Systematic Conservation Planning: A Better Recipe for Managing the High Seas for Biodiversity Conservation and Sustainable Use

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Abstract

At the UN Conference on Sustainable Development in Rio in June 2012, world leaders committed to the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction (the high seas). Our analysis of gaps in high seas management indicates that a paradigm shift to a more systematic approach will be needed to safeguard high seas biodiversity from mounting threats. Experience from terrestrial and coastal areas indicates that a systematic approach to conservation planning and management can help to maintain ecosystem health and productivity while enabling sustainable use. Our analysis further demonstrates that the current legal regime on the high seas is insufficient to realize these objectives: management institutions have neither an adequate mandate for integrated planning nor the ability to effectively coordinate across multiple management regimes. We identify key elements for future high seas management and posit that a two-pronged approach is most promising: the development of an improved global legal regime that incorporates systematic planning as well as the expansion of existing and new regional agreements and mandates. This combined approach is most likely to achieve the required ecosystem-based, integrated and science-based management that world leaders at Rio acknowledged should underpin ocean management.

Seeking a future for the high seas

Covering almost half of Earth's surface, the waters and seabed beyond national jurisdiction (hereafter the "high seas") are one of Earth's last resource management and conservation frontiers. Driven by diminishing resources within national jurisdictions and improving technologies, demand for and access to resources in the high seas is increasing. The expanding human footprint in the high seas threatens marine biodiversity and challenges sustainable resource use (Halfar & Fujita 2007; Halpern *et al.* 2008; Ramirez-Llodra *et al.* 2011). Conservation and sustainable use of high seas biodiversity was a major focus of the June 2012 UN Conference on Sustainable Development ("Rio+20"), including the possible development of a new international legal instrument under the UN Convention on the Law of the Sea (UNCLOS, Res. A/66/28; United Nations General Assembly 2012). Government leaders at

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Rio+20 fell short of agreeing, as many had hoped, to immediately launch the implementation process of such a new legal instrument. Nonetheless, participating nations committed to form an informal UN Working Group to facilitate debate and reach a decision on such a new instrument before the end of the 69th session of the United Nations General Assembly (i.e., by the end of 2014). At the same time, world leaders reaffirmed the importance of adopting ecosystem and precautionary approaches to oceans management, and committed to protecting and restoring the health, productivity, and resilience of oceans and marine ecosystems (United Nations General Assembly 2012). Given a commitment to reach a decision by 2014, there exists both a need and an opportunity to update a governance system initiated 40 years ago in a very different technical and political climate by informing the ongoing processes with analyses of high seas governance gaps and failures, as well as possible solutions.

The problem: fragmented management of the high seas

UNCLOS provides the overarching governance framework for human activities in the ocean. While recognizing the freedom of all States to access the high seas for resource exploitation, navigation and marine scientific research, it also contains an unequivocal obligation for all States to protect and preserve the marine environment. The environmental provisions in UNCLOS, however, are based on a 1970s view of the world where pollution was the major threat, climate change impacts were not widely anticipated, and most of the diverse and vulnerable deep sea ecosystems, such as hydrothermal vents, cold-water corals, and most seamounts, had yet to be discovered (Gjerde 2012). A key problem for biodiversity protection and sustainable use is that UNCLOS relegates authority for specific activities to an array of sector-based international organizations and conventions (Table 1), and separates governance of high seas water column from the seabed. This sector-specific management poses the same challenges to development of an integrated approach (widely advocated by, e.g., UNCED 1992) as is seen within national jurisdictions. However, within national jurisdiction, there is generally a single government with a cabinet (or similar structure) where decisions may be balanced among the interests of different ministries, and hence different stakeholders. For the high seas, such balancing mechanisms are weak or nonexistent, and thus management remains fragmented and sectoral interests overshadow comprehensive management (Gjerde & Rulska-Domino 2012). Expanding and intensifying activities on the high seas continue to magnify the potential for conflicts among management authorities (and users) and further loss of biodiversity.

Beyond fragmentation, current governance of the high seas is also spatially incomplete, with activities in some regions having no agreements in place (e.g., the regulation of fisheries in the southwest Atlantic) and other areas with fisheries agreements yet to come into force (e.g., the north Pacific; Figures 1 and 2; Gjerde *et al*. 2008). Further gaps are evident in the adoption and application of spatial management measures (Figure 3). Moreover, of the 18 regional seas organizations charged with ensuring cooperation for conservation and sustainable development, only four include areas of the high seas (Gjerde & Rulska-Domino 2012; Figure 4).

The result of the traditional approach taken to manage the high seas has been a limited, regional, sector-by-sector approach, with multiple authorities managing parts of the same regions, extensive areas without governance arrangements, and few attempts to coordinate activities, mitigate conflicts, address cumulative impacts, or facilitate communication. Such regional agreements only apply to participating States and are exposed to the risk that third parties will not join or abide by the rules (Gjerde *et al*. 2008), contributing to major deficiencies identified in most regional fisheries management organizations (RFMOs; Cullis-Suzuki & Pauly 2010). The only global agreement that contains clear objectives for conservation and sustainable use of marine biodiversity, the Convention on Biological Diversity (CBD), currently has limited legal authority in the high seas, and serves mainly as a vehicle to promote cooperation and provide scientific and technical advice, including describing ecologically or biologically significant areas (EBSAs; Dunn *et al*. 2011). Of the organizations or conventions with authority over some portion of the high seas, perhaps only the Southern Ocean (discussed later) is approaching "comprehensive management" (i.e., ecosystem-based, integrated, systematic, with spatial and nonspatial measures and coordinated science to inform management), and even then only for use of living marine resources (Figure 5). No other high seas management authority has conservation as a major objective. Yet, the science and expectations of the international community, as made clear at Rio +20, has changed in the 40 years since UNCLOS was first negotiated, such that ecosystem-based management and conservation, including protected areas, are expected to be a core concern.

Ecological evidence indicates the importance of coordinated and systematic management for high seas biodiversity. First, processes in the water column link the surface to deep waters and the seafloor, and link water masses laterally, requiring regionally and vertically integrated management (McIntyre 2010). Second, species

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Table 1 Key global agreements and UN bodies relevant to marine biodiversity and sustainable use in the high seas. Summarized from Gjerde *et al*. (2008)

Key global agreement	Description
United Nations Convention on the Law of the Sea (UNCLOS), 1982, in force 1994	Provides the legal order for the oceans to promote peaceful uses, equitable and efficient utilization of resources, conservation of living resources, and study, protection, and preservation of the marine environment. Includes high seas freedoms (Article 87), such as the freedom to fish and navigate, and environmental duties (Articles 192–196 and 204–206), including duty to protect and preserve the marine environment.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973, in force 1975	Objective is to promote international cooperation to protect threatened and endangered wildlife species against overexploitation from international trade.
International Whaling Convention (IWC), 1946, in force 1948	Ensures conservation of whale species.
International Convention for the Prevention of Pollution from Ships (MARPOL), 1973, and modified by Protocol of 1978	Seeks the elimination of intentional pollution of the marine environment by oil and other substances, and minimization of accidental discharge.
International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention), 2004, not yet in force	Seeks to prevent, minimize, and eliminate transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments.
Convention on the Prevention of Marine Pollution by Dumping Wastes and other Matter (London Convention), 1972, in force 1975, and its Protocol to the London Convention (1996, in force 2006)	Promotes all practical steps to prevent pollution of the sea by dumping of wastes and other matter. The London Protocol modernized the Convention by calling for a precautionary approach.
Convention on the Conservation of Migratory Species (CMS), 1979, in force 1983	Objective is to protect migratory listed species, conserve, or restore habitat and mitigate impacts that may impinge on their migration or survival.
Convention on Biological Diversity (CBD), 1992	Objectives are conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of benefits. In the high seas, applies only to processes and activities carried out under the control of Parties, which may have an adverse impact on biodiversity.
UN Fish Stock Agreement (UNFSA, an implementing agreement under UNCLOS), 1995, in force 2001	Ensure long-term conservation and sustainable use of straddling and highly migratory fish stocks through improving the implementation of relevant provisions of UNCLOS.
Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (FAO Compliance Agreement), 1993, in force 2003	Objective is to deter the practice of flagging and reflagging as a means to avoid compliance with national conservation and management measures. Does not apply to vessels fishing in areas where there are no RFMOs or agreed international conservation and management measures.
Key UN bodies	**Description**
United Nations General Assembly (UNGA)	The key political forum for member states to raise issues relevant to oceans and Law of the Sea.
UN Division on Oceans and Law of the Sea (DOALOS or the Division)	Serves as the secretariat of UNCLOS.
UN Informal Consultative Process on Oceans and Law of the Sea (UNICPOLOS)	Was established in 2000 for informal discussions on pressing issues regarding ocean affairs.
UN-Oceans	Interagency coordinating mechanisms within the UN system, established in 2003.
International Seabed Authority (ISA)	Established under UNCLOS as the organization through which States organize and control activities for exploration for and exploitation of nonliving resources.
UN Food and Agriculture Organization (FAO), Committee on Fisheries (COFI)	Global intergovernmental forum where major international fisheries and aquaculture problems and issues are examined and recommendations developed.
International Maritime Organization (IMO)	The United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships.
Intergovernmental Oceanographic Commission (IOC)	Focuses on international oceanographic research programs; part of the UN Educational, Scientific and Cultural Organization (UNESCO).
United Nations Environment Programme (UNEP)	Supports and coordinates activities and major international programs for conservation and sustainable use of oceans, including the Regional Seas Conventions and Action Plan.

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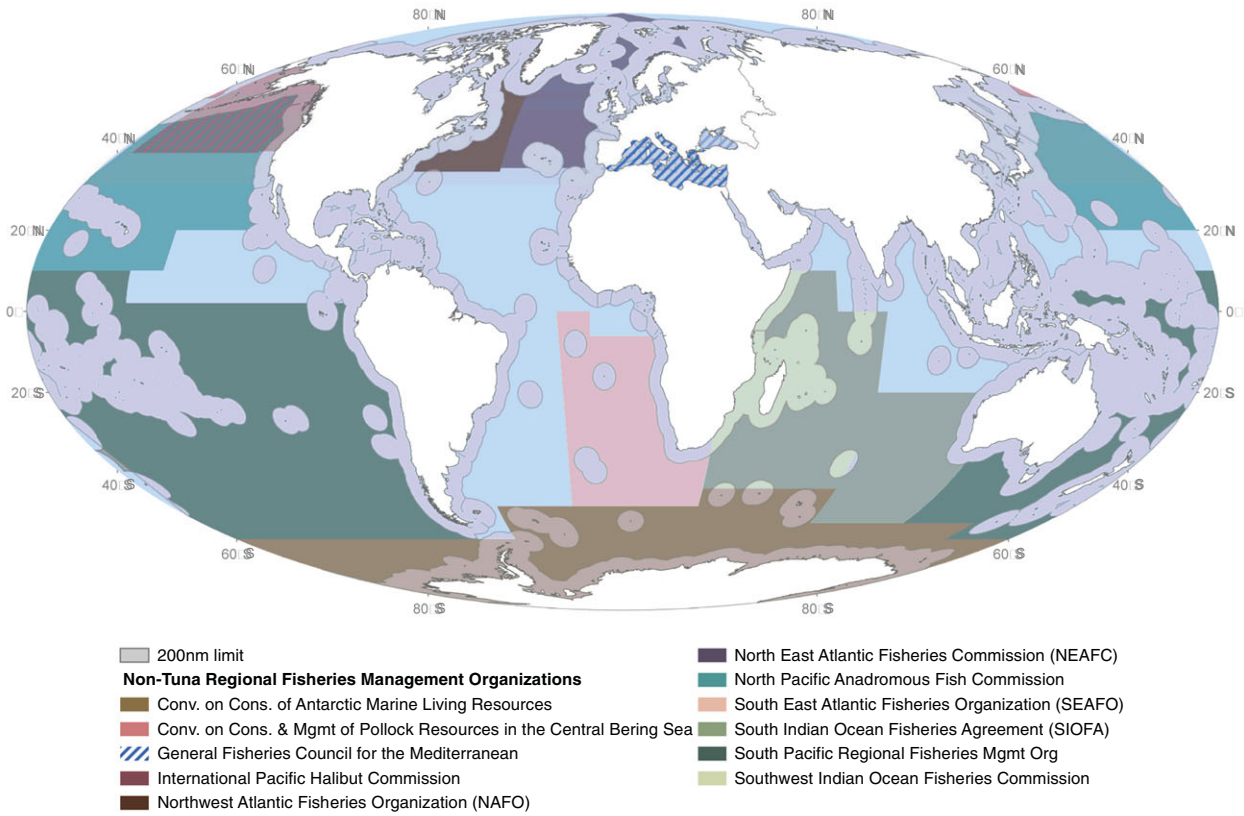

Figure 1 RFMOs that manage bottom fisheries and species other than tunas. Notable gaps exist in parts of the Atlantic, Indian, and Pacific Oceans. The 200 nm data were obtained from the VLIZ maritime boundaries geodatabase (http://www.vliz.be/vmdcdata/marbound/index.php). RFMO boundaries were provided courtesy of FAO (http://www.fao.org/geonetwork/srv/en/metadata.show?id=31675).

and habitats have differing vulnerabilities to exploitation and some are critically endangered, requiring cross-sectoral cooperation to ensure cumulative impacts do not drive extinctions and regime shifts (Dulvy *et al*. 2003). For example, while some pelagic fisheries are profitable and sustainable, bycatch has driven severe declines of oceanic sharks (Baum *et al*. 2003), with three-quarters of oceanic shark species now classified as threatened or near-threatened (Dulvy *et al*. 2008). Similarly, prey requirements are rarely considered in fisheries management (Cury *et al*. 2011; Smith *et al*. 2011). Third, even less is known about ecosystem functioning and species life-cycles in the high seas than in coastal areas (McIntyre 2010; Webb *et al*. 2010), emphasizing the need for adaptive and precautionary management. Such challenges can only be met with integrated, ecosystem-based, cross-sectoral management. The question before States, then, is whether existing multilateral agreements provide a suitable basis and the necessary authority to support such comprehensive governance of the high seas, or whether new regional and/or global legal instruments are needed to fill gaps. Numerous political and societal considerations will shape future governance of the high seas, but achieving sustainable resource management and conservation will require robust and proven scientific methods.

A way forward: systematic conservation planning

Systematic conservation planning (SCP), developed for terrestrial conservation and more recently used for marine conservation in national waters, provides a proven framework to examine whether existing mechanisms meet the basic requirements for conservation and sustainable management (Margules & Pressey 2000). Years of experience in the terrestrial realm have demonstrated the benefit of a systematic approach to planning and managing multisectoral spaces (Cowling *et al*. 1999; Pressey *et al*. 2003; Rouget *et al*. 2003; Fernandes *et al*. 2005; Sarkar *et al*. 2006; Lombard *et al*. 2007; Pressey & Bottrill 2009), and indicate that those benefits potentially extend well beyond the natural environment (Bottrill &

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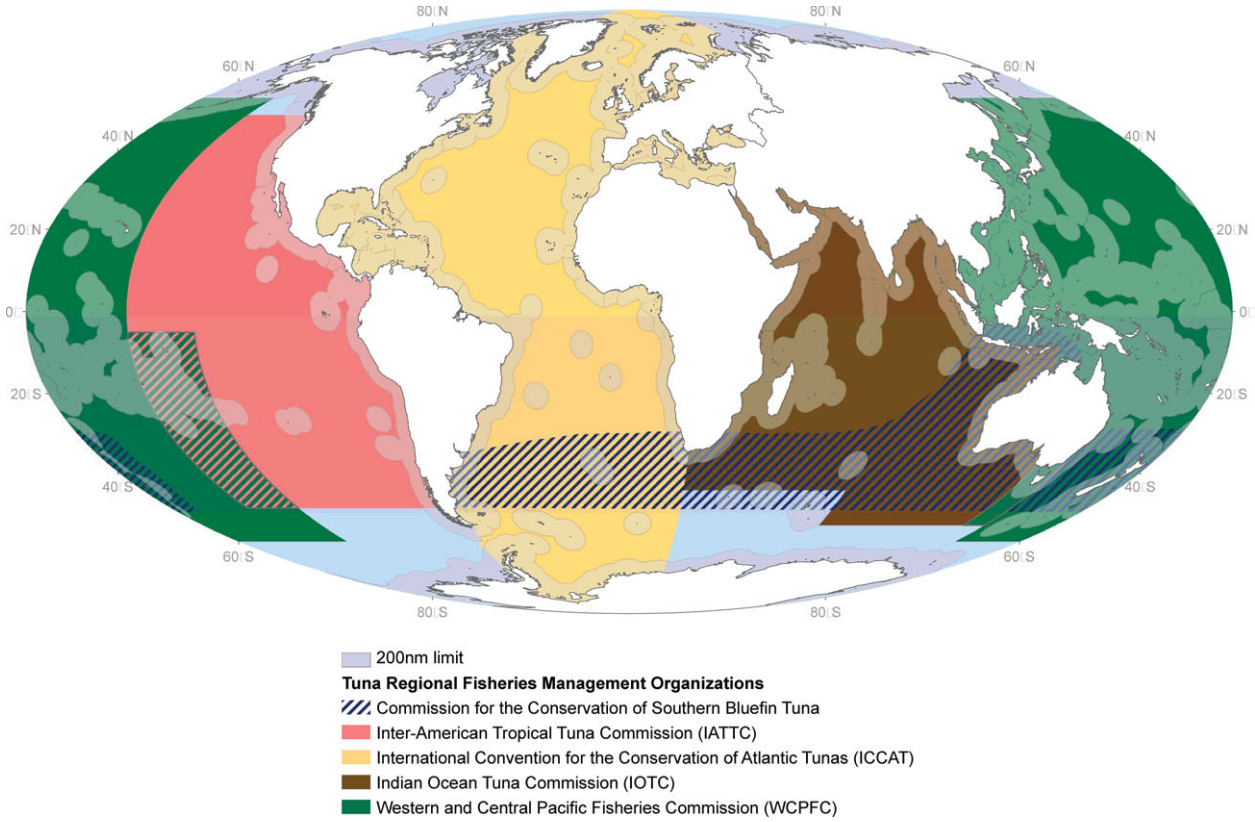

Figure 2 RFMOs that manage tuna and tuna-like species. Areas in light blue indicate no RFMO exists; all fisheries in the Southern Ocean are managed by CCAMLR. The 200 nm data were obtained from the VLIZ maritime boundaries geodatabase (http://www.vliz.be/vmdcdata/marbound/index.php). RFMO boundaries were provided courtesy of FAO (http://www.fao.org/geonetwork/srv/en/metadata.show?id=31675).

Pressey 2012). The process of SCP aims to meet goals and objectives through 11 stages that extend well beyond spatial prioritization (see Figure 3; Pressey & Bottrill 2009). Key components—and benefits—of systematic planning, compared to sector-specific or ad hoc approaches, include transparency (e.g., defined goals, explicit analyses of data, quantitative objectives), inclusiveness (e.g., engaged stakeholders, consideration of known elements of biodiversity), integration (e.g., complementarity of selected areas and actions, spatial connectivity), and efficiency (e.g., costs to users and implementers are minimized [Margules & Pressey 2000; Pressey 2007; Pressey & Bottrill 2009; Ban *et al.* In press]). These are some of the basic requirements for a future high seas governance structure that supports transparent and effective decision-making.

We reviewed existing legal agreements, and related spatial management tools for the high seas to the 11 planning stages. The tools included fisheries closures (for individual species and full closures), marine protected areas (MPAs), EBSAs, and vulnerable marine ecosystems (VMEs). Coverage of the recommended stages of SCP varied (Table 2). No management regime fully includes all stages or has an adequate mandate for the whole planning process (Figure 6, Table 2, Table S1). Emphasis has been focused on initial planning stages, particularly stakeholders (though almost always sector-specific), context, goals, and data, with little follow-through to subsequent stages. Moreover, data on features of concern (e.g., threatened species or fragile habitats) and human impacts (e.g., fishing, mining) are not integrated because they arise from independently managed industries. Missing or poorly covered stages include scoping (i.e., assessment of personnel and funding requirements), formulating quantitative objectives, identifying management gaps, selecting new systems of conservation areas, and applying actions to fill gaps.

Charting a course ahead

The general lack of a systematic approach is a serious concern for effective management of the high seas. We believe SCP can significantly contribute to achieving successful conservation and sustainable use of biodiversity

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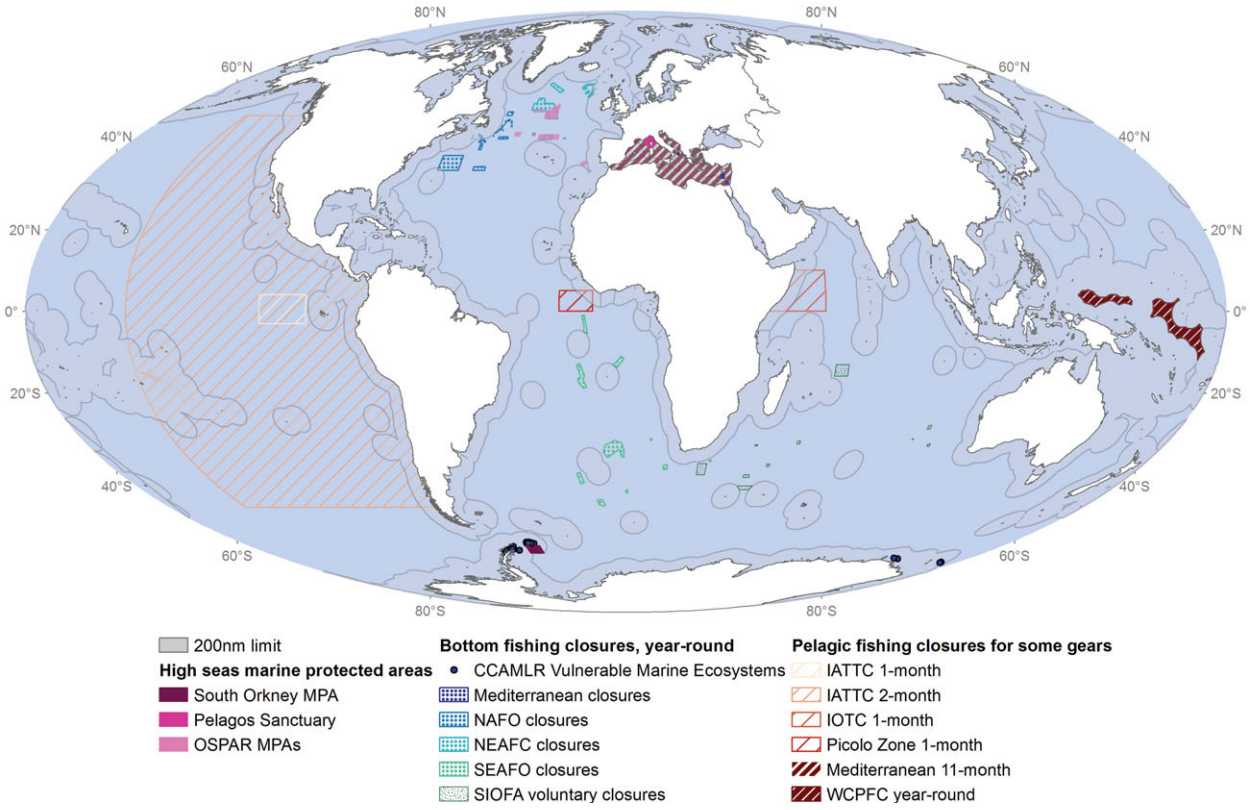

Figure 3 MPAs and fishing closures. Acronyms are explained in the captions of Figures 1 and 2. The closures depicted might be incomplete because no database of closures currently exists. The 200 nm data were obtained from the VLIZ maritime boundaries geodatabase (http://www.vliz.be/vmdcdata/marbound/index.php). Closures and spatial management areas were provided by CCAMLR, SIOFA, NEAFC, OSPAR, CBD, and FAO.

and resources in the high seas. Without systematic planning, there is little scope for integrating across sectors, working toward agreed objectives, or designing and implementing comprehensive and cost-effective management actions. However, SCP is not the sole ingredient needed to achieve these goals. We have identified five key elements for effective use of SCP for high seas management, and suggest that these should be integrated into such an approach:

(1) Ecosystem-based management. Management based on ecological realities of complex and interconnected food webs (Ardron 2010), including the full diversity of species and habitats with different vulnerabilities to human activities, has the best prospect of maintaining ecosystem services (Cury *et al.* 2011). While ecosystem-based management, including precautionary measures, is widely called for in national policies and global declarations, no overarching legal mandate exists in the high seas to embrace this approach. The CBD is working toward developing and monitoring ecosystem indicators (http://www.cbd.int/2010-target/framework/indicators.shtml), but these are as yet quite broad. There is thus a need to better integrate ecosystem objectives into the development of conservation objectives (stage 7 of the SCP framework).

(2) Integrated management. Management policies targeting individual objectives and ignoring interactions and synergies with others—a current practice in the high seas—risk being ineffective or even counterproductive in sustaining complex systems (Viguie and Hallegatte 2012). For example, States and RFMOs are mandated by a UN General Assembly resolution to identify and protect VMEs in the context of deep-sea bottom fishing only. Areas that are vulnerable to the impacts of pelagic fishing, seabed mining or to other human impacts have no comparable trigger for action, despite global commitments to establish MPA networks. Similarly, conflicting mandates and lack of communication between sectors and agencies can complicate regulations, increasing the burden

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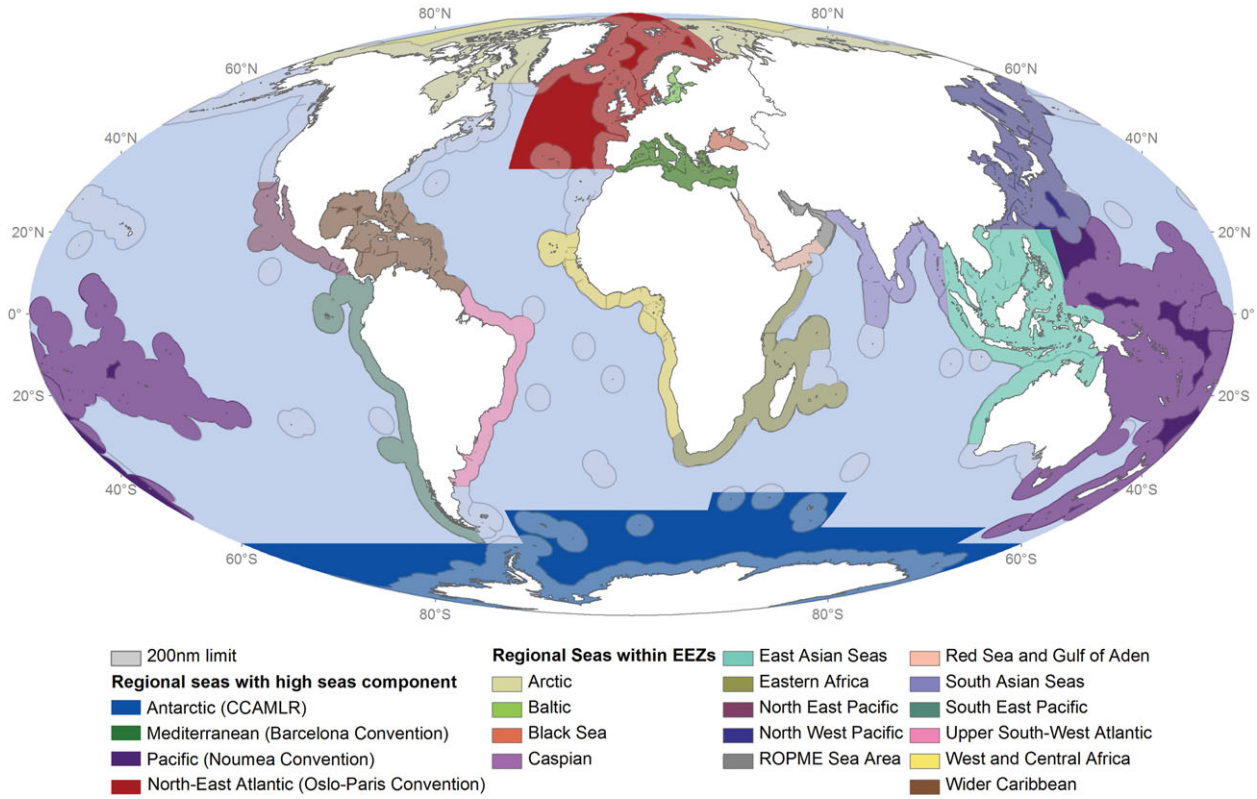

Figure 4 Regional seas organizations with and without a high seas component. The areas that remain in the background blue ocean color indicate a lack of regional seas organization. Notable gaps exist in most of the high seas. Data provided by UN University and CCAMLR. No spatial database of regional seas organizations exists, and hence boundaries of regional seas organizations are approximate and not intended to be fully accurate spatial descriptions. The 200 nm data were obtained from the VLIZ maritime boundaries geodatabase (http://www.vliz.be/vmdcdata/marbound/index.php).

of enforcement and potentially resulting in reduced compliance.

(3) Systematic approach to management and planning. Systematic planning provides a structured, transparent process for making decisions that weave together existing tools, and would allow managers to deliver on the two elements above. As identified earlier, a systematic approach can also help to identify and fill spatial and nonspatial gaps in management measures in the high seas. Currently, major geographic gaps exist between MPAs and fishing closures (Figure 3), and between RFMOs that manage bottom fisheries and species other than tunas (Figure 1), although fewer gaps exist for RFMOs that manage tuna and tuna-like species (Figure 2). Scientific tools to assist in filling such gaps using a systematic approach are available. These include Marxan (Watts *et al*. 2009), Atlantis (Fulton *et al*. 2011), and ecological risk assessment tools (e.g., Hobday *et al*. 2011), some of which have an established history of facilitating consensus across broad stakeholder groups.

(4) Coordinated spatial and nonspatial measures. Spatial measures such as fisheries closures or MPAs are crucial for ensuring conservation of vulnerable species and habitats, while nonspatial measures, such as catch limits for fisheries that span multiple regions or reballasting regulations for shipping, are also important. Both types of measures would benefit from a complementary and coordinated approach to avoid gaps and duplication. Given the vast area of the high seas and their presently fragmented management, a shared information system to track and coordinate such measures is essential.

(5) Coordinated science and monitoring to inform management. In remote regions such as the high seas, scientific understanding and data are usually limited, requiring additional data collection, better data sharing, and scientific analyses to monitor and adaptively

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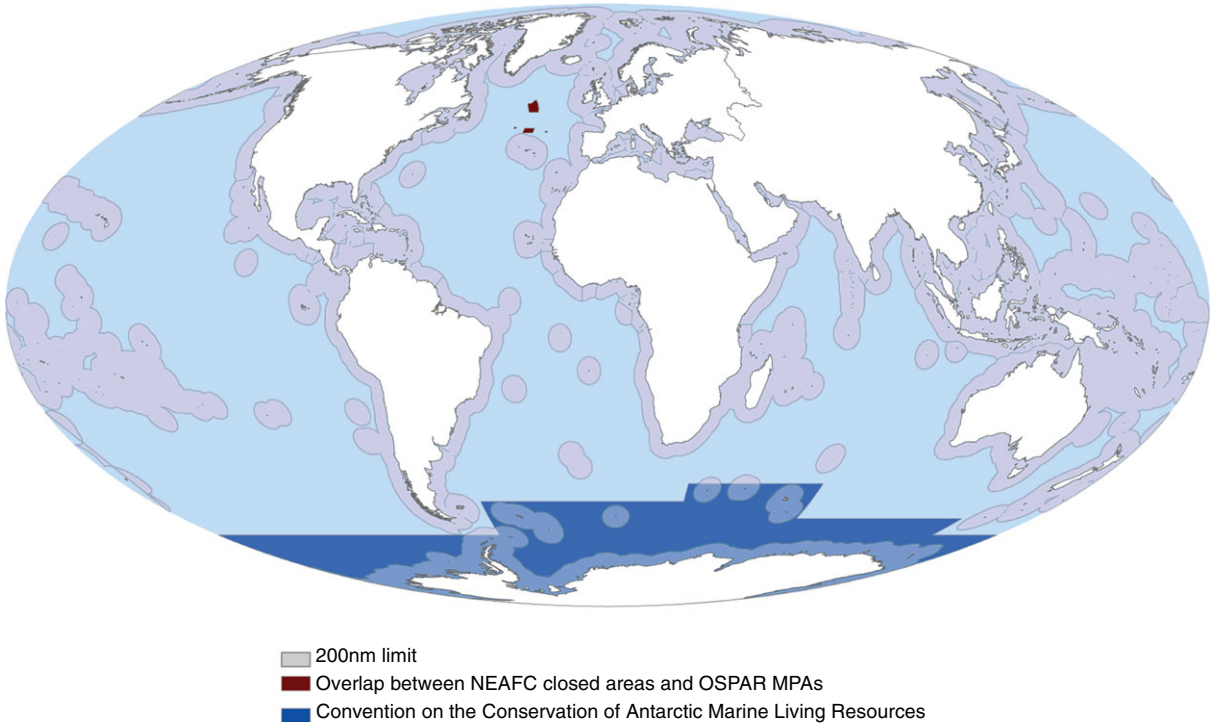

Figure 5 High seas areas with management approaching the integrated model put forward in this article. The CCAMLR encompasses management of the Southern Ocean. Overlap between NEAFC and OSPAR MPAs indicates the coordinated spatial coincidence of the NEAFC fisheries closures and the MPAs designated by the OSPAR for the protection of the marine environment of the North-East Atlantic.

improve ecosystem-based, integrated, and systematic management. Identifying and prioritizing science needs for cost-effective management would help build international collaboration and direct funding toward the science most useful for managers and policy-makers (Williams *et al.* 2010). The Intergovernmental Platform on Biodiversity and Ecosystem Services and the series of Global Ocean Assessments committed to by the UN General Assembly in 2010 under the "Regular Process" could become platforms for prioritizing data gaps and standardizing monitoring and assessment in the high seas (Bernal 2011). The international Ocean Biogeographic Information System (http://iOBIS.org), as part of the Framework for Ocean Observing being developed by the Intergovernmental Oceanographic Commission, can assist in the aggregation and sharing of biological and ecological data for the high seas. Data used to identify EBSAs, currently being described by the CBD (CBD 2010; Weaver and Johnson 2012), could be used in future systematic planning processes. Wider appreciation of the importance of better managing high seas biodiversity at global and regional scales could see initiatives such as the Global Ocean Biodiversity Initiative (http://GOBI.org) empowered to more fully engage the scientific community.

While the above suggestions are not individually new, there is a new urgency to describe if and how they can be incorporated into existing management mechanisms in the high seas, and what additional authority or mandate is needed to inform the process leading to a decision regarding a new implementing agreement under UNCLOS before 2014.

Building governance structures for conservation and sustainable use of the high seas

Given that no existing management regime comprehensively encompasses SCP on the high seas, nor do they have a mandate to engage in the full planning process, other avenues must be developed. Two complementary approaches are emerging as ways to implement conservation and sustainable use of the high seas: a legally binding agreement under UNCLOS and regional multilateral agreements (Table 3). Some argue that an agreement to implement and update the general environment

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Table 2 Alignment of policy processes and their spatial measures in the high seas with stages of SCP. Only the measures currently implemented in the high seas (yellow and green shading) were included in the analysis (Figure 6), with each partial coverage given half the weight of full coverage. For description of acronyms, see Table S1

	Implemented in high seas							Being implemented in high seas	Not (yet) implemented high seas		
				Regional Seas (in high seas)							
Stages of SCP	FAO/ RFMO (VMEs)	RFMO (fishing closures)	ISA (ASMAs)	CCAMLR (including ASPAs and ASMAs)	OSPAR (MPAs)	Mediterranean protocol	Pacific regional seas	CBD (EBSAs)	IMO (PSSAs)	UN regular process	World heritage convention (Sites)
1. Scoping	X	X	X	✓	X	X	X	X	X	X	X
2. Stakeholders	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	✓
3. Context	✓	✓	✓	✓	✓	X	✓	X	✓	X	X
4. Goals	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	✓
5. Social data	✓	✓	✓	✓	✓	X	X	X	✓	✓	✓
6. Biodiversity data	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	✓
7. Objectives	X	X	✓	✓	X	X	X	X	X	X	X
8. Analyze gaps	X	X	X	✓	X	X	X	X	X	X	X
9. Select system	X	✓	✓	✓	✓	X	X	X	X	X	X
10. Apply actions	✓	✓	✓	✓	✓	X	X	X	✓	X	✓
11. Monitor	✓	✓	✓	✓	X	X	X	X	✓	✓	✓

✓ Comprehensive coverage.
✓ Partial coverage.
X No coverage.

provisions under UNCLOS would be the more effective (Gjerde 2012). As with a prior UNCLOS implementing agreement for straddling and highly migratory fish stocks (UN Fish Stocks Agreement), this approach could operationalize management principles such as ecosystem-based and precautionary management. It could set explicit goals, objectives, and targets for protection of biodiversity and the marine environment alongside sustainable use of resources, designate responsible organizations to implement tools such as MPAs and cumulative impact assessments on the basis of a systematic approach (Gjerde 2012). It need not replace existing sectoral or regional organizations, rather it could establish a conference of parties and secretariat to facilitate coordination, enhance coherence, and promote compliance through global-level review and assistance. In short, it could establish the balancing mechanism for decision-making that is currently lacking, and the legal mandate and procedure for incorporating a systematic approach into management planning and decision-making. As scientific input is vital, a new agreement could designate or create a science body to inform the systematic planning efforts.

However, implementation of a new international agreement is likely to be time consuming, and most progress to date has been made within specific regions, such as in the North-East Atlantic and the Southern Ocean (see next section; Druel *et al.* 2012). Thus, another avenue for working toward conservation and sustainable use in the high seas is through existing regional efforts (Table 3). The North-East Atlantic provides an illustration of how progress has been made in regions. In this region, six high seas MPAs were established in 2010 through the unanimous agreement of the Contracting Parties to the Convention for the Protection of the Marine Environment of the North-East Atlantic (Oslo and Paris Conventions [OSPAR]; O'Leary *et al.* 2012). The MPAs protect a series of seamounts and sections of the Mid-Atlantic Ridge and host a range of vulnerable deep sea habitats and species. A seventh pelagic high seas MPA, without seafloor protection, was designated in 2012. In all, five of the OSPAR MPAs span the legal high seas and seafloor that is under claim by a State. Four of these were established cooperatively with Portugal and have commitments to protect the seafloor as well as the water column. In these hybrid cases,

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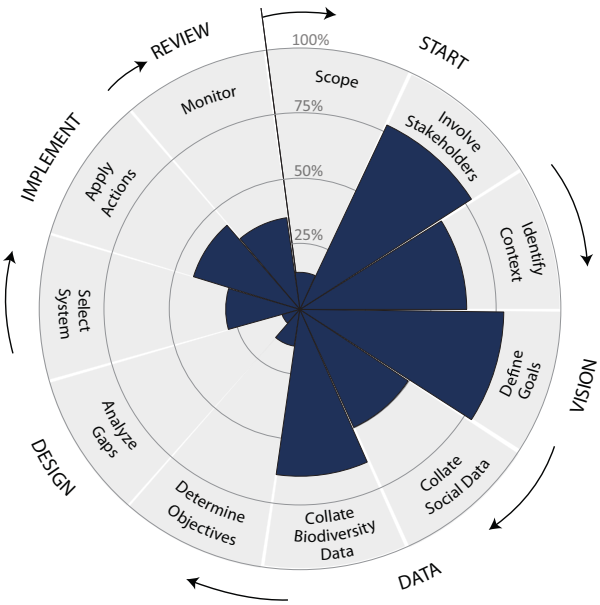

Figure 6 Percentages of existing policy and spatial management measures in the high seas that cover each of the 11 stages of systematic planning. Blue segments indicate the percentages of existing policy and spatial management measures in the high seas ($n = 7$, see Table 2) that cover each of the 11 stages of systematic planning (Pressey & Bottrill 2009). "Scope" defines the planning region, project team, and budget. "Involve stakeholders" identifies stakeholders for subsequent stages and develops strategies for engagement. "Identify context" describes the social, economic, and political context for planning, threats to natural features, and both spatial and nonspatial requirements for mitigating threats. "Define goals" generates a vision statement for the region and elaborates this to qualitative statements of intent. "Collate social data" and "collate biodiversity data" involve spatially explicit data on human uses and natural features to be managed. "Determine objectives" interprets goals, through the filter of available data, into quantitative targets for specific natural features. "Analyze gaps" reviews achievement of objectives in established spatial management areas. "Select system" identifies spatial management actions, in addition to established ones, necessary to achieve objectives. "Apply action" translates indicative system designs into designated actions in the ocean. "Monitor" ensures that areas with applied actions are managed appropriately to promote the achievement of objectives.

approval of a management plan or individual conservation measures is challenged by the need to respect both national requirements and those of international bodies (Ribeiro 2010). Nevertheless, through the collective efforts of certain champion Contracting Parties, NGO observers, and an active Secretariat, OSPAR achieved what many thought was highly improbable just 5 years earlier (O'Leary *et al*. 2012). The sites were selected based on a scientific analysis and review process, and thus was somewhat systematic, though arguably not comprehensive. The gains made to date can be used as a strong basis for a follow-up systematic approach to fill remaining gaps. Furthermore, OSPAR and the North-East Atlantic Fisheries Commission (NEAFC) have signed a memorandum of understanding that includes, inter alia, cooperating on questions of conservation. NEAFC fisheries closures and OSPAR high seas MPAs largely overlap, though there are some discrepancies, highlighting that the two approaches have not yet been completely integrated.

Regional agreements such as that in the North-East Atlantic offer a pragmatic way forward because they require buy-in from a smaller group of States and more directly address the constraints of political and scientific realities within the respective regions, but might be insufficient by themselves. Regional agreements could influence global approaches by offering a prototype for future global efforts, especially if they are given the mandate to pursue a systematic approach. However, such regional multilateral agreements are not common, leaving large spatial gaps in the high seas, and without an overarching global mandate, some regions and entrenched sectors may never see such management, or the resulting measures might not reach the acceptable standard determined globally. Furthermore, multilateral agreements only bind the regional parties, and may be taken advantage of by non-Party States. Also, no one approach is ideal in all circumstances (Ostrom 2007). Instead, different approaches at multiple nested levels, if coordinated, can work effectively and provide safety nets should one fail (Ostrom & Cox 2010). Thus, a hybrid approach is likely required: to support existing regional efforts in the short to medium terms, while also pursuing a new legally binding global implementing agreement for the longer term.

Regional ecosystem-based management in the Southern Ocean: proof of concept for the high seas?

The Southern Ocean offers the one example of reasonably comprehensive and integrated regional governance approaching the full SCP framework described above (Constable *et al*. 2000; Kock *et al*. 2007; Österblom *et al*. 2010). In this region, management and prohibition of resource extraction and other activities are enabled by the Antarctic Treaty System with its Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), covering the whole Southern Ocean, and the Environment Protocol (Madrid Protocol) encompassing other human uses south of 60°S. Unlike RFMOs that focus on achieving the maximum sustainable yield of targeted fish stocks, the explicit objective of CCAMLR is to ensure the conservation of living marine resources, where conservation includes rational use. The Madrid

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Table 3 Hypothetical examples of how an SCP approach could work in the high seas. The key stages of SCP are shown to illustrate differences between a regional and global approach. See Figure 6 for the full list of SCP stages

Stage of SCP	Global approach	Regional approach	General issues
Scope	Could set forth the mandate, principles, goals, and objectives to develop an improved global legal regime that incorporates systematic planning as well as the expansion of existing and new regional agreements and mandates. Would have to address all pertinent global issues.	Could be restricted to the most relevant issues or a subset of issues that are considered tractable (with a risk of not being truly systematic). Bodies well-placed to adopt or adapt a systematic planning approach include regional seas and RFMOs (if strengthened and with broader participation).	The overall approach of how decisions will be made in the planning process needs to be determined, and the advantages of taking an inclusive approach balanced with the disadvantages that one, or a few parties, can hold a consensus-like process hostage to its minority position. Agreement in advance on formal procedures to overcome such impasses can lead to solutions in a timely fashion. For example, while the ISA has successfully used consensus in its decision-making, it has the option of bringing "questions of substance" to vote requiring a two-thirds majority (UNCLOS, Part XI, Art. 159, §8).
Involve stakeholders	Could include an approach to identify stakeholders and their engagement, ensuring that decision-making is inclusive and transparent. Can ensure consideration of interests of the wider global community in the conservation and sustainable use of high seas, regional circumstances, as well as economic needs.	Smaller and likely more tractable group of stakeholders. Strategies for engagement are needed, and funding is likely necessary to enable less-developed nations and industries to participate.	Identifying and engaging stakeholder is a challenge in the high seas. Theoretically, every nation has access to the high seas and its resources, but only few highly specialized professions spend time in the high seas, generally associated with highly developed industries: defense, shipping, fishing, cable lying, oil and gas, and mining exploration and exploitation. Industry organizations and multiindustry bodies such as the World Ocean Council and International Chamber of Shipping can assist in stakeholder identification for these specialized industries, but the broader interests of all nations cannot be forgotten.
Define goals	Could include legally binding goals, which can then be implemented globally or regionally.	Would focus on regionally relevant goals.	Internationally agreed-upon biodiversity goals already exist under the CBD, but the CBD has limited legal authority in the high seas, and mainly promotes cooperation and provides scientific and technical advice.
Collate social and biodiversity data	Could facilitate data collation and collection, make data available to regional and global planning bodies and assessments, and carry out regional comparisons.	Allows for more focused data collation, but potentially increases duplication of data collection and storage if not shared across regions.	Scarcity of data is a problem in the high seas. Efforts have been underway to collect biodiversity data (e.g., Census of Marine Life, iOBIS), but no such effort exists for socioeconomic data.
Monitor	At the global scale, can coordinate data collected at a global level (e.g., remotely sensed environmental data, fishery catch statistics) and facilitate distribution to regions; can also coordinate to tackle global issues such as illegal, unreported, and unregulated (IUU) fishing.	Use remote monitoring tools such as vessel monitoring systems (VMS), automatic identification systems (AIS), and remotely sensed environmental data, coupled with on-the-ground tools such as at-sea surveys, to monitor human and ecological activity to determine effectiveness of actions.	Monitoring in an area as vast as the high seas is a challenge, but technologies are continually being developed and improved to make monitoring more feasible.

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Protocol provides a framework for managing other, mainly terrestrial, activities through environmental impact assessments, as well as a mandate for a system of Antarctic Specially Protected Areas and Antarctic Specially Managed Areas, including marine areas, and species conservation measures. Management of fisheries, one of the main responsibilities of CCAMLR, is based on a precautionary approach to minimize the risk of long-term adverse effects, and an ecosystem-based approach that seeks to account for all components of the ecosystem.

While the Southern Ocean provides a good example of regional ecosystem-based management, it emerged out of a different context than UNCLOS and is facing some challenges. The Antarctic Treaty emerged to avoid territorial conflicts among nations over the Antarctic and its waters, and to protect the then considered "pristine continent." The early emergence of overarching treaties, in response to the rush to exploit the Antarctic, likely contributed to the willingness of countries to work together in this region toward common management goals. This region has followed, or has indicated that it will follow, many of the stages of the systematic approach, even though not necessarily referred to as such (e.g., framework to establish MPAs, CCAMLR Conservation Measure 91–04). Yet, challenges remain even in this relatively progressive region, especially to regulate in pace with new or increasing threats such as climate change and pollution (Veitch *et al*. 2012). For example, a challenge is the time involved in using a consensus approach to decision-making (see also Table 3). A case in point is the CCAMLR meeting in 2012, when a series of MPAs were proposed but, unable to achieve consensus, discussions and negotiations were postponed to a special meeting in mid 2013 (http://www.ccamlr.org/en/news/2012/ccamlr-strengthens-marine-conservation-antarctica). Despite challenges, the Southern Ocean does illustrate that international cooperation with the aim of conservation of biodiversity and sustainable use of fisheries is possible, if difficult.

Conclusion

At Rio+20, the global community called for urgent action to improve biodiversity conservation and sustainable use of the high seas. To achieve these goals, and to realize the associated environmental, social, and economic aspirations, a systematic approach is required that is ecosystem-based, integrated across sectors, and coordinated across spatial and nonspatial measures. To support such an approach, two improvements to governance of the high seas are urgently required: a new international legal agreement building on the existing UNCLOS framework; and improved regional arrangements, complemented with a renewed impetus in international scientific cooperation.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Table S1: Description of high seas management measures from Table 1.

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