complement to more traditional measures, such as imposition of fines and penalties.[41]

75. Owing to the fact that cold-water corals exist beyond national jurisdiction and that coral reefs in general face not only local but also global threats, coral-reef protection has to be conducted not only at the local, regional and national levels but also at the international level, while still allowing local communities to exercise a strong ownership role in the management of coral reefs and their resources.

76. Regional fisheries management organizations have a key role to play in the conservation of marine species beyond national jurisdictions, as they are responsible for managing high-seas fish stocks and highly migratory species and can help to set catch and fishing effort limits, implement technical measures and oversee control obligations.

V. The role of national legislation in protecting coral reefs (including the importance of involving indigenous and local communities)

77. The role of national Governments and legislation in providing an enabling environment within which all stakeholders can meaningfully contribute to coral-reef protection is a pivotal one.[42]

78. In Brazil for example, nine coral-reef conservation units have been created, including municipal, State and federal units. The Government initiated the National System of Conservation Units, which brought together all existing instruments and regulations on the issue, to establish a framework for the creation, implementation, consolidation and management of these units. Through the integration of the various units, the federal Government is able to join State and local governments in providing better protection of the environment in Brazil.

79. Apart from focusing on coral-reef protection, national legislation should also include climate change adaptation measures, which could reduce the vulnerability of reef-dependent populations. Effective government institutions, regulations and enforcement mechanisms also play an important role in the establishment, monitoring and enforcement of sustainable marine managed areas and marine protected areas.

80. The application of payments for ecosystem services (PES) and other incentive-based mechanisms can support the implementation of protection and conservation measures.[43] Of particular importance for marine and coastal payments for ecosystem services, owing to the public-good nature of these resources, is the ability to identify “sellers” and “buyers” of the ecosystem service of interest. New

[41] See, also, E. Niesten and H. Gjertsen, “Economic incentives for marine conservation” (Arlington, Virginia, Science and Knowledge Division, Conservation International, 2010).

[42] See also the National Environmental Policy for Sustainable Development of Oceans and Coastal Areas and Islands of Colombia.

[43] See, also, http://ec.europa.eu/environment/nature/biodiversity/economics/.

institutional arrangements, such as community-based management, management concessions, and co-management schemes, can substitute use and access rights for ownership.

81. A notable example of payments for ecosystem services within the context of coral-reefs habitat is provided by the private and non-profit Chumbe Island Coral Park in the United Republic of Tanzania. The Government of Zanzibar established a protected area around the island and its fringing coral reef in 1994 and gave the management rights to the Park, which is responsible for implementing the Chumbe Island Coral Park management plans 1995-2016.

82. The success of national legislation often depends on the integration of all stakeholders in the decision-making process. The inclusion of indigenous and other local communities is therefore of the utmost importance, as those communities are often the ones most dependent on coral reefs for food and livelihood.

83. In this regard, the Government of Germany provides support to international initiatives and projects devoted to coral reefs in the context of integrated coastal area planning and management, that include indigenous and local communities, as well as partners at local, national, regional and international levels.

84. Through their national legislation, Australia and Palau, which could offer valuable lessons learned, have implemented successful measures designed to protect coral reefs while involving their indigenous and other local communities.

A. Protection of Australia's Great Barrier Reef

85. The Government of Australia had begun taking steps to protect its Great Barrier Reef when it created, in 1975, the Great Barrier Reef Marine Park Authority. Various protection and conservation measures have been put in place, including the establishment in 2004 of a new zoning plan which increased the proportion of the Marine Park that was highly protected by "no take zones" from less than 5 per cent to more than 33 per cent.[44]

86. The Great Barrier Reef Marine Park Authority is working in partnership with indigenous groups (Aboriginal and Torres Strait Islander) to develop formal legally recognized agreements, known as Traditional Use of Marine Resource Agreements, regarding the management of the Marine Park. The Agreements provide a practical and more flexible pathway towards expression by traditional owner groups of their rights and interests. The framework also provides collaborative opportunities for protecting cultural values and managing culturally important species in accordance with traditional lore, and for addressing other activities that impact Aboriginal and Torres Strait Islander people, such as illegal fishing and resource poaching.

87. Other important initiatives include the Reef Water Quality Protection Plan (Reef Plan) and Reef Rescue, a five-year programme (2008-2013) that aims to reduce the discharge of dissolved nutrients and chemicals from agricultural lands into the Great Barrier Reef lagoon by 25 per cent and the discharge of sediment and nutrients by 10 per cent.

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[44] See, also, in this regard, Mexico's "National Law of the Waters" (approved in 2008), which specifically addresses the issue of the establishment of regulated zones, zones closed to fishing, and water reserves.

88. Australia's marine bioregional planning is designed to provide long-term protection of coral reefs and related ecosystems by improving the conservation, sustainable use, and management of marine resources and ecosystems (through marine managed areas and marine protected areas), including coral-reef habitats.

89. Implementation of General Assembly resolution 65/150 was initiated by the Government of Australia in close partnership with Pacific and other countries that may be directly affected by the degradation or loss of coral reefs and related ecosystems (for example, Nauru).

B. Marine protected areas in Palau

90. Palau is located approximately 800 km east of the Philippines. In 2003, the Government introduced the Protected Areas Network Act (PAN Act), which consisted in the establishment of a nationwide network of marine protected areas for the purpose of protecting biodiversity and natural resources. Of the 28 marine protected areas designated, 24 contain coral reefs.

91. The PAN Act has been supported by indigenous communities and at the highest level of national government, as it allows stakeholder involvement and flexibility in the planning process. It encompassed the establishment of the Protected Areas Network Fund (PANF), a non-governmental corporation, and the implementation of the imposition of an admission fee of US$ 15, collected from visitors upon their departure from the airport (Green fee). The Act inspired several Governments of the Federated States of Micronesia to establish the Micronesia Challenge, launched in 2006.

VI. The way forward: potential actions (consistent with international law) needed to protect coral reefs and related ecosystems, including proposals for coordinated and coherent action across the United Nations system

92. The protection of oceans and related ecosystems, including coral reefs, remains a main objective, as already envisaged in chapter 17 of Agenda 21, the Johannesburg Plan of Implementation and other international agreements.

93. Recent studies have shown that coral reefs have the capacity to recover even from very extreme damage if adequate protection, resilience-building, recovery and conservation measures, such as the Coral Reef Conservation Act (United States of America), are in place. In this context, the establishment of marine national parks and artificial coral reefs[45] has been successful in certain areas. Other positive trends are increased public awareness and a more active local engagement. Although strong recovery has been seen in parts of the Indian Ocean and Western Pacific, especially

[45] See, also, London Convention and Protocol/UNEP, *Guidelines for the Placement of Artificial Reefs* (London, IMO, 2009); and "Aquarius coral restoration and resilience experiments", in "Report on NOAA Coral Reef Conservation Program activities from 2007-2009: implementation of the National Coral Reef Action Strategy — report to Congress" (Washington, D.C., U.S. Department of Commerce, 2010), p. 84.

where direct stress is low, recovery has been stalled or weak in areas where there are substantial human pressures.

94. Further major efforts are therefore needed to diminish threats to coral reefs, particularly since appropriate actions can generate significant social, economic and environmental benefits.

95. As coordination mechanism on ocean and coastal issues UN-Oceans could play an expanded role in ensuring coordinated and coherent action across the United Nations system with respect to coral-reef protection. The creation of a specialized coral-reefs task force under its umbrella, comprising experts from its respective member organizations and including collaboration with national coral-reef task forces, could be considered.

96. Others recommendations for the protection of coral reefs for sustainable livelihoods and development at the global and local levels include:

(a) Minimize global CO_2 emissions, as they lead to ocean acidification and ocean warming, thus destroying coral reefs. Urgent progress towards multilateral agreements and action to reduce CO_2 and other greenhouse gases responsible for climate change is essential for both short- and longer-term efforts to reduce the impacts of climate change on coral-reef biodiversity and ecosystem services;

(b) Reduce unsustainable fishing practices such as overfishing and destructive fishing by (i) addressing their primary drivers (for example, food insecurity and poverty) through appropriate measures (for example, promotion of alternative livelihoods); (ii) establishing sustainable management policies, practices and guidelines[46] for fisheries; (iii) reducing excess fishing capacity; (iv) combating illegal, unreported and unregulated fishing, inter alia, through enhanced port State control and port State measures; (v) eliminating unsound fishing subsidies; (vi) prohibiting destructive fishing; and (vii) enforcing fishing regulations;

(c) Decrease watershed-based sedimentation and pollution through (i) improved agriculture, livestock and mining practices; (ii) the minimization and control of industrial, urban and mining run-off; and (iii) the protection and restoration of vegetation (especially mangroves and seagrass beds). These measures can be supported by applying payments for ecosystem services and other incentive-based mechanisms;

(d) Reduce marine-based pollution and damage by (i) controlling and regulating ballast discharge from ships through protocols and conventions; (ii) improving waste management at ports and marinas; (iii) designating safe shipping lanes and boating areas, and particularly sensitive sea areas; and (iv) efficiently managing offshore oil and gas activities (including through risk assessment and emergency plans);

(e) Improve coastal development through (i) ecosystem-based management; (ii) integrated coastal management; (iii) ocean zoning; (iv) linkage of terrestrial and marine protected areas; (v) prevention of unsound land development; (vi) restriction or limitation of coastal development within a specified distance from the coast (coastal development setbacks); (vii) adequate watershed management; and (viii) protection and recovery of critical coastal habitats and vegetation (including

[46] See, also, FAO “Technical Guidelines for Responsible Fisheries”.

reforestation measures). Adequate coastal development is especially important in light of predicted population growth in coastal areas, which will continue to outpace overall population growth;

(f) Increase the coverage and effectiveness of marine managed and marine protected areas, including through the building of networks. The provision of sufficient financial resources, adequate equipment and trained staff through resource mobilization and capacity-building measures is crucial for guaranteeing their effective functioning;

(g) Reinforce regional and international collaboration in protection, resilience-building, recovery, adaptation and conservation measures through: (i) implementation of international agreements (for example, the United Nations Convention on the Law of the Sea and the International Convention for the Prevention of Pollution from Ships); (ii) establishment of transboundary collaboration and regional agreements; (iii) improved international regulations regarding trade of coral-reef products (particularly live coral-reef organisms); and (iv) enhanced regional and international climate change efforts;

(h) Promote sharing of successful approaches related to coral-reef protection, recovery, resilience-building, adaptation and conservation (best practices), and the transfer of (new) technologies;

(i) Implement sustainable tourism and promote ecotourism, as tourism is projected to continue to increase worldwide. The establishment of partnerships with the tourism industry and the use of incentives for coral-reef protection (for example, certification schemes, awards for eco-friendly hotels, and engagement of diving or tour operators) can play an important role in this regard;

(j) Encourage data collection and scientific research directed towards further exploration of the economic, social and environmental benefits of coral reefs in support of the development by decision makers of measures designed to protect coral reefs, reinforce their resilience and enhance the ability of coastal communities to adapt to environmental changes and coral-reef degradation. There is a particular need to carry out assessments on the status and trends in respect of cold-water coral-reef ecosystems. In addition, the extension and/or establishment of coral-reef monitoring systems (including socio-economic factors) should be supported;

(k) Promote education and communication on the subject of coral reefs so as to inform citizens, the private sector, government representatives and potential donors on current threats affecting coral reefs and the urgent need to protect them. Governments should encourage sustainable individual action of citizens by raising awareness of local laws and regulations and by promoting sustainable fishing practices, the purchase of sustainably caught seafood and the reduction of household waste and pollution;

(l) Ensure the involvement of all stakeholders, especially local and indigenous communities, in the development and implementation of national legislation, inter alia, through partnership programmes.

A more sustainable future for coral reefs is achievable. International cooperation on mapping out a vision and action plan designed to spur action on implementing policies needed to ensure the protection of coral reefs could be considered.