The Second World Ocean Assessment

WORLD OCEAN ASSESSMENT II

Volume II

United Nations

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Cover photo: Yung-Sen Wu
United Nations World Oceans Day Photo Competition

United Nations publication
Sales no.: E.21.V.5
ISBN: 978-92-1-1-130422-0
eISBN: 978-92-1-1-604006-2

Printed at the United Nations, New York

Chapter 27
Developments in management approaches

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Keynote points

- The ecosystem approach is one of the most significant approaches to ocean management, consisting of the environmental, social and economic management of human interactions with oceans and coasts at multiple levels (transboundary, regional, national and local).
- While there is general agreement that the ecosystem approach provides an effective framing of ocean management, further research and capacity-building are needed to realize its full potential benefits across the oceans.
- Management has two different levels of governance, namely: decision-making processes that provide a framework for making decisions and implementing policy focused on the conservation and sustainable use of marine resources; and management tools (area-based and non-area-based) that can be used to regulate and modify human activity in a particular system.
- The implementation of the 2030 Agenda for Sustainable Development[1] requires management grounded in the ecosystem approach in order to achieve the integrated set of global priorities and objectives set out in the Sustainable Development Goals. That will allow for the integration of interactions, benefits and trade-offs between the Goals and support the achievement of each of the ocean-related targets.
- There is a growing trend towards incorporating the cultural values of the ocean into management.

1. Introduction

1.1. Need for management of the marine environment

The past decade has seen a step change in the development of management approaches for ocean resource management and sustainability. The present chapter is aimed at providing an overview of the nature of that change, as well as examples of selected good practices worldwide, including decision-making processes and tools. To understand those changes, it is important to recognize that approaches to ocean management have deep roots in local and indigenous communities, as well as in science, having evolved incrementally from initial attempts to deal with specific environmental issues, such as pollution from land-based sources in the 1960s, to more integrated approaches, such as integrated coastal zone management starting in the 1970s. Modern approaches to ocean management cover many different tools, tailored to regionally specific issues at various scales. The needs and nature of ocean management are influenced by social, cultural, economic and governance contexts, including the norms and value systems that have an impact on approaches to decision-making between government, industry and civil society at various levels. In general, ocean management is expanding from coasts and regional seas to include the regulation of increasing human activities in deeper waters of exclusive economic zones and continental shelves, such as through marine spatial planning (see chap. 26). Areas beyond national jurisdiction are currently the focus of negotiations at the United Nations in the context of the intergovernmental conference on an international legally binding instrument under the United Nations Convention on the Law of the

[1] See General Assembly resolution 70/1.

Sea[2] on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (see chap. 28). In applying the many different forms of management, an understanding of the approaches and their success to date is, therefore, necessary.

The present chapter commences with an introduction to one of the most significant emerging paradigms for ocean management, the ecosystem approach, which is now universally accepted at the global, regional and national levels (Secretariat of the Convention on Biological Diversity, 2004) as a strategy for integrated management. The ecosystem approach embraces the need for the engagement of all relevant sectors of society and has motivated increasing levels of support for bottom-up, community-led approaches to ocean management that take into consideration traditional rights and social justice and apply participatory processes. Those trends are juxtaposed in a stocktaking of global approaches to management, organized according to area-based and non-area-based examples. The bottom-up approaches are complemented by top-down approaches, developed through international, regional and national governance initiatives. That shows a diversity of ocean management interventions designed to address a wide range of issues, from global wetlands conservation to networks of marine protected areas. Adaptive management to integrate flexible strategies that mitigate and adapt to shifts in marine ecosystems associated with climate change is also analysed in the context of region-specific issues, capacity-building, gaps and future research.

1.2. Summary of the first *World Ocean Assessment*

The first *World Ocean Assessment* (United Nations, 2017) did not explicitly include management approaches in a stand-alone chapter, but rather provided a high-level commentary on management approaches integrated into individual chapters. Recognizing the importance of providing a consolidated overview of the many approaches to marine management and their application, a chapter specifically focused on ocean management has been included in the present Assessment.

1.3. Overlaps and interactions with other chapters

Management tools broadly apply across all marine uses and users; therefore the present chapter is relevant to all other chapters in the present Assessment, in particular chapter 15 on capture fisheries, chapter 16 on aquaculture, chapter 21 on renewable energy, chapter 25 on cumulative effects and chapter 26 on marine spatial planning.

2. Management approaches

2.1. Introduction to the ecosystem approach

The ecosystem approach consists of an integrated approach with three main pillars, namely the environmental, social and economic management of human interactions with oceans and coasts at multiple levels (i.e., transboundary, regional, national and local), incorporating both top-down and bottom-up perspectives. The Conference of the Parties to the Convention on Biological Diversity (United Nations Environment Programme (UNEP), 2000), in its decision V/6, described the ecosystem approach as "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use of biodiversity in an equitable way". As such, the approach has been widely

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

accepted and implemented as an effective management mechanism (see, for example, the European Union Marine Strategy Framework Directive[3] and the integrated ecosystem assessment implemented by the National Oceanic and Atmospheric Administration[4]).

There is a plethora of legislative instruments covering all aspects of marine use and requiring both vertical and horizontal integration (Boyes and Elliott, 2014). Top-down management approaches generally include policy and legislative instruments focused on implementing international conventions, agreements and instruments and meeting national priorities for marine spaces. Bottom-up management tools, including customary or indigenous ecosystem-based and stakeholder-based approaches to resource management (Thornton and Maciejewski Scheer, 2012; Turner and Berkes, 2006), are generally driven by a local-level need to implement effective management on a local scale. Bottom-up management tools can be motivated by social, economic or environmental aspects specific to an area, such as the need to address point source pollution impacts through targeted management.

Principles of the ecosystem approach adopted by the Conference of the Parties to the Convention on Biological Diversity (see decisions V/6 (2000) and VII/11 (2004))

Principle 1: the objectives of management of land, water and living resources are a matter of societal choice.

Principle 2: management should be decentralized to the lowest appropriate level.

Principle 3: ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Principle 4: recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:

(a) Reduce those market distortions that adversely affect biological diversity;

(b) Align incentives to promote biodiversity conservation and sustainable use;

(c) Internalize costs and benefits in the given ecosystem to the extent feasible.

Principle 5: conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Principle 6: ecosystems must be managed within the limits of their functioning.

Principle 7: the ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Principle 8: recognizing the varying temporal scales and lag effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Principle 9: management must recognize that change is inevitable.

Principle 10: the ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Principle 11: the ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Principle 12: the ecosystem approach should involve all relevant sectors of society and scientific disciplines.

[3] See https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm.

[4] See www.integratedecosystemassessment.noaa.gov.

The Conference of the Parties to the Convention on Biological Diversity acknowledges in its implementation guidelines (see box) that there are often limitations in current understanding and, in such cases, a precautionary approach should be followed.[5] The precautionary approach, as reflected in principle 15 of the Rio Declaration on Environment and Development of 1992[6] – in which it is stated that, where there are threats of serious or irreversible damage, a lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation – has been incorporated into an increasing number of international treaties and other instruments, reflecting a trend towards making the precautionary approach part of customary international law (see, for example, the advisory opinion of the Seabed Disputes Chamber of the International Tribunal of the Law of the Sea, 2011, para. 135).

2.2. Implementation of the ecosystem approach to management

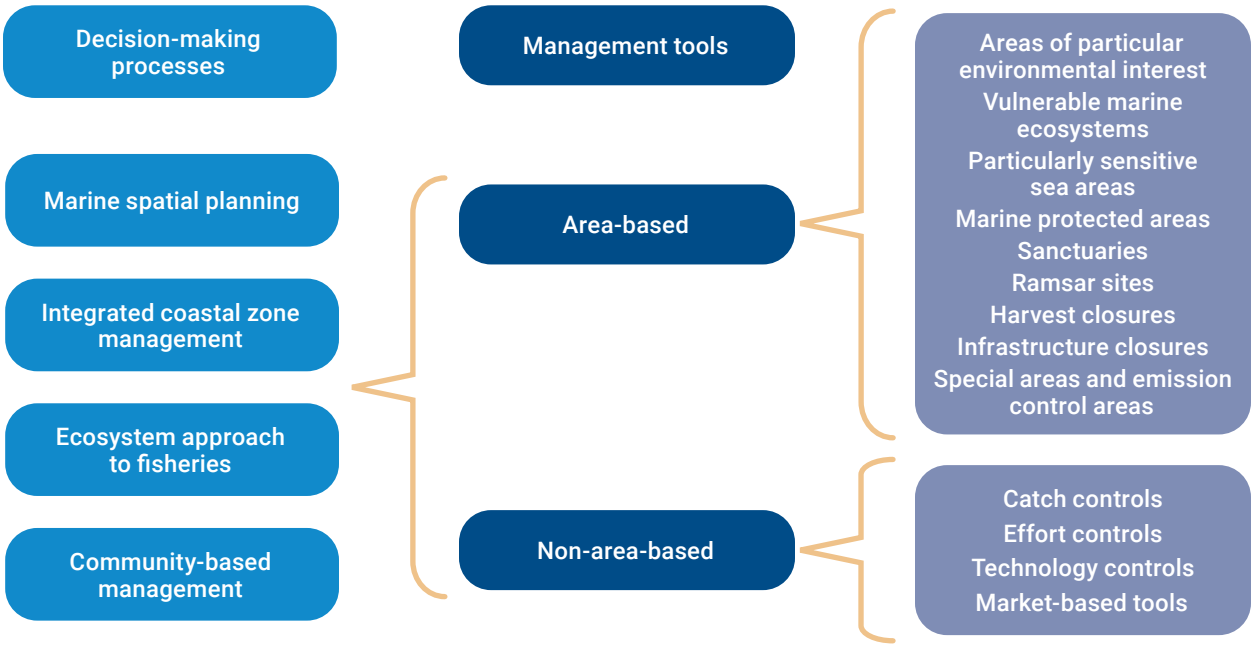
The ecosystem approach can be operated and implemented in a single sector, as in the case of ecosystem-based fisheries management (Cowan and others, 2012), ecosystem approaches to fisheries and aquaculture (Brugère and others, 2019), or in multiple sectors, as with integrated coastal zone management (UNEP, 2018). Over the past decade, specific cases of implementation of the ecosystem approach have resulted in management mechanisms moving towards establishing methods for operation and implementation (Zhang and others, 2011; Link and Browman, 2017). Despite this, there are still large gaps in implementation and incomplete uptake across sectors and regions. For example, there are still significant differing opinions on the implementation of ecosystem-based fisheries management from different stakeholders, such as policymakers, managers, scientists, conservationists and ecologists (Trochta and others, 2018). It is, therefore, necessary to create frameworks and criteria for ecosystem assessment (Harvey and others, 2017; Zador and others, 2017), in particular on the basis of demonstrated best practices. Developing methods to increase stakeholder engagement is also essential to ensuring successful implementation (Oates and Dodds, 2017).

Management is generally conducted at two different levels of governance: (a) decision-making processes that provide a framework for making decisions and implementing policy focused on the conservation and sustainable use of marine resources, such as marine spatial planning, an ecosystem approach to fisheries and integrated coastal zone management; and (b) management tools (area-based and non-area-based) that can be used to manage or regulate human activity in particular systems, such as marine protected areas and zoning (Maestro and others, 2019), fisheries closures (Hall, 2002), particularly sensitive sea areas (Basiron and Kaur, 2009) and fisheries management tools (Pope, 2002) (see also sect. 3 below). Numerous approaches have been developed to facilitate the implementation of ecosystem approaches through management mechanisms. The figure below illustrates a typology of approaches to ocean management.

[5] See Conference of the Parties to the Convention on Biological Diversity decision VII/11 (2004), annex I, implementation guideline 6.2.

[6] 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. See also www.cbd.int/doc/ref/rio-declaration.shtml.

Illustrative typology of approaches to ocean management



2.3. Community-based and culture-based management

One area in which ocean management based on ecosystem approaches continues to develop is the way that it supports engagement with communities and their culture. The Millennium Ecosystem Assessment identified cultural ecosystem services as the non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (Milcu and others, 2013; Díaz and others, 2018). As already noted, the principles of the ecosystem approach include the decentralization of management to the lowest appropriate level and the involvement of all relevant sectors of society. Furthermore, management approaches should recognize that the cultural services provided by the marine environment also include specific values and benefits derived from sites of anthropogenic origin, including archaeological and historical sites (such as shipwrecks and prehistoric submerged sites, known as underwater cultural heritage). Such sites or locations can exhibit a variety of values, including those of historical and archaeological significance, of a sacred nature (war graves or tombs) or of cultural importance (myths and folklore). They are benefits provided by the cultural footprint within the marine ecosystem. Hence, there is growing recognition that many marine ecosystem services are hybrids of culture and nature, appreciated holistically by coastal communities. For example, management of the Papahānaumokuākea Marine National Monument in Hawaii, United States of America, is framed by native Hawaiian understanding of the ocean as a cultural seascape, where all natural resources are cultural resources, connected through ancestral stories and perpetuated through traditional practices, including wayfinding and voyaging (Kikiloi and others, 2017). Notwithstanding an anthropogenic emphasis, community-based and culture-based management approaches respect the intrinsic value of nature for its own sake.

Equally, recognition of the limitations of top-down management approaches and increased understanding of the rights, tenures and

traditional and indigenous customary uses of inshore marine environments have catalysed widespread recognition of the strength and sustainability of community-based management, or bottom-up, approaches to marine conservation. Community-based management recognizes local community stewardship, knowledge and practices in monitoring, assessing and managing marine resources and through participatory, collaborative governance structures led by or involving local communities and systems of authority (Turner and Berkes, 2006). Many such schemes often develop from long-standing local institutions, such as the Alaska Eskimo Whaling Commission (Meek, 2013) and its self-organized aboriginal whaling captain associations that are now engaged in cross-scale (local to international) and community-based management. In the southern hemisphere, dugong management is shared by State and territorial agencies and communities in the Torres Strait between Australia and Papua New Guinea, through a system of indigenous rangers and Papua hunters (Miller and others, 2018). Such systems of shared management may be framed by a general understanding of the ecosystem approach but, at the local level, communities shape management approaches within their social and cultural values and the cultural benefits of their traditional practices (Delisle and others, 2018). As another example, networks of locally managed marine areas in the Pacific are building community resilience by supporting village-level management and sustainable use of marine resources (Govan, 2009; Veitayaki, 2003).

Growing recognition of the importance of marine ecosystem services to coastal communities and culture will undoubtedly intensify as those communities face pressures associated with climate change, in particular sea level rise and both temporary and permanent coastal inundation (Goodhead and Aygen, 2007; see also chap. 9). Cultural information is increasingly regarded as an integral part of ecosystem-based management, both in the context of community-based management and for safeguarding the cultural dimension of the marine environment. Such information may be very diverse and intangible, relating to, for example, traditional marine resource use, sea routes, ancient navigational skills, maritime identities, legends, rituals, beliefs and practices, aesthetic and inspirational qualities, cultural heritage and places of spiritual, sacred and religious importance.[7] That may make it challenging to incorporate such cultural values and practices into planning and management. Nonetheless, the cultural dimension of the sea can be integrated and mapped as a precursor to management. Once taken on board, culture can be powerful, not simply as a factor to be managed and monitored, but as the foundation upon which ecosystem approaches to management may be developed in the context of sustainable development.

3. Advances in ocean management approaches

The past decade has been characterized by the proliferation and expansion of new and existing approaches to the management of the oceans and seas. That has been manifested by the regulation of human activity in specific areas to achieve conservation or resource management policy objectives. Although all areas of the marine environment may be managed in

[7] A number of cultural practices relating to the sea have been inscribed in the Representative List of the Intangible Cultural Heritage of Humanity of the United Nations Educational, Scientific and Cultural Organization. See https://ich.unesco.org/en/lists.

some way (e.g., fisheries, tourism, oil and gas extraction), it often consists of a patchwork of policies and legislation that results in piecemeal approaches to protection (Boyes and Elliott, 2014). While the management processes and tools described in the present section tend to have a spatial dimension, they share the following set of common characteristics:

- Scale: from global to regional and to local
- Driving factors: motivated by conservation, economic development, environmental, social/cultural concerns
- Sectoral dimensions: single sector, multi-sector or cross-sector
- Implementation measures: hard measures (legally binding), soft measures (voluntary)
- Approaches to management: top-down, bottom-up or both

The present Assessment is focused on management approaches that alter some aspect of human use. Other tools, such as the description of ecologically or biologically significant marine areas[8] under the Convention on Biological Diversity,[9] do not change use but provide information that may play a role in decision-making processes. They should be distinguished, however, from decision-making processes, such as fisheries stock assessments, integrated ecosystem assessments and strategic environmental assessments, as they are a purely scientific and technical process exercise and do not include management measures, even though they have the potential to inform policy and management decisions. The same applies to other tools, such as important marine mammal areas.

3.1. Decision-making processes for management

Decision-making processes are used to identify the most appropriate policy and management objectives of competent authorities tasked with developing and implementing management approaches or strategies (see table 1). Governments, industry, communities and civil society identify the outcomes that they wish to achieve (i.e., management objectives) and use one of the potential approaches to identify how and where to achieve those outcomes. The outcomes described cover different aspects of sustainable development, including environmental, economic and social aspects. They may be global, regional, national, subnational or community-led. Common examples are marine spatial planning, integrated ecosystem assessments, strategic environmental assessments, an ecosystem approach to fisheries, ecosystem-based fisheries management, systematic conservation planning (McIntosh and others, 2017), community-based resource management (see sect. 2.3), source-to-sea approaches[10] and integrated coastal zone management.

At the regional level, examples of such approaches can be found in the context of the Convention for the Protection of the Marine Environment of the North-East Atlantic,[11] the Convention on the Protection of the Marine Environment of the Baltic Sea Area,[12] the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention)[13] and the Convention on the Protection of the Black Sea against Pollution. The conventions use an area-based approach to assess the status of the environment and control activities, aimed

8 See www.cbd.int/ebsa.
9 United Nations, *Treaty Series*, vol. 1760, No. 30619.
10 See www.siwi.org/publications/implementing-the-source-to-sea-approach-a-guide-for-practitioners.
11 United Nations, *Treaty Series*, vol. 2354, No. 42279.
12 Ibid., vol. 2099, No. 36495.
13 Ibid., vol. 1102, No. 16908.

at ensuring the good environmental status of marine assets. The organizations established under the conventions have working groups that focus on marine spatial planning, fisheries management and integrated coastal zone management.

The concept of adaptive management or adaptive resource management is shared across the decision-making processes listed (Dunstan and others, 2016), but the actual process used is often determined by the policy objectives (see also sect. 4). Within adaptive management frameworks, management measures or actions are implemented sequentially over time, taking into account future conditions and uncertainties associated with the responses of the resource being managed (Schultz and others, 2015). Conservation objectives are often met by using systematic conservation planning and community-based approaches at the local level in order to support local communities in the sustainable use and conservation of marine resources (Berkes and others, 2000; Nguyen and others, 2016). In contrast, the ecosystem approach to fisheries is aimed at providing a holistic approach to managing fisheries and other living marine resources by taking into account relevant human activities and their interactions with the ecosystem, with the purpose of maintaining health, productivity and resilience in order to ensure the continued delivery of ecosystem services and societal goods and benefits (Cowan and others, 2012). However, even with the more holistic processes, issues regarding the integration of multiple sectors remain (Jones and others, 2016).

3.2. Area-based management tools

Area-based management tools provide a spatial context to management approaches, whereby, usually, the area is defined as having distinctive characteristics that warrant measures that are different from the management of surrounding sea areas. Examples of area-based management tools that change or regulate aspects of human use of the marine environment include marine protected areas, particularly sensitive sea areas, areas of particular environmental interest, world heritage sites, fisheries closures, infrastructure closures and designations under the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention).[14] The application of the tools worldwide and the use of terminology is highly variable, owing in part to local hazards, risk and vulnerability and the need for resilience-building (Fanini and others, 2020). Notwithstanding such variability, there is general consistency in overall goals to improve pathways towards sustainability, and some of the tools could be used as other effective area-based conservation measures.[15] Examples (by no means exhaustive) of area-based management tools currently in use are highlighted below.

[14] United Nations, *Treaty Series*, vol. 996, No. 14583. See also www.ramsar.org.

[15] A definition and voluntary guidance for other effective area-based conservation measures was adopted by the Conference of the Parties to the Convention on Biological Diversity, at its fourteenth session. See www.cbd.int/doc/decisions/cop-14/cop-14-dec-08-en.pdf.

Table 1
Decision-making processes and their associated attributes, including primary drivers, sectors, implementation measures, direction and scale

Decision-making processes		Management approach													
		Primary driver			Sector			Measures		Direction			Spatial scale		
Example in practice	Relevant authority	Economic	Environmental	Social well-being/cultural	Single-sector	Multi-sector	Cross-sector	Legally binding	Voluntary	Top-down	Bottom-up	Both	Global	Regional	National	Subnational
Marine spatial planning (zoning, consenting, licensing, policy-led mechanisms)	Competent national or local authorities	x	x	x		x	x	x				x		x	x	x
Integrated coastal zone management		x	x	x		x	x	x	x			x		x	x	x
Systematic conservation planning			x		x	x		x		x					x	
Integrated ecosystem assessment		x	x		x	x		x		x					x	
Ecosystem approach to fisheries		x	x		x			x		x				x	x	x
Community-based management plans		x	x	x	x	x		x	x		x					x
Strategic environmental assessment		x	x	x	x	x		x		x				x	x	x

Marine protected areas provide specific protection mechanisms for specific areas of the ocean. They have been identified as one of the tools that should be implemented to achieve Aichi Biodiversity Target 11[16] and target 5 of Sustainable Development Goal 14.[17] The indicators and global targets for marine protected areas as identified under the Convention on Biological Diversity are currently undergoing revision through the process of negotiation of the post-2020 global biodiversity framework of the Convention. The areas can take many forms, covering varying spatial scales and providing varying levels of marine environmental

16 See United Nations Environment Programme, document UNEP/CBD/COP/10/27, annex, decision X/2, target 11: "By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes".

17 See General Assembly resolution 70/1, Sustainable Development Goal 14, target 5: "By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information".

protection. Examples of such areas include the 94,000 km^2 South Orkney Islands Southern Shelf area (established in 2009) and the 1.5 million km^2 Ross Sea area (established in 2017) designated by the Commission for the Conservation of the Antarctic Marine Living Resources;[18] the network of areas under the Convention for the Protection of the Marine Environment of the North-East Atlantic, with a total surface area of 864,337 km^2;[19] the specially protected areas of Mediterranean importance under the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean to the Barcelona Convention, including the 87,500 km^2 Pelagos Sanctuary for the Conservation of Marine Mammals established by a tripartite agreement between France, Italy and Monaco (established in 2001),[20] and the Natura 2000 network of the European Union, the largest coordinated network of protected areas in the world, spanning the marine territory of 23 European Union countries and, as at the end of 2018, covering more than 551,000 km^2.[21] Marine protected areas have increased rapidly in both number and size in recent years, largely in response to internationally agreed targets under the Convention on Biological Diversity and the 2030 Agenda, and are an important tool for marine conservation (Humphreys and Clark, 2020). Currently, global coverage in areas within national jurisdiction has reached 18 per cent, which amounts to 8 per cent coverage of the entire ocean. In contrast, only 1 per cent of areas beyond national jurisdiction have been established as protected areas (World Conservation Monitoring Centre and International Union for Conservation of Nature, 2019).

With regard to incorporating community and indigenous values into area-based management, examples can be found in the marine protected areas of Canada in the Arctic (including Anguniaqvia niqiqyuam in the Amundsen Gulf, Tarium Niryutait in the Beaufort Sea and Tuvaijuittuq off the north-west coast of Ellesmere Island in Nunavut). Anguniaqvia niqiqyuam was the first marine protected area in Canada with conservation objectives based on traditional and indigenous knowledge. The sites were identified as ecologically important areas that provide habitat for species of cultural importance and contribution to social and cultural values.[22]

Other examples of area-based management tools are provided for under conventions that seek to protect specific areas of diversity, habitat or heritage. In areas designated under the Ramsar Convention, for example, the broad aim is to halt the worldwide loss of wetlands and to conserve those that remain through wise use and management. As at February 2019, 2,341 sites had been designated under the Convention, comprising 252.48 million ha of internationally significant wetlands. A recently designated site is the Qurm Nature Reserve in Oman, which has successfully protected 106.83 ha of coastal wetland ecosystems through specific planning and management, as a result of its designation as a site listed under the Convention. Programmes include encouraging the development of nature-based tourism and community engagement in active management of the wetlands, which has

18 See www.ccamlr.org/en/science/marine-protected-areas-mpas.

19 As at 1 October 2018, the network of marine protected areas under the Convention for the Protection of the Marine Environment of the North-East Atlantic comprised 496 such areas, including 7 collectively designated in areas beyond national jurisdiction. See 2018 Status Report on the OSPAR Network of MPAs, Commission for the Protection of the Marine Environment of the North-East Atlantic, 2019. See also https://ospar.org.

20 See www.rac-spa.org/spami.

21 See www.eea.europa.eu/data-and-maps/dashboards/natura-2000-barometer.

22 See https://cases.open.ubc.ca/the-cultural-and-conservation-significance-of-anguniaqvia-niqiqyuam-marine-protected-area-mpa-north-west-territories-canada.

resulted in an increased economic value of the reserve to the community.[23]

Other mechanisms that use area-based management include the implementation of offshore exclusion zones or closures to facilitate infrastructure installation and operation, such as pipelines, offshore wind farms and telecommunications cables. Those areas are restricted primarily for public health and safety although, indirectly, they have resulted in the protection of marine habitats and biodiversity.

The area-based management tools of particular sectors, such as shipping, encompass the 17 areas designated by the International Maritime Organization as particularly sensitive sea areas,[24] including the Great Barrier Reef, the Torres Strait, the Florida Keys, the Papahānaumokuākea Marine National Monument, the Galapagos Islands, the Wadden Sea and Western European waters. The protection afforded in those areas includes routing measures and anchoring bans, mandatory reporting requirements and the strict application of discharge and equipment requirements for ships, such as oil tankers, as set out under the International Convention for the Prevention of Pollution from Ships of 1973, as modified by the Protocol of 1978 and the Protocol of 1997.[25] Four of the areas (the Great Barrier Reef, the Papahānaumokuākea Marine National Monument, the Galapagos Islands and the Wadden Sea) are also protected as marine world heritage sites (see below).

The regional environmental management plan adopted by the International Seabed Authority for the Clarion-Clipperton Zone in the eastern central Pacific included the establishment of an initial set of nine areas of particular environmental interest as "no-mining areas", on the basis of expert recommendations. Those areas were intended to protect the biodiversity and ecosystem structure and functioning of the Zone from the potential impacts of seabed mining (Jones and others, 2019; see also chap. 18).

Marine protected areas may also be used in combination with fisheries management tools and sanctuaries (no-take zones, which may be within such areas). Sanctuary areas, seasonal and year-round fisheries closures[26] and exclusion zones provide area-based management mechanisms that seek to improve species population and biodiversity recovery. For example, the International Whaling Commission has established two sanctuaries, both of which prohibit commercial whaling: the Indian Ocean Whale Sanctuary, which was established in 1979 and covers the whole of the Indian Ocean as far south as 55° S; and the Southern Ocean Whale Sanctuary, which was established in 1994 and covers the waters around Antarctica.[27]

Seasonal and year-round fisheries closures support the maintenance or recovery of overexploited species, preserve the livelihoods of local communities, protect habitats and key ecological processes, such as spawning, and prevent the exploitation of living resources in areas beyond national jurisdiction prior to specific rule setting as a precautionary measure. Examples include the identification of vulnerable marine ecosystems and spatial closures by regional fisheries management organizations or associations, no-trawl zones in the United

23 See https://rsis.ramsar.org/ris/2144.

24 See www.imo.org/en/OurWork/Environment/Pages/PSSAs.aspx.

25 See www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx.

26 See, for example, European Union Regulation No. 2019/1022 establishing a multiannual plan for the fisheries exploiting demersal stocks in the western Mediterranean, which provides, inter alia, for the establishment of three-month closures of areas for the protection of juveniles, to be determined spatially and temporally by each member State. See www.consilium.europa.eu/en/press/press-releases/2019/06/06/first-ever-multi-annual-management-plan-for-fisheries-in-the-western-mediterranean-becomes-reality.

27 See www.iwc.int/sanctuaries.

Kingdom of Great Britain and Northern Ireland to protect fish stocks and habitats, dynamic spatio-temporal closures in Australia to manage catches associated with migratory species and the closure of Arctic waters to commercial fishing under the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, pending a scientific assessment of the sustainability of such fisheries.

Area-based management is also used to safeguard marine sites of significance owing to their cultural value or the way in which the marine seascape combines cultural and natural attributes. World heritage sites under the United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention for the Protection of the World Cultural and Natural Heritage of 1972 (UNESCO, 1972) provide an international example. Since the inscription of the first marine site on the UNESCO World Heritage List in 1981, 50 marine sites in 37 countries have been recognized for their unique marine biodiversity, ecosystems, geological processes or incomparable beauty.[28] The largest is the French Austral Lands and Seas, designated in 2019, covering 67,296,900 ha, followed by the Phoenix Islands Protected Area in Kiribati, at 408,250 km², inscribed in 2010.[29] Four of the sites (the Papahānaumokuākea Marine National Monument in the United States; Saint Kilda in the United Kingdom; Ibiza in Spain; and Rock Islands Southern Lagoon in Palau) are internationally recognized for their mixed cultural and natural outstanding universal value. In a national context, all of the national marine sanctuaries in the United States include protections for historical, archaeological and cultural resources throughout the sanctuary system, and there are several sanctuaries designated specifically for their collections of historic shipwrecks (e.g., Thunder Bay sanctuary, Monitor sanctuary and Mallows Bay sanctuary).[30] In Scotland, the marine protected area concept has been developed to introduce areas around significant historic wreck sites (Historic Environment Scotland, 2019). Similarly, many national heritage laws provide for the designation of protection zones around underwater archaeological and historical sites, including measures such as the prohibition of fishing, anchoring and scuba diving without special authorization (e.g., Law No. 3028/2002 of Greece on the protection of antiquities and cultural heritage in general). Finally, special reference should be made to the recognition of the wreck site of RMS *Titanic* as an international maritime memorial under United States law and the international agreement between the United Kingdom and the United States that entered into force in 2019.[31]

[28] See whc.unesco.org/en/marine-programme.

[29] In addition, the number of marine world heritage sites declared as being "in danger" has been reduced from three to two sites. The Belize-Barrier Reef Reserve System was removed from the List of World Heritage in Danger in 2018 owing to the effective implementation of a national policy specifically relating to the adoption of forests (protection of mangroves) regulations, a moratorium on oil exploration and other petroleum operations within the entire maritime zones of Belize, and further revision and amendment of the environmental impact assessment checklist and the corresponding ongoing revision of the assessment regulations.

[30] See https://sanctuaries.noaa.gov.

[31] See www.gc.noaa.gov/gcil_titanic.html. See also the International Maritime Organization circular (MEPC.1/Circ.779, dated 31 January 2012) on pollution prevention measures in the area surrounding the wreckage of RMS *Titanic*. Since 2012, the wreck site has fallen within the scope of protection of the Convention on the Protection of the Underwater Cultural Heritage of 2001 (United Nations, *Treaty Series*, vol. 2562, No. 45694), which applies to all traces of human existence having a cultural, historical or archaeological character that have been under water for at least 100 years. See www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/the-heritage/did-you-know/titanic.

3.3. Non-area-based management tools

The management of the ocean is not limited to area-based approaches, although, paradoxically, all management measures are applied across a spatial area even if they are required or sanctioned at larger scales. Many activities are dealt with through a range of other measures, such as the regulation of chemicals and pollution events, the management of transboundary migratory species and the application of technical measures in fisheries management (see chap. 15).

Non-area-based tools are primarily sectoral in nature and regulate specific sectoral activities of a specific sector to achieve a specific outcome. For example, global emissions controls are applied to international shipping vessels (global sulphur cap),[32] while catches within fisheries can be restricted through catch limits and limits on effort (such as through quota-based systems, hook limits and capacity limits). Technology-based measures can also be applied to fisheries to restrict catches of non-target species (e.g., turtle exclusion devices), and market-based approaches (e.g., accreditation schemes, seafood sustainability or eco-labelling) can be applied across an entire fishery, at the global, regional, national or subnational level.

Non-area-based tools are also widely used in national law for managing cultural heritage at sea, such as the requirement to report discoveries and obtain a licence before carrying out any activities directed towards the excavation, removal or disturbance of underwater cultural heritage.

At the international level, the United Nations Convention on the Law of the Sea sets out the jurisdictional framework for the duty to protect objects of an archaeological and historical nature at sea (see art. 303 of the Convention; Strati, 1995). The Convention on the Protection of the Underwater Cultural Heritage of 2001 elaborates on that duty in specific rights and obligations within the various maritime zones as defined by the United Nations Convention on the Law of the Sea, by providing for, inter alia, a system of reporting or notification and consultation for the protection of underwater cultural heritage found in the exclusive economic zone and on the continental shelf, as well as in the Area. In addition, the rules annexed thereto concerning activities directed at underwater cultural heritage contain general principles of protection along with technical rules, such as standards for conservation and management.

[32] See www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx.

Table 2

Area-based management tools and their associated attributes, including primary drivers, sectors, implementation measures, direction and scale

Decision-making processes		Management approach													
		Primary driver			Sector			Measures		Direction			Spatial scale			
Example in practice	Relevant authority	Economic	Environmental	Social well-being/cultural	Single-sector	Multi-sector	Cross-sector	Legally binding	Voluntary	Top-down	Bottom-up	Both	Global	Regional	National	Subnational
Areas of particular environmental interest	International Seabed Authority	x	x		x			x		x			x			
Vulnerable marine ecosystems	Regional fisheries management organizations or associations, or competent national authorities		x		x			x		x				x		
Particularly sensitive sea areas and areas to be avoided	International Maritime Organization	x	x		x			x		x			x			
Fisheries closures and fisheries restricted areas	Food and Agriculture Organization of the United Nations, regional fisheries management organizations or associations, European Union or competent national authorities		x		x			x		x				x	x	x
Whale sanctuaries	International Whaling Commission		x		x			x		x			x			
Infrastructure closures: pipeline (e.g., oil, gas, waste, freshwater) and cable closures (e.g., telecommunications, grid)	International Maritime Organization or competent national authorities	x			x			x		x					x	

National marine conservation zones and priority areas for conservation	Competent national authorities				x			x			x			x				x	x
Aquaculture closures	Competent national authorities	x		x				x			x			x				x	x
World heritage sites, including those recognized for their mixed cultural and natural outstanding universal value	United Nations Educational, Scientific and Cultural Organization				x	x			x		x			x				x	
Marine protected areas	Aichi Biodiversity Targets, regional seas conventions or competent national authorities				x			x			x			x			x	x	
Protection zones around archaeological and historical sites	Competent national authorities					x					x			x				x	
Sites listed under the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	Ramsar Convention				x			x			x			x			x	x	
Species-specific sanctuaries (e.g., shark or dugong)	Competent national authorities				x			x			x			x			x	x	
Co-location (e.g., ocean energy or aquaculture)	Competent national authorities	x		x					x			x		x				x	x
Special areas and emission control areas	International Convention for the Prevention of Pollution from Ships of 1973 or International Maritime Organization				x			x			x			x			x	x	x
Community-based spatial closures	Local government or communities				x	x		x		x		x			x				x
Traditional management approaches, including indigenous ranger programmes	Community leadership or authority, or competent national or local authorities	x		x	x	x		x	x			x			x				x

Table 3
Non-area-based management tools and their associated attributes, including primary drivers, sectors, implementation measures, direction and scale

Decision-making processes			Management approach														
			Primary driver			Sector			Measures		Direction			Spatial scale			
Example in practice	Relevant authority		Economic	Environmental	Social well-being/cultural	Single-sector	Multi-sector	Cross-sector	Legally binding	Voluntary	Top-down	Bottom-up	Both	Global	Regional	National	Subnational
Catch and effort controls	Regional authorities	Competent national authorities	x	x		x			x		x				x	x	x
Technology controls			x	x		x			x		x				x	x	x
Market-based tools			x	x		x			x	x		x			x	x	x
Underwater cultural heritage protection mechanisms				x	x	x			x		x					x	x

4. Management tools to support mitigation of and adaptation to climate change, including building resilience

In undertaking the ecosystem approach, decision-making processes are also required to consider knowledge of climate impacts and mitigation and adaptive responses. In that regard, identifying the adaptation pathways that may be undertaken to advance climate resilience is important in determining which management processes and tools can incorporate the uncertainty and unpredictability of environmental impacts and responses across spatio-temporal scales (Holsman and others, 2019; Wise and others, 2014). The choice of different adaptive measures that may be implemented to achieve greater resilience can vary greatly and is contingent upon the decision-making processes that frame them. As an example, ecosystem-based disaster risk reduction contributes to the adaptability of integrated coastal zone management and protected area management, in particular in the case of vulnerable communities and countries (Ferrario and others, 2014; Satta and others, 2017). Alternative strategies may apply mitigation and compensation measures,[33]

[33] These follow a hierarchy of management measures: preventative measures (e.g., stopping pollutants from entering the sea); mitigation measures (e.g., reducing direct impacts); and compensation (e.g., the user (such as fishers for loss of catch), the resource (by restocking fishes or replanting mangroves) or the habitat (creating new habitats to replace those lost to new infrastructure)) (Elliott and others, 2016).

such as the blue carbon initiative. Effective mitigation approaches should also enhance linkages with adaptation finance, technology transfer and capacity-building, while adaptive responses should consider environmental, social and economic aspects in order to identify effective mechanisms that balance the needs and maximize benefits to all.

The global application of marine protected area networks helps to promote mitigation and adaptation to climate change (Dudley and others, 2010; Roberts and others, 2017) by supporting ecosystem resilience. By building resilience, ecosystems have a greater ability to cope with perturbations and recover from adverse circumstances, thereby maintaining ecosystem functions and the provision of services necessary for human well-being (Chong, 2014).

Resilience-based management (alongside area-based management tools) uses knowledge of current and future drivers that influence ecosystem function (e.g., coral disease outbreaks and changes in land use, trade or fishing practices) to prioritize, implement and adapt management actions that sustain ecosystems and human well-being (Mcleod and others, 2019). To support the maintenance of ecosystem resilience, managers must reduce local stressors (e.g., pollution and destructive fishing pressures), while fostering key resilience processes (e.g., recovery, reproduction, recruitment and connectivity) (Anthony and others, 2015; Graham and others, 2013). That requires managing the causes and consequences of the endogenic (local) pressures and responding to the consequences of the exogenic (global) pressures, given that responding to the causes of the latter requires global action (Elliott, 2011). For example, marine protected area networks can be designed for climate resilience by maintaining a diversity and redundancy of species, habitats and functional groups and pathways of connectivity and reducing stressors, and by including adaptive processes to accommodate uncertainty and change (Mcleod and others, 2019). Coral resilience and the associated ability to recover from bleaching events across the marine protected area network of Hawaii is supported through active management of herbivore fish aimed at maintaining and increasing herbivore biomass, abundance and functional diversity (Chung and others, 2019).

Along with marine protected area networks, there is a diversity of adaptation measures that can be carried out at the community and institutional levels. They include tools such as cross-sectoral coordination, flexible fishing licences, seasonal rights, transboundary management and enhanced institutional cooperation that can be applied in conjunction with market and livelihood diversification and resilience-building tools such as emergency preparedness, early-warning systems, remittances and post-disaster recovery plans (Poulain and others, 2018). In applying specific management tools, trade-offs should also be considered, as the tools can trigger contrasting effects on different sectors or countries. In the Arctic, for example, transboundary cooperation engages new actors and sectors, such as polar tourism, but also brings new risks, such as shipping and mineral exploration and exploitation. In the Mediterranean, transcontinental cooperation (between Africa and Europe) is needed to embrace regional adaptation measures to deal with the contrasting local needs and adaptive capacities of African and European countries (Karmaoui, 2018; Hidalgo and others, 2018).

5. Key region-specific issues

The implementation of the ecosystem approach through decision-making processes and management tools in the marine environment has progressed at different paces in different regions. Regions with higher skill levels, financial capacities and resources have experienced considerable progress in the implementation of the ecosystem approach. For example, rapid environmental change in the Arctic Ocean, driven by large-scale warming, has necessitated a shift by the Arctic Council from a focus on soft-policy scientific assessments to legally binding agreements negotiated by member countries. Those agreements have also become necessary as a result of the increasing opportunities for industrial uses of the Arctic Ocean and their attendant risks, including shipping activities, Arctic tourism, the transfer of alien species and mineral exploitation on the continental shelf of Arctic coastal States. Such rapid changes have prompted countries to adjust their policies to better respond to fast-emerging social, economic and environmental challenges resulting from climate change. Canada, for example, amended its Oceans Act in 2019 to be able to apply precautionary principles and allow interim protection for an area for up to five years, through the use of a ministerial order provision that freezes the footprint of human activities, meaning that no new or additional human activities will be allowed in the area for the duration of the order. In 2019, the Tuvaijuittuq marine protected area, the first created through the use the ministerial order provision, was established to protect the oldest and thickest sea ice in the Arctic Ocean as an important summer habitat for species as ice cover continues to decline in the Arctic.

In regions with more limited capacity, it is more difficult to implement the ecosystem approach. Many marine and coastal areas in such regions are confronting decades, if not centuries, of degradation as a result of a lack of management practices or controls and owing to the fact that restoration approaches are being implemented reactively. In South America (Gianelli and others, 2018; Reis and D'Incao, 2000), the implementation of ecosystem approaches to fisheries has been challenging, with restrictions on both institutional and scientific capacity, which has limited success to areas with favourable enabling conditions. Similar capacity challenges can be seen in the management of marine protected areas (Gerhardinger and others, 2011), although engagement with local knowledge holders has led to improvements in outcomes (Gerhardinger and others, 2009).

Much of the recent growth in the surface areas of marine protected areas can be accounted for by a small number of countries that have established large marine protected areas. Although the data reflect progress towards the conservation of biodiversity and marine resources, protection is still focused on waters under national jurisdiction and countries with the capability and capacity to identify and implement marine protected area networks. However, the designation of a marine protected area is not necessarily reflective of active management and protection, since many of them lack adequate management plans and associated enforcement measures (World Conservation Monitoring Centre and International Union for Conservation of Nature, 2019; Maestro and others, 2019). Similarly, the uneven geographical distribution of the areas limits their effectiveness, connectivity, coherence and representativeness.

Finally, climate change is becoming a key driver in prioritizing restoration approaches in many parts of the world, including the restoration of mangrove forests in Indonesia and in a number of small island developing States in the Pacific, which are aimed at protecting local communities from coastal inundation (Food and Agriculture Organization of the United Nations, 2016) and increasing resilience to future changes,

as well as restoring parts of the Great Barrier Reef in Australia following multiple bleaching events (Reef Restoration and Adaptation Program Consortium, 2018). The restoration of coral reefs in the Caribbean and oyster reefs worldwide employed small-scale techniques, such as micro-fragmentation, to address local-scale damage (Gilby and others, 2018). However, such approaches are often still limited in their scale. Further examples of climate adaptation and disaster risk reduction include the measures taken by Colombia, Ecuador and Grenada for mangrove restoration and coastal protection; the United Kingdom for coastal realignment; Mexico for sustainable fishing and mangrove rehabilitation; and Vanuatu for coral reef restoration (Secretariat of the Convention on Biological Diversity, 2019). The forthcoming United Nations Decade on Ecosystem Restoration (2021–2030)[34] is aimed at accelerating that trend (Waltham and others, 2020).

6. Capacity-building

Most management approaches require information that cuts across the natural and social sciences. In many regions, especially in developing countries, scientists and practitioners are simply not sufficiently trained to implement existing or new approaches to management, in particular those involving the ecosystem approach. Increased capacity, not only in understanding management approaches, but also in having the tools to implement them, will support Governments and other stakeholders in understanding the suite of options available for marine management and governance in their jurisdictions. Hence, there are several key capacity-building and technology-transfer requirements in that field. First, there is a need for training and expertise in marine management and governance linked to the relevant science, including training in policy drivers, as well as in policy-relevant science and policy repercussions of science – that is, how relevant science can be used in developing policy and what adaptations or revisions need to be made to policy as new scientific information becomes available. Second, there is a large scope for learning within and between nations and regions (i.e., knowledge and technology transfer), especially since some approaches have worked well in certain conditions, such as marine spatial planning programmes under the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Western Indian Ocean. In that regard, increased capacity in transboundary cooperation is needed, with science-based management as a core element. Third, there is also a large scope for learning across the breadth of different policies, including how policy was derived, especially for new practitioners but also as continuing professional development for more experienced professionals.

Knowledge of the key stages in implementing the planning and policy process for marine management, as well as the metrics for measuring and monitoring the effectiveness of management measures, are key requirements for countries that are starting to implement management approaches. An understanding by scientists and other stakeholders (including the public) of policymaking and the management of public behaviour, including related economic aspects, is also important in that regard. To achieve those goals, both formal and non-formal approaches to education are required. In addition, the transfer of knowledge regarding decision-making processes and tools across sectors should be promoted in order to ensure that the ecosystem approach can be applied holistically across marine sectors.

[34] See General Assembly resolution 73/284.

Gill and others (2017) indicated that staff and budget capacity were the strongest predictors of conservation impacts. Their study indicated that marine protected areas with adequate staff capacity had ecological benefits 2.9 times greater than those with inadequate capacity. Creating such areas without adequate investment will, therefore, result in suboptimal conservation outcomes. Limited resources in some cases may increase the need for citizen science programmes that can complement or support monitoring limitations (e.g., in the United Kingdom for shore biota and beach litter monitoring and clean-up programmes, as well as the Reef Check Foundation, MangroveWatch and the Manta Trust) in their global programmes (see also sect. 7.1 below). The techniques can be deployed worldwide as best practices for greater benefit.

7. Gaps and future perspectives

7.1. Data and information for management needs

Marine management approaches, processes and tools are often hampered by a lack of data of appropriate quality and quantity (Borja and others, 2017). Recent developments in the use of big-data methods, the innovative use of data and information in policy approaches and the linking of databases help to provide information in such situations. However, understanding of ecological causes and effects related to socioeconomic priorities, as reflected in modelling expertise and scientific support systems for decision-making (recognizing the complexity of coastal and marine systems) is still limited across many regions. The sharing of knowledge (e.g., the Ocean Biodiversity Information System) and open access to information and data streams, in particular across sectors, should be encouraged in order to ensure that the data collected are made available to all (e.g., "collect once, use many times"). The enhanced collaboration and connectivity of monitoring programmes will assist, not only in the sharing of capacity across sectors and institutions, but also in providing for more efficient approaches to the monitoring and provision of data and information. Data from citizen science are increasingly becoming an important source of monitoring information, where they are validated and accepted by the academic community (Bennett, 2019) to provide key information on environmental states and trends (e.g., Edgar and Stuart-Smith, 2014).

Challenges that still need to be addressed include the gathering of data for marine management in a cost-effective manner. The role of technology in marine conservation and management will become increasingly important, especially the collection and use of data from remote sensing and satellites. In sectoral and spatial management, for example, automatic identification system and vessel monitoring system data are used to manage shipping and fishing activities, in particular for mapping. Novel analytical approaches, such as machine learning, are increasingly being applied to the identification of illegal activities in those sectors (Longépé and others, 2018) and to monitor fishery catches (Lee and others, 2008).

7.2. Management requirements

Marine management requires the best available science for maintaining and protecting the natural system, while also providing benefits for the private sector and for society. More research is needed on ecological adaptation and resilience, inter alia, and the prediction of ecosystem response trajectories. Those variables should be built into management approaches that cover the scale of both the impact and response of marine ecosystems, which implies the need for a greater recognition of

human intervention in the marine environment as measured against baselines and for using thresholds and targets for unacceptable change. However, it is a major challenge and there is often no baseline or, because of climate change, baselines are moving. Better interconnected monitoring programmes across institutions also need to be established. Areas beyond national jurisdiction present a major challenge in that regard, in particular in deep sea ecosystems that are poorly surveyed.

Management approaches are underpinned by detailed governance mechanisms, such as policies, polities, administration and legislation. Improving the science-policy interface by enhancing capacity is necessary and particularly important where the knowledge base of informing decision-making is quickly expanding and emerging. Greater coordination is needed in that regard between social and natural sciences, between scientists and policymakers and between science and civil society, including industry, as is the inclusion of traditional knowledge, culture and social history in management. Such cross-sectoral understanding is important for management that is truly holistic.

7.3. Incorporating multiple values into management

The present chapter has shown an evident trend in management approaches from being focused on predominantly ecological aspects to the inclusion of diverse links between ecological aspects and societal, economic and cultural aspects of the marine environment. Management would be better equipped to achieve the fundamental goal of protecting and maintaining natural systems if it also recognized the wide range of ecosystem services and benefits derived from the oceans. Protecting and preserving the marine environment depends on engaging those who live or work with the sea and who gain benefits from it, in order to address deleterious behavious, restore inadvertently damaged systems and mitigate the impacts of a changing climate.

However, the values that people place on the marine environment and its services vary not only in quantity but also in character. Challenging to most management systems is the need to accommodate the multiplicity of values, for which real or perceived benefits cannot be equated with each other or reconciled. The best opportunities to understand and address multiple values are those that engage affected communities in the management approach, resulting in the need to combine ecosystem-based management with community-based management that is sensitive to the cultural dimensions of the sea. Such hybrid systems are more capable of balancing all three pillars of sustainable development (environmental, economic and social) and, as such, are likely to be more successful.

8. Outlook

While the present chapter has identified a plethora of approaches to the management of the marine environment, there is still much that can be done to improve and enhance progress, including with regard to the successful integration of the Sustainable Development Goals, especially Goal 14, into management objectives and programmes. There is also a need for the increased integration of measures to manage anthropogenic pressures that are not currently the focus of management measures, such as anthropogenic noise.

The implementation of the 2030 Agenda requires management grounded in the ecosystem approach in order to achieve the integrated set of global priorities and objectives set out in

the Goals. That will allow for the integration of interactions, benefits and trade-offs between the Goals and support the achievement of each of the ocean-related targets. Overall, the progress made to date, notwithstanding existing actions for the implementation of Goal 14, is insufficient. Accelerated action, in particular with regard to the targets of Goal 14 that mature in 2020, is necessary as a matter of urgency, including for targets 14.2, 14.4, 14.5 and 14.6. Although Goal 14 does not explicitly include any reference to marine cultural aspects, the outcome of the United Nations Conference to Support the Implementation of Sustainable Development Goal 14, entitled "Our ocean, our future: call for action", includes the need to develop comprehensive strategies to raise awareness of the natural and cultural significance of the ocean.[35] Similarly, the SIDS Accelerated Modalities of Action (SAMOA) Pathway recognizes the cultural connection of the communities of small island developing States to the ocean and the importance of traditional knowledge in the sustainable development of ocean-based economies.[36]

The outputs of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030)[37] and the concurrent United Nations Decade on Ecosystem Restoration will support the implementation of Goal 14 and provide many of the necessary data sources to apply management processes and tools, and will also increase ocean literacy.[38] The initiatives have the potential to advance the tools needed for current and future decision-making, improve overall understanding of issues and solutions for ocean management and increase societal engagement in decision-making and solution applications. Integrating the protection of the underwater cultural heritage into the United Nations Decade of Ocean Science for Sustainable Development[39] is also pertinent to support the tangible and intangible resources and cultural benefits provided by the oceans (UNESCO, 2019; Trakadas and others, 2019).

While it is implicit in the context of marine management, the present chapter has not covered the detailed nature of marine governance, nor the challenges associated with the sectoral and often fragmented nature of administrative bodies (e.g., Boyes and Elliott, 2014; 2015). In order to be effective across wider scales and for species that span large scales, both area-based and non-area-based management approaches will need to overcome the often fragmented and complex governance regimes worldwide.

The effective management of marine resources will also need to extend past areas under national jurisdiction to those that are beyond national jurisdiction, where challenges are greater owing to the complexities of the legal regime. That gives added significance to the current negotiations at the United Nations on an international legally binding instrument under the United Nations Convention on the Law of the Sea for the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (see chap. 28). Similar discussions have been initiated at UNESCO on expanding the scope of application of the Convention for the Protection of the World Cultural and Natural Heritage to provide for the protection and management of marine sites of outstanding universal value in high seas areas (UNESCO, 2016; 2019).

35 See General Assembly resolution 71/312, annex.
36 See General Assembly resolution 69/15, annex. See also https://sidsnetwork.org/samoa-pathway.
37 See General Assembly resolution 72/73.
38 See https://oceanconference.un.org/commitments/?id=15187 and http://ioc-unesco.org/index.php?option=com_oe&task=viewEventAgenda&eventID=2200.
39 See General Assembly resolution 72/73, para. 292. See also www.oceandecadeheritage.org.

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