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***Parks* is published to strengthen international collaboration among protected area professionals and to enhance their role, status and activities by:**

- maintaining and improving an effective network of protected area managers throughout the world, building on the established network of WCPA;
- serving as a leading global forum for the exchange of information on issues relating to protected area establishment and management;
- ensuring that protected areas are placed at the forefront of contemporary environmental issues such as biodiversity conservation and ecologically sustainable development.

Cover: *Ocean sunfish and drift kelp. Drift algae is an essential grazing habitat for large pelagic fish, like this ocean sunfish* Mola mola, *cruising along drift kelp in the Eastern Pacific.* Photo: © Phillip Colla / SeaPics.com

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Editorial

GRAEME KELLEHER AND KRISTINA GJERDE

THIS EDITION of PARKS recognises the critical roles played by the world's oceans in maintaining the biosphere and the rapidly increasing stresses being applied to them by human activities. The oceans, and consequently the biosphere, are under threat. These threats are embodied in the great reductions in populations of fishery-targeted marine species, the destruction of deepsea benthic habitats which are biological 'islands' with many endemic, slow-breeding species and the now almost universally recognised increases in global temperatures, among other issues. In particular, the latter may lead to unpredictable changes in ocean circulation patterns, with potential dramatic effects including shifts in species composition, migratory patterns and even entire ecosystems. Healthy ecosystems are better able to respond to changing oceanic conditions. The time to act is now.

Many of the threats to fished species have long been recognised and attempts to ameliorate them by conventional fishery management approaches have often demonstrably failed, particularly, but not only, in the sea areas beyond national jurisdiction referred to here as the High Seas.

The High Seas are special. They cover about 50% of the world's surface but are regulated in almost inverse proportion to the size of the area they occupy, as well as to their substantial importance to life on earth. The United Nations Convention on the Law of the Sea (UNCLOS) provides a fundamental framework, but it has many deficiencies as it is presently applied. The Convention on Biological Diversity (CBD) is a complement to UNCLOS as are regional fishery management organisations (RFMOs) and other regional arrangements, but they are not working adequately either. Marine protected areas (MPAs) have been shown to be successful in Exclusive Economic Zones (EEZs) of nations in protecting biological diversity and productivity when traditional fishery management approaches have failed. Because we are now seeing the same problems in the High Seas as we have seen in EEZs, it is time to use MPAs to achieve the fundamental objectives of the World Conservation Strategy – repeated in IUCN's Guidelines for Marine Protected Areas:

- to maintain essential ecological processes and life support systems;
- to preserve genetic diversity; and
- to ensure the sustainable utilisation of species and ecosystems.

This edition of PARKS addresses the opportunities and challenges of achieving the High Seas component of the target of the World Summit on Sustainable Development (WSSD) and other fora: representative networks of MPAs by 2012. The articles cover a wide range of topics by some of the leading experts in the field:

- *Protecting earth's last frontier: why we need a global system of High Seas marine protected areas networks*, Dan Laffoley, Vice-Chair Marine, World Commission on Protected Areas.
- *High Seas marine protected areas on the horizon: legal framework and recent progress*. Graeme Kelleher, Chair of the WCPA High Seas MPA Task Force and Kristina M. Gjerde, IUCN Global Marine Programme.
- *Improved oceans governance to conserve high seas biodiversity*. Elizabeth Foster and Tia Flood of the Australian Department of Agriculture, Fisheries and Forestry, Alistair Graham, WWF International and Martin Exel of Austral Fisheries.
- *The economic rationale for marine protected areas in the High Seas*. Paul Morling, RSPB.

- *Pelagic protected areas: the greatest parks challenge of the 21st century*. Elliott Norse, President of Marine Conservation Biology Institute.
- *Challenges of marine protected area development in Antarctica*. Susie Grant, Scott Polar Research Institute, Cambridge, United Kingdom.
- *Conservation on the High Seas – drift algae habitat as an open ocean cornerstone*. Arlo Hemphill, Conservation International.
- *Conservation and management of vulnerable deep-water ecosystems in areas beyond national jurisdiction: are marine protected areas sufficient?* David Leary, Macquarie University, Australia.

The views expressed are those of the authors of each article. They are deliberately disparate. We hope that they will encourage readers to assist in saving the earth's most mysterious and last great frontier.

We, the co-editors, would like to take this opportunity to provide special thanks to Elliott Norse, President of the Marine Conservation Biology Institute, whose timely financial contribution made this extended issue of PARKS possible. We are also grateful for the financial support of the JM Kaplan Fund and the IUCN Global Marine and Protected Areas Programmes. We also thank Jessica Barder for her skilled assistance in editing. We express our extreme gratitude to the contributors to this volume, whose expertise and enthusiasm – and patience – were a great inspiration to us, as we hope they will be to you.

NB The views presented here are those of the authors and should not be considered as representative of their employers.

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Foreword: high time for High Seas marine protected areas

SYLVIA EARLE

AMONG THE MOST AMAZING DISCOVERIES of the 20th century is the awareness of how little is known about the ocean, especially the great blue expanse beyond the jurisdiction of any nation known as the 'High Seas' – an area comprising about 64% of the ocean as a whole. Spacecraft fly over it, documenting temperature, salinity, wave height and even the broad configuration of the sea floor far below. Thousands of ships cross over it, some dedicated to probing the three-dimensional realm below with ingeniously-crafted instruments and sampling devices. A few manned submersibles, remotely operated vehicles, and divers breathing compressed air and sometimes exotic mixes of gases, have descended into previously unexplored parts of the open sea. In the past 50 years we have learned of the existence of great mountain chains in the deep ocean, the forces of plate tectonics that drive the movement of continents, and the power of deepsea hydrothermal vents and ecosystems based on chemosynthesis by microbes – not sunlight and photosynthesis. Yet, as the 21st century begins, less than 5% of this amazing three-dimensional realm has been seen, let alone fully explored or even mapped with the accuracy accorded to the moon, Mars, and other distant parts of the solar system.

Slowly, exploration is proceeding, yielding priceless insights about the value of the open sea and the deep sea – including the High Seas beyond national jurisdiction, as the blue heart of the planet, the vital core of what makes life on earth possible – generating oxygen, absorbing carbon dioxide, stabilising temperature, governing climate, weather and planetary chemistry. The world ocean is the largest ecosystem in the universe, populated with representatives of nearly all of the major divisions of life, half of them entirely marine. A single bucketful of water dipped from the open sea may contain planktonic young or adults of a dozen major categories of life and more than a thousand kinds of microbes. It is a realm unimaginable to those who have not dived into the sea at night and experienced a glimpse of what it is like to be immersed in a vast, deep, liquid living space illuminated only by the flash, sparkle and glow of bioluminescent jellies, fish, squid and numerous tiny creatures. Sunlight penetrates to approximately 200 metres in this immense, flowing system, where the average depth is about 4,000 metres, the maximum, 11,000 metres. From the surface to the great depths below, life abounds, sometimes in patchy, exuberant abundance, sometimes sparse, but always there.

In recent years, exploitation of a few species of life in the High Seas has progressed apace, despite the unknowns, arousing grave concerns about the consequences not only to the individual species being extracted but also to their habitats, and ultimately, to the nature of the ocean systems as a whole. As coastal populations of fish, molluscs and crustaceans have been depleted, fishing fleets have moved offshore into deeper waters, taking advantage of new technologies to safely go farther and longer than was previously possible. There, they seek, find and extract previously hidden populations of creatures never before consumed by humankind, now marketed as orange roughy, Chilean sea bass, monkfish, oreos, hoki, firefly squid, deep sea lobsters or red prawns to name but some, as well as millions of tons of other species taken for use as bait or for animal feed.

Especially vulnerable are creatures that live on and around deepsea mountains – 'seamounts' – where forests of corals and sponges prosper and provide food and shelter for diverse populations of fish and invertebrates. Few of the thousands of known seamounts have been

scientifically explored, but enough is known to recognise that each one potentially hosts a high percentage of species unique to each place. Previously protected by their inaccessibility, these areas are now being fished with trawls that scrape the bottom with the efficiency of bulldozers, taking entire ecosystems along with long-lived, slow-reproducing fish with astonishing eyes, unique sensory systems and mysterious modes of communicating. Before they have been explored or even named, seamounts are being systematically destroyed by unlikely terrestrial hunters. Nothing in the repertoire of survival techniques developed for living in the icy, dark, high pressure environment of the deep sea has prepared these creatures for predation by crafty humans accessing their realm for the first time in history. With modern deepsea trawling gear, it takes only minutes to eliminate whole species, some with a highly restricted range and complex ecosystems fine-tuned over hundreds of millions of years.

Increasingly, deepsea trawling is moving from the Exclusive Economic Zones of various countries to the open ocean beyond, where fishing practises are largely unregulated. While bottom fishing in some regions on the high seas is controlled by regional fisheries management organisations, few restrict bottom trawling or its impacts. Vast areas of the High Seas (a frighteningly high 75%) lack any management body currently capable of restricting bottom trawling. Troubled by the potential losses to biodiversity and the future economic potential of deep sea systems, in November 2004 the Congress of the World Conservation Union (IUCN) called on the United Nations General Assembly to adopt a resolution calling for an interim prohibition on high-seas bottom trawling, until a legally binding regime could be developed to conserve and protect high seas biodiversity. The United Nations Millennium Project Task Force on Environmental Sustainability confirmed and reinforced this goal, calling more broadly for the elimination of bottom trawling on the high seas by 2006.

Clearly, the oceans beyond national jurisdiction, as those closer to shore, can no longer support inherently unsustainable and unregulated fishing practices. Instead we need to ensure a balance between use and protection, so we do not 'use up' the living systems that make up the High Seas. To achieve this we need over-arching policies aimed at integrated conservation and sustainable management of all human activities. A key part of this will be High Seas MPAs and representative networks of MPAs.

This volume includes thoughtful deliberations by various experts who consider these issues and explore possible actions. The need is urgent. Continuing business as usual will result in biodiversity losses unparalleled in history, but there is also an unparalleled opportunity to forestall catastrophe and help ensure an enduring place for the creatures of the high seas – and humankind – far into the future.

In this regard, I invite you to read this special High Seas issue of PARKS as a call to action. Protection of the High Seas can begin with the United Nations General Assembly's adoption of a short-term moratorium on deepsea bottom trawling in areas beyond national jurisdiction, halting the destruction and allowing us to develop not only an improved ocean governance system but also inclusive, effective and forward-thinking marine protected areas on the High Seas.

As never before, we recognise the fundamental value of the ocean to human health, to economies, to security, to the existence of life itself. As never before, we recognise that the ocean is in trouble. And as never again, we have this opportunity to recommend real action that might reverse the disturbing trends we see in our seas today and maintain a vibrant future for the ocean – and for ourselves.

Sylvia Earle, *Executive Director, Global Marine Division, Conservation International.*

Protecting earth's last frontier: why we need a global system of High Seas marine protected area networks

DAN LAFFOLEY

This article identifies the High Seas as the last great frontier on earth. It emphasises that we are now in the critical situation where we can avoid the mistakes humanity has made in marine areas within national jurisdiction and on land. Enough is known to allow us to establish a global representative system of marine protected area networks. Such networks should be embedded within integrated ocean ecosystem management. It is recognised that, while marine protected areas are tools and not ends in themselves, they are essential in order to protect marine biodiversity and achieve sustainable fisheries.

WE LIVE ON THE 'BLUE PLANET', so-called because approximately 70% of it is ocean, with about half the earth's surface falling on the High Seas, or areas of ocean beyond the national jurisdiction of individual countries.

As a child, these seas seemed endless to me. It was almost inconceivable that one day our activities could threaten their furthest limits and deepest depths. That day is here. Through a mix of inadequate management, data-poor management, and frankly no management at all, we have serially depleted wildlife in the shallow waters and are now turning to the High Seas to exploit their resources. They are our last and least protected frontier. Thus there is an urgent need for nations to join together in ensuring their protection and future health. In recent years, the scale and intensity of human uses of our oceans have increased dramatically.

In 1962 John Glenn sent a message to mission control as his pioneering flight on the *Friendship 7* spacecraft passed across Western Australia at night: "The lights show up very well. Thank everyone for turning them on, will you?". If he looked back from space today he might no longer see only the lights of our cities, the forest fires and the glow from gas flares, but also the lights of many fishing boats. Unknown to most is that the light from these boats can be so dense that they visibly outline the outer part of the South America continental shelf and entire sea areas in Asia (Elvidge *et al.*, 2000) (see Figure 1). Even though such fishing occurs at the margins of the High Seas, it does bring into stark relief the plight facing our oceans and the sheer scale of impacts involved. These lights are from fishers using light to lure squid, a species to which they have turned as stocks of commercial fishes have collapsed. These lights only represent a small fraction of fishing pressures, but they symbolise the broader plight of our oceans, as the greater unseen footprint of humanity progressively stretches out towards the High Seas, damaging and depleting almost everything in its path.

Though our scientific knowledge of the High Seas remains severely limited, we know enough to realise that the normal 'rules of the game' of exploitation on land do not apply. Many species that form key parts of these ecosystems are very long-lived and slow growing. An individual deepsea fish or coral may be frequently around 200 to 250 years old, meaning it came into being at the dawn of modern America. Deep sea coral reefs have been located in the past three years that date back 8,000 years, to the dawn of modern civilization, making them far older than even America's bristlecone pines, now carefully guarded by the US Forestry Service. These ancient fish and corals can be swept up in a single trawl by a deep sea fishing vessel, and the damage done has been compared by my colleague Sylvia Earle to the effects of going into the forest to hunt squirrels with a bulldozer.

In addition to bottom trawling, other fishing practices such as longlining put at risk many of these slow growing and long-lived species because their life histories span one or more ocean

Figure 1. *A composite map showing the oceans around South America. The box shows the white lights of night-time fishing vessels fishing for squid towards the edge of the continental shelf.* Source: Base map © Google Earth, overlay courtesy Elvidge *et al*. 2000.

basins. Loggerhead sea turtles, for example, born on Japanese beaches will travel as juveniles to Mexico via the Hawaiian Islands; at maturity they return to their Japanese nesting beaches to reproduce. Sadly, due to longlining at sea and habitat destruction on land, populations of loggerhead sea turtles have declined by 80–90% in the past decade. A grey-headed albatross can circle the globe in 46 days, plucking food from oceanic oases along the way, but conflicts with longlining hooks have rendered 19 out of 21 albatross species at global risk of extinction. There is an urgent need for new approaches to management and co-operation on the High Seas if these species are to survive beyond our lifetimes.

Fishing is not the only threat to the High Seas. Improvements in technology and innovation and new demands for resources are also extending the footprint of humanity. Traditional uses such as shipping, waste discharges and military activities are assaulting marine species, habitats and ecosystems with increasing noise, pollution and litter. While these inputs recognise no boundaries they may also have very direct local impacts. Activities such as marine scientific research and bioprospecting, cable and pipeline laying may also have severe local effects which are basically unregulated. All of these conditions pose a grave threat to the fragile ecosystems in the High Seas and make the need for conservation an even greater challenge.

However, a key advantage we have right now for the High Seas, and one that we never took full advantage of on land, is the ability to act before it is too late. In addition to providing interim protection for the deep seabed ecosystems under greatest threat, a comprehensive, adequate and representative system of marine protected area (MPA) networks is urgently needed for the High Seas.

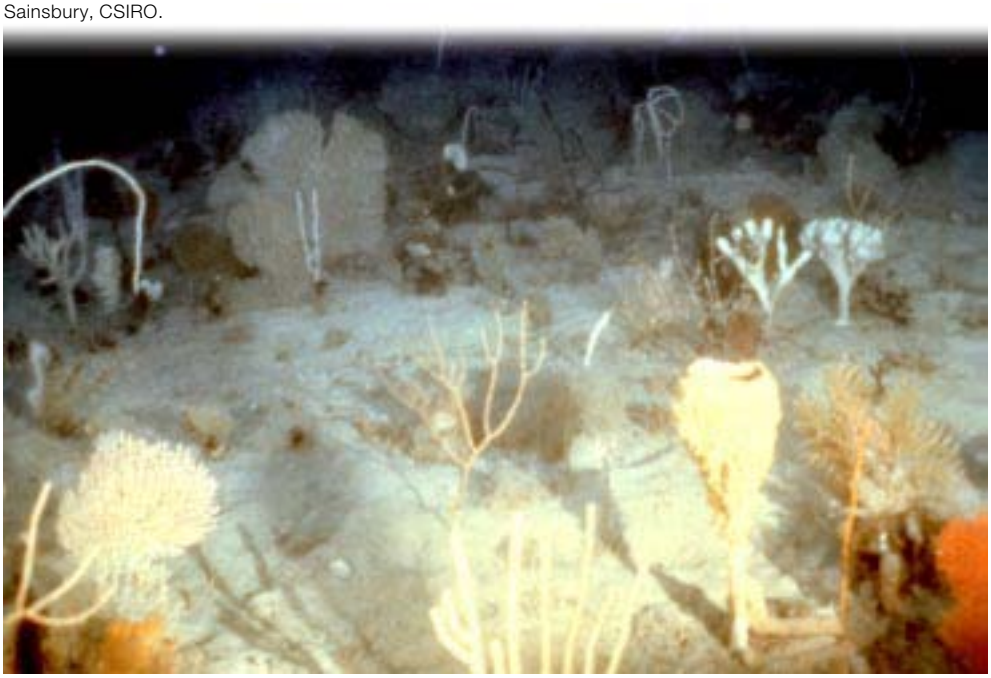
What is meant by a comprehensive, adequate and representative system?

As defined by IUCN, an MPA is 'any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment' (Kelleher 1999). Such protection can range from areas managed strictly for science or wilderness values where extractive activities such as mining and fishing are excluded, to areas managed more broadly for the sustainable use of natural resources and ecosystems. Kelleher and Recchia, 1998, provide a detailed overview of the six IUCN Protected Area Management Categories as applied to the marine environment.

As noted by Norse (this issue), the ocean may look vast and indistinguishable, but in fact it consists of many distinct ecosystems, habitats and communities, with vast differences in species and genetic composition from region to region. At the same time, many species, like the loggerhead sea turtle, transcend these boundaries. Representative MPA systems could encompass known ecologically and biologically significant areas such as seamounts, cold-water coral reefs, hydrothermal vents, and upwellings, convergence zones and other areas important to fisheries and migratory species. At the same time, they could also protect areas that are representative of specific ecosystems, habitats and communities, but whose significance has not yet been assessed. Networks of MPAs, usually within a single ecosystem, are necessary to ensure that biological connections are maintained between interdependent MPAs. A common example of this interdependence is where populations of one or more species within one MPA are supported by larvae from another MPA.

A comprehensive, adequate and representative system of MPA networks would provide protection for examples of all major ecosystem components in conjunction with their characteristic habitats and species at an appropriate scale within and across each bioregion. It would also have the required level of restrictions to ensure their ecological viability and integrity, be effectively managed, address the full range of human activities, and be sufficiently duplicative so that a single event, such as an oil spill, would not eradicate that diversity.

The untrawled seafloor off North-west Australia showing dense populations of corals and sponges. Photo: Dr Keith Sainsbury, CSIRO.



The development of representative MPA systems is generally achieved through demarcation of ecological regions of open ocean (pelagic) and/or seafloor (benthic) components on large geographic scales using biogeographic classification systems. These regions are then examined more closely to identify the range of habitat/biotope types, species assemblages, ecological processes or other natural features that are characteristic of the larger marine region.

Representative networks and systems of MPAs add value to the case-by-case approach traditionally taken with MPAs by focusing on protecting species and ecosystems before they become endangered or irreversibly damaged (Laffoley, *et al*. 2004). Past practice focused only on the protection of rare, threatened, declining or endangered species and small-scale protected areas often succeeded only in generating longer and longer lists of habitats and species needing urgent action. Too often, action to restrict human activities is only taken when the future viability of species or biological communities is in doubt, or where proof of damage to the ecosystem or its features is clear and is produced. In the poorly understood remote and deep oceans, this strategy can turn out to be costly and largely unsuccessful, as information and management processes will inevitably fail to keep up with expanding human activities.

Rolling out a system of High Seas marine protected areas

A representative system of High Seas MPAs is now achievable. It should be foremost and fundamentally based on the available geophysical information we already have about the seabed and water masses, building in the knowledge we have about particular habitats and species. Systematic work will be needed to compile and apply this geophysical information and knowledge of water masses, together with knowledge of ecological processes and biodiversity (such as is being made available by the work of the Census of Marine Life) to develop the framework within which to identify comprehensive, adequate and representative networks of High Seas MPAs. This need not be dependent on a predetermined knowledge of ecological processes or on human notions of 'significance', as some currently advocate. Given our massive gaps in information such a route would be a mechanism for endless debate and delay. Clearly we need to use our knowledge about endemic species and functionality where we have it, but

The seafloor off North-west Australia after trawling. Photo: Dr Keith Sainsbury, CSIRO.

as we are finding in national waters, perfect knowledge need not be the linchpin for rolling out a representative system of networks of MPAs.

I believe, therefore, that over the next two years the following four steps towards achieving a representative system of MPA networks should be given priority:

First, immediate protection from destructive high seas bottom fishing activities should be sought for the known most vulnerable areas, such as seamounts, cold water corals and sponge beds, until effective measures are in place to ensure sustainable fisheries in these areas and to protect biodiversity.

Second, identification and interim protection should be provided to other vulnerable areas, including candidate MPA sites, where more information is necessary in order to reach a final decision on appropriate measures for these sites.

Third, efforts should be dedicated to developing agreed site-selection criteria and advancing biogeographic classification systems in order to establish representative MPA networks.

Fourth, and last, a framework should be developed to:

1. set priorities for biodiversity conservation and sustainable use in areas beyond national jurisdiction;
2. promote co-ordinated decision-making amongst international and regional bodies with competence to take action; and
3. ensure consultations with the full range of interested stakeholders.

The question that is repeatedly raised at this point is how to do all this in areas beyond national jurisdictions. Implementation of existing legal responsibilities to conserve and sustainably use biodiversity throughout the High Seas is clearly a priority (see Gjerde and Kelleher, this issue). Whilst this is debated through the relevant United Nations processes, the example in the early stages of consideration for Antarctica gives some hope that a workable template will soon emerge (See Grant, this issue). The progress in Antarctica shows the potential for a Regional Fisheries Management Organisation (RFMO) to work in concert with conservation. If this happens and results in High Seas MPAs and improved protection overall for Antarctica's marine ecosystems, it will set new standards to be met by other bodies with jurisdiction on the High Seas, such as in relation to other RFMOs**,** elsewhere in the world.

Policy makers also repeatedly remind us that 'good science' is needed to underpin good decisions. An ongoing priority is for further collaborative scientific research to improve understanding of ocean life and processes and to enhance our capacity to conserve and sustainably use marine biodiversity in areas beyond national jurisdiction. Whilst we know little or nothing about some aspects of the High Seas, good data do exist in a number of areas. Therefore, I hope we can move forward on high seas conservation in a more effective manner than that currently implemented by the scientific community responsible for sharks, skates and rays. In the case of those species, we have very good data showing their perilous condition, but crucial decisions have still not been made, and so the species move ever closer to the brink of extinction. Given the fragility of the environment, we simply do not have the luxury of time for the High Seas. The quality and speed of decision-making by governments and governing bodies must improve and be combined with far greater levels of precaution and commitment to the vision that now needs to be followed.

MPAs are not a substitute for sustainable**,** integrated oceans management, whether within or beyond national jurisdiction. However, as is the case closer to shore, they are a necessary tool within such management regimes and have value beyond their benefits for conservation, (Agardy 2005). First, they can help transcend the limited sectoral management that currently hampers our ability to address multiple and cumulative impacts from diverse human activities. They can provide small-scale examples of how all ocean sectors can work together to achieve conservation goals. Second, MPAs can help transcend the notion that our ocean is a single homogenous fluid environment, and by providing a spotlight on specific habitats and ecological

communities, focus co-operation on a regional, and where necessary, global scale. Third, they can create the impetus and political will to address problems that originate outside the area, such as pollution from ships or from land. Finally, they can build on the success of regional seas and large marine ecosystem programmes, while promoting improved co-ordination and co-operation with existing sectoral regimes (see Gjerde and Kelleher, this issue).

It is a fact of life on earth that every successive human generation possesses more information than the preceding one. I hope that the next generation will look back on ours and say two things: we were smart and realised what needed to be done for conservation on the High Seas; and, that we actually made the right moves before it was too late. The facts are clear: this responsibility to act falls resoundingly to our generation. The survival of countless species and some ecosystems that we are only just discovering, let alone beginning to understand, is at stake. I believe that the next few years will be critical in deciding whether we are seen to deliver or fail. I hope that you will join with me and my colleagues across the world in helping introduce protection for our very last vast wilderness on earth – the High Seas.

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High Seas marine protected areas on the horizon: legal framework and recent progress

KRISTINA M. GJERDE AND GRAEME KELLEHER

Almost two-thirds of the oceans lie beyond the territorial seas and exclusive economic zones (EEZs) of coastal nations. The extension of the concept of marine protected areas (MPAs) from national waters to these areas –the High Seas –is a complex task and global co-operation is essential, since efforts to establish higher levels of protection for specific areas must conform to international law. Many governments are now recognising High Seas MPAs and MPA networks as key instruments for protecting High Seas biodiversity, making fisheries sustainable, and preserving ecosystem structure, functions and associated processes. However, much work needs to be done to develop mechanisms for designation, creation and management of High Seas MPAs and networks. Simultaneously, threats such as High Seas bottom trawling in vulnerable areas will need to be addressed so that all high seas activities are conducted on a sustainable basis supported by sound science.

This article provides an overview of the legal framework for High Seas marine protected areas, summarises recent progress made, and identifies some critical next steps towards establishing representative networks of marine protected areas on the High Seas.

The legal regime for High Seas marine protected areas

The global legal regime

The international legal regime for the water column and the seabed 'area' beyond national jurisdiction (together referred to here as 'High Seas'), is composed of a web of global and regional legal instruments. The comprehensive legal framework for all these instruments is the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which came into force in 1994. UNCLOS was designed to cover all ocean uses and resources and to serve as a unifying framework for a growing number of more detailed international agreements that address one or more particular ocean use.

Iridogorgia coral close-up showing feeding polyps: international law for the High Seas like a growing coral radiates from the main trunk of UNCLOS, which serves as a unifying framework for a growing number of more detailed international and regional agreements. Photo: courtesy of Deep Atlantic Stepping Stones Science Team/IFE/URI/NOAA.

Under UNCLOS, all States must respect the high seas freedoms and the rights of access of other States to the High Seas and its resources, but States also have the duty to conserve high seas living marine resources, to protect and preserve the marine environment, and to co-operate for these purposes. In key language catalysing the development of MPAs within national waters and regional seas, UNCLOS calls for measures to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life. Unlike the open access regime for the high seas water column, in UNCLOS, the seabed 'area' and its mineral resources are declared the 'common heritage of mankind'. Mineral activities are to be carried out for the benefit of humankind, with due regard for the need to protect the marine environment and animal life, and under the supervision of the International Seabed Authority (ISA).

The 1992 Convention on Biological Diversity (the CBD) is the other leading international agreement that obligates nations to conserve High Seas biodiversity (Kimball 2005). Parties to the CBD are required to implement the Convention consistently with the rights and obligations of States under UNCLOS. In areas beyond national jurisdiction, CBD parties must ensure that processes and activities carried out under their jurisdiction or control do not have adverse impacts on biodiversity. As part of this process they are to identify, assess and monitor activities and seek to minimise the risk of significant adverse effects. The CBD also calls for co-operation among parties for the conservation and sustainable use of the High Seas.

The 1995 UN Fish Stocks Agreement is also key. Although this only applies to highly migratory fish stocks and fish stocks that straddle national and international waters, it sets an agreed performance standard that should guide all high seas fisheries. In addition to detailed requirements for precautionary and ecosystem-based management, this agreement calls for States to minimise the impact of fishing and to protect biodiversity in the marine environment.

Apart from UNCLOS and the CBD, there is no single global framework agreement for addressing threats posed by multiple activities to geographically-defined areas or for identifying such areas on a scientific basis. Individual High Seas MPAs can already be established by the collective action of several willing States in conformity with UNCLOS. As was done via the Titanic Memorial Agreement between the United States, the United Kingdom, France and Canada, protection for specific areas can be achieved by each party agreeing to strictly regulate the conduct of its nationals and nationally flagged vessels. However the absence of globally agreed criteria, management guidelines and enforcement protocols may hinder the establishment of comprehensive, effective and representative networks of High Seas MPAs.

The regional legal regime: regional seas and fisheries agreements

At the regional level, some legal agreements provide for MPAs beyond national jurisdiction, while ensuring that the regulation of particular activities is consistent with High Seas freedoms under UNCLOS. As these agreements bind only parties, they cannot control non-party States whose vessels or citizens may use a specific area. Nevertheless, as many marine activities are carried out by coastal States party to the regional agreement, they are important tools for helping establish MPAs in the High Seas. The Convention for the Protection of the Marine Environment of the North-East Atlantic 1992 (OSPAR Convention) applies throughout the 'OSPAR Maritime Area'. This extends from the shores of its Parties to a substantial adjacent high seas area (40%). The OSPAR parties have committed to developing an ecologically coherent network of MPAs by 2010. It must be noted that, as with most regional seas agreements, the OSPAR Convention has no authority to regulate fishing or shipping activities.

The 1959 Antarctic Treaty and subsequent agreements cover the continent and surrounding seas south of 60° south latitude. Antarctic Treaty members have adopted an agreement calling for protected areas in terrestrial and marine areas and have designated six entirely marine

protected areas in the Southern Ocean (see Grant, this issue). With no universally recognised territorial seas or EEZs adjacent to Antarctica, any MPAs established adjacent to that continent can be considered as within the High Seas.

Regional seas agreements and action plans under the auspices of the United Nations Environment Programme (UNEP) in the Mediterranean and the Pacific also include marine areas beyond national jurisdiction. In the Mediterranean, this is a substantial area, as coastal States have so far limited their offshore claims and most have not established EEZs. They have adopted an agreement to designate 'Specially Protected Areas of Mediterranean Significance' that can include High Seas areas, and have established one in the Ligurian Sea spanning both national and international waters. The 'Pelagos Sanctuary' in the Ligurian Sea is an example of an MPA that was initially established through the collective action of a few nations (France, Italy and Monaco) and later adopted at the regional level.

Regional Fisheries Management Conventions apply to specified regions or fisheries and generally only empower their operative bodies – Regional Fisheries Management Organisations (RFMOs) – to focus on management and conservation of fishery resources. Despite the abundance of Regional Fisheries Bodies (RFBs) and RFMOs, management of high seas fisheries is far from complete. Only tuna and tuna-like species are covered on a global scale. See: http://www.fao.org/fi/body/rfb/Big_RFB_map.htm

However, some conventions provide explicitly for their RFMOs to designate or recommend designation of special areas for protection and scientific study, or to declare closed areas to conserve fish stocks, thus setting a precedent for agreements (binding parties only) to prohibit certain activities within a discrete area. Several significant RFMOs are now in the process of updating their legal mandate and scope to include ecosystem-based management and biodiversity protection, as called for by the Fish Stocks Agreement.

International progress towards a global representative network of High Seas marine protected areas

Progress before the Vth IUCN World Parks Congress (WPC) 2003

One of the first international commitments to a global system of MPAs, including on the High Seas, was the resolution adopted at the IUCN General Assembly in 1988. However, the majority of such commitments have occurred this century. These include commitments to establish representative networks of MPAs by 2012 at the World Summit on Sustainable Development (WSSD) in 2002; and subsequent United Nations General Assembly (UNGA) resolutions and CBD decisions.

At the Vth IUCN World Parks Congress in 2003, the IUCN's World Commission on Protected Areas (WCPA) adopted the IUCN 10-year High Seas MPA Strategy (Gjerde ed. 2003). The establishment by WCPA of a High Seas MPA Task Force in 2003, which brings together IUCN, WWF, WCPA and governmental, scientific and non-governmental (NGO) experts in the cause of High Seas MPAs, has aided other governmental and NGO activities and developments.

Governmental progress since the Vth IUCN World Parks Congress

Since the WPC in 2003, many more countries and organisations have expressed their support for High Seas MPAs, and activities are now underway in a variety of inter- and non-governmental bodies to translate these words into action. The following relevant events have occurred:

Global level

In February 2004, the 7th Conference of the Parties to the CBD called for effectively managed and ecologically representative MPAs that contribute to a global network. A CBD *ad hoc* Informal Working Group on Protected Areas was charged with the task of exploring options for co-operation to establish High Seas MPAs.

The CBD Protected Areas Working Group met in June 2005 and recommended that parties improve co-operation and co-ordination among various forums for establishment of MPAs consistent with international law, and recognised the need for further collaborative scientific research to develop criteria and biogeographical classification systems for potential MPAs beyond national jurisdiction. In response, the Canadian government hosted a workshop on criteria for 'ecologically and biologically significant areas' in December 2005.

Important global discussions also occurred under UN auspices in February 2006. The *Ad hoc* Open-ended Informal Working Group – established pursuant to a 2004 UNGA resolution – considered issues related to the conservation and sustainable use of marine biological diversity in the High Seas. While acknowledging that urgent action is necessary to address the two greatest threats to high seas biodiversity, namely illegal, unreported and unregulated (IUU) fishing activities and destructive fishing practices, many nations agreed that MPAs were a key tool to manage biodiversity in the High Seas. It was noted that additional co-operation was necessary on criteria for the identification of ecologically and biologically significant areas and on biogeographic classification systems for representative MPA networks. There was some debate among delegations over a European Union proposal for a new implementing agreement to UNCLOS to provide for, among other things, establishment and regulation of High Seas MPAs. The results of the meeting will be fed into the deliberations of the UNGA, which will decide what further actions should be taken. Many hope that, at a minimum, an additional meeting will be convened to further explore the options raised in February 2006.

Interest in MPAs within sector-based international organisations has been growing. Serious discussions on the role of MPAs at the UN Food and Agriculture Organisation's (FAO) Committee on Fisheries (COFI) in March 2005 resulted in acknowledgement that MPAs may enhance fisheries management as well as protect biodiversity conservation.

COFI recommended FAO develop technical guidelines on the design, implementation and testing of MPAs and assist members to achieve the goal of representative MPA networks by 2012. Many States noted the need for RFMOs to update their mandates and improve their performance to enable this broader focus on both sustainable fisheries and biodiversity conservation. Hopefully the Review Conference of the UN Fish Stocks Agreement in May 2006 will provide renewed encouragement for RFMOs to adopt pro-active conservation measures.

Action is also being taken to address the problem of IUU fishing. The Ministerially-led High Seas Task Force (HSTF) on IUU Fishing launched a multi-national effort in 2003. This aimed to deter IUU fishing, expose IUU fishing vessels and States, and improve enforcement. The HSTF consisted of Ministers from Australia, Canada, Chile, Namibia, New Zealand and the United Kingdom (Chair) and the Directors-General of WWF, IUCN, the Earth Institute and the Marine Stewardship Council. In March 2006 it released its comprehensive recommendations for action. Building global support is a key component of their strategy.

With respect to international shipping activities, the International Maritime Organisation (IMO) adopted revised Guidelines for the Designation of Particularly Sensitive Sea Areas (PSSAs) in December 2005. PSSAs may be designated in national waters and the High Seas to gain international recognition of the sensitivity of a specific area to impacts from international shipping. As designation *per se* does not introduce legally binding requirements, protective measures such as special reporting, routeing or discharge measures, would need to be introduced and approved separately.

Regional level

Some regional organisations have made significant headway in the development of criteria, biogeographic classification systems and commitments to developing representative MPA networks.

In November 2005, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) launched work on an integrated system of MPAs throughout the Southern Ocean. A joint workshop is proposed for 2007 in conjunction with the Antarctic Treaty Committee for Environmental Protection to develop a biogeographic classification system for the region. CCAMLR agreed that attention may need to be given to, *inter alia*, the protection of:

1. representative areas;
2. scientific areas, to assist with distinguishing between the effects of harvesting and natural ecosystem changes in areas not subject to human interference; and
3. areas potentially vulnerable to impacts by human activities.

Interim protection for candidate sites was seen as an essential step to enable information collection necessary to reach a final decision (Grant, this issue).

Additionally, two RFMOs have taken steps to protect vulnerable deepsea habitats from specific fishing activities. In January 2006, the General Fisheries Commission for the Mediterranean (GFCM) agreed to protect three ecologically-important deepsea areas in international waters off Italy, Cyprus and Egypt. The decision requires Mediterranean States to prevent bottom-trawl fishing fleets from operating in the designated areas. This follows two important GFCM decisions in 2005: to ban both bottom trawling at depths beyond 1,000 m, and the use of driftnets, throughout the Mediterranean Sea.

In November 2004, the North-East Atlantic Fisheries Commission (NEAFC) closed four seamounts and part of the Reykjanes ridge to bottom-trawl and static-gear fishing for a three-year test period, based on a proposal from Norway. Two other proposed areas, including one requested by OSPAR, were referred to the International Council for the Exploration of the Sea (ICES) for further study. ICES submitted its recommendations in November 2005. Both NEAFC and the North-west Atlantic Fisheries Organisation (NAFO) are currently updating their underlying legal agreements to broaden their remits to include ecosystem-based management.

Furthermore, a new regional fisheries management agreement for the South Pacific is under development. Australia, Chile and New Zealand stress that such an agreement will set a new global standard for attention to biodiversity conservation and provision for MPAs.

Under the OSPAR Convention for the North-East Atlantic, the OSPAR Commission has invited parties and NGOs to submit proposals for High Seas areas to be included as components of the OSPAR network of MPAs. Several proposals are under development. OSPAR and NEAFC are seeking to enhance co-operation with respect to cold-water corals.

Non-governmental initiatives

In October 2005, over 800 experts gathered in Geelong, Australia for the first International Marine Protected Areas Congress (IMPAC1). The expert panel on High Seas MPAs and biodiversity conservation identified a range of ways forward, some of which are further explored in this issue of PARKS magazine. These include:

1. a new implementing agreement under UNCLOS for improving high seas governance and creating High Seas MPAs;
2. a Global Oceans Commission to enable a strategic approach to governance and oceans conservation with effective enforcement modalities;
3. 'Marine Ecosystem and Resource Management Organisations' (MERMOs), similar to but broader than RFMOs, to balance fishing, shipping, and conservation at the regional level;
4. mechanisms to establish 'moving' or 'dynamic' High Seas MPAs to protect vulnerable pelagic species (Norse, this issue; Hemphill, this issue);
5. national efforts to join all sectors, including the fishing industry, NGOs and government, to promote responsible high seas management (Foster *et al*. this issue); and

6. a Global Commons Trust Fund funded though royalties from successful patents based on genetic resources retrieved from seabed areas beyond national jurisdiction to support, *inter alia*, conservation and High Seas MPAs (Leary, this issue) (www.impacongress.org). Acknowledgement should also be given to the colossal collaboration that is the Census of Marine Life (CoML), as it promises to advance our knowledge and understanding of open ocean, mid-water column and deep seabed biodiversity and ecosystem functioning. The CoML is a growing global network of researchers, in more than 70 nations, engaged in a ten-year initiative to assess and explain the diversity, distribution and abundance of life in the ocean and how it changes over time. Fruits of this project will support and enhance the scientific basis for designating High Seas MPA networks.

Next steps

As we have seen, there is a vast array of legal agreements and fora relevant to high seas biodiversity conservation. Given current awareness of the need for urgent action, discussions at regional levels and global levels will continue with the dual aims of conserving high seas biodiversity and improving the productivity and sustainability of fisheries. They will address better implementation of existing instruments and options for new mechanisms or instruments.

While these discussions take place, the eight practical steps identified below can be taken now to enhance protection of vulnerable ecosystems and species and to lay the scientific groundwork for representative networks of MPAs.

First, States should immediately implement existing legal responsibilities to conserve and sustainably use high seas biodiversity, and to co-operate through the array of existing mechanisms. This includes immediate protection of the most vulnerable known areas such as seamounts, cold water corals and sponge beds through an interim prohibition of destructive high seas bottom-fishing activities until effective measures are in place to ensure sustainable fisheries in these areas and protect biodiversity.

Second, States should work within existing global and regional bodies and instruments to protect vulnerable areas, consistent with international law. States can seek global recognition of the need for international co-operation to protect a specific area through the UNGA, the FAO's COFI, or conferences of the Parties to the CBD or the Convention on Migratory Species. Where shipping impacts are a potential threat to a sensitive pelagic habitat, a State or group of States can petition the IMO to designate an area as a PSSA and seek Member State consent to apply stricter discharge, routeing or reporting requirements. If there is concern that future minerals development activities in the Area may be damaging, the ISA can be requested to protect this area.

Third, at the regional level, where fishing activities are the primary threat, the most direct route to protection may be to appeal to the relevant RFMO, if one exists. However, RFMOs do not cover all regions or all fisheries, and many RFMOs currently are not empowered to address broad biodiversity conservation issues. (See Figure 1).

Fourth, parties to regional seas agreements that encompass High Seas areas should seek to establish regionally agreed High Seas MPAs and networks consistent with international law. Even where agreements do not extend beyond national jurisdiction, parties may still wish to create a side agreement to protect adjacent High Seas areas. Such regional agreements would only be binding on parties to the agreement, and could not affect other States' fishing or commercial shipping activities. To accomplish the latter, it would be necessary to apply to the relevant RFMO or to the IMO for complementary protective measures. If the proposed area includes the seafloor beyond national jurisdiction, the ISA should be consulted as well.

Fifth, as was done for the Titanic Memorial site, States should agree to establish new agreements to co-operatively manage specific areas consistent with international law. They should agree to regulate their own nationals and flag vessels and consent to mutual enforcement

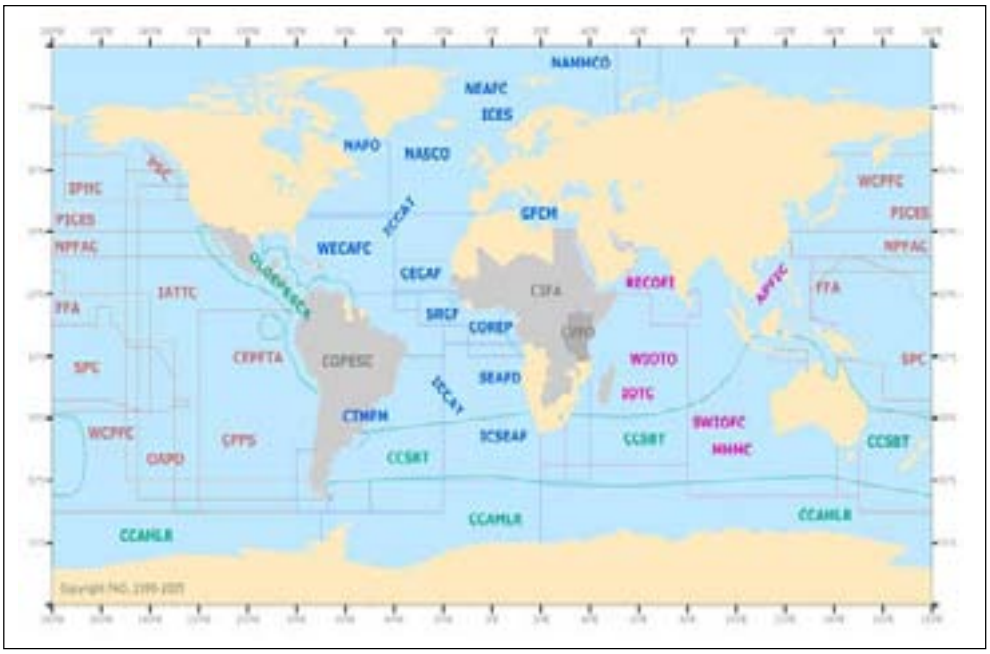

Figure 1. *Only five RFMOs have legal authority to manage all fish stocks within their geographic ambit. Thus fisheries for shark, squid or deepsea fish such as orange roughy are not currently regulated outside these five regions.* Source: P. Hoagland. 2004. An Overview of the Economic Aspects of Deep-sea Fisheries. Mimeo. Woods Hole, MA: Marine Policy Center, Woods Hole Oceanographic Institution. (Map by Roger Goldsmith, WHOI).

procedures. Tools such as codes of conduct, and environmental impact assessments can be more broadly utilised to aid integrated and precautionary management for the areas. Non-initiating States can be invited to join in.

Sixth, work should commence on the development of a framework or mechanism, on an informal basis at first, to: set priorities for biodiversity conservation and sustainable use; promote co-ordinated decision-making amongst international bodies with competence to take action; and ensure consultations with the full range of interested stakeholders.

Seventh, work should be initiated to promote scientific and technical progress, particularly with respect to biogeographic classification systems, as described by Dan Laffoley in this issue.

And eighth, urgent action should be taken to improve high seas fisheries management and governance and to curtail destructive fishing practices and IUU fishing activities.

Two key reviews of actions by States and RFMOs are scheduled to occur in 2006. States should use these opportunities to promote reforms in high seas fisheries governance and improvements in the performance of RFMOs to effectively incorporate ecosystem-based and precautionary management, including mechanisms for biodiversity protection such as High Seas MPAs.

IUCN, WWF and other members of the WCPA High Seas MPA Task Force are working at the global, regional and national levels to spur rapid and scientifically-based establishment of High Seas MPAs and representative MPA networks at the same time as we seek broader support to improve high seas governance. We welcome your participation in our efforts.

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Improved oceans governance to conserve high seas biodiversity

ELIZABETH FOSTER, TIA FLOOD, ALISTAIR GRAHAM AND MARTIN EXEL

Establishment of marine protected areas (MPAs) in the oceans beyond national jurisdiction (High Seas) for biodiversity conservation is a commitment made by governments at the 2004 Convention on Biological Diversity (CBD) Conference of Parties (COP) and at the 2002 World Summit on Sustainable Development (Johannesburg Plan of Action). However, High Seas MPAs remain aspirational tools for effective biodiversity conservation, given current oceans governance arrangements.

Governance arrangements for High Seas MPAs are weak. Any ecological benefits expected from the establishment of MPAs would be undermined in the absence of an agreed management framework and effective and enforceable conservation measures. Effective governance would need to include provisions for monitoring, control and surveillance (MCS), especially in relation to preventing any unregulated fishing. The economic costs of management may be substantial. This article argues that there is a pressing need to improve oceans governance arrangements as a precursor to the establishment of High Seas MPAs. There is also a need to improve those management measures requiring regulatory control in order to justify management costs through improved effectiveness.

Regional Fisheries Management Organisations (RFMOs) provide examples of concrete steps taken towards sustainable natural resource management under existing governance arrangements. The Manuka Vision described herein provides an example of how industry, environmental non-government organizations (NGOs) and governments can come together to develop shared visions and approaches to address High Seas governance inadequacies. This article draws from some of these experiences and provides insights into cost effective governance arrangements, which could pave the way for the establishment of effective High Seas MPAs.

MARINE PROTECTED AREAS (MPAs) have been identified as a tool for resource management and biodiversity conservation in several recent international fora. The growing support for MPAs is highlighted in the decisions of the Convention on Biological Diversity (CBD) 1995 Conference of Parties (COP) (the Jakarta Mandate) and the 2002 World Summit on Sustainable Development (WSSD). The latter adopted the Johannesburg Plan of Implementation (JPOI), which commits governments to 'develop and facilitate the use of diverse approaches and tools, including the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery ground'. This commitment was further elaborated by the CBD COP in 2004 (Dec. VII/5 and VII/28).

Australia has long sought to establish MPAs both within waters of national jurisdiction and also on the high seas. Nationally, this is demonstrated through the establishment and ongoing management of the Great Barrier Reef Marine Park and, more recently, the Heard and Macdonald Islands MPA. Additionally, Australia's Oceans Policy and Environment Protection and Biodiversity Conservation Act commit the Australian Government to establishing a National Representative System of Marine Protected Areas, to ensure the sustainability of the fisheries it controls, to protect the marine environment, and to develop Regional Marine Plans covering all relevant maritime activities (Foster 2005).

Through these national developments, Australia is meeting its commitment to contribute to the establishment of a global representative system of MPAs. Beyond national jurisdiction, however, there are significant practical governance issues, relating to how to legislate their development and how to enforce them once established, which will need to be addressed before MPAs on the High Seas can become an effective reality.

MPAs need to be considered as one part of a larger package of oceans management tools. When implemented in totality, these should result in effective resource management and biodiversity conservation arrangements that incorporate appropriate measures to ensure monitoring, performance assessment, enforcement and compliance. Effective oceans

governance arrangements are an essential first step if High Seas MPAs are to be of any utility.

There is a plethora of hard and soft law instruments used to govern maritime activities and, in the first instance, these should be examined for their potential to incorporate provisions for High Seas resource management and biodiversity conservation, including MPA management. Making the most of what we have is the critical first step in oceans governance reform – we need to identify and fill governance gaps, not duplicate efforts.

As a first step, there needs to be a commitment by all countries to fully participate in, and adhere to, all relevant international and regional agreements, which relate to the conservation and management of the world's oceans. The UN Convention on the Law of the Sea (UNCLOS) is acknowledged as the most important agreement, along with the UN Agreement for the implementation of the provisions of the UNCLOS relating to the conservation and management of straddling fish stocks and highly migratory fish stocks (UNFSA), the CBD, and the Food and Agriculture Organisation's (FAO) Agreement to promote compliance with international conservation and management measures by fishing vessels on the high seas (the Compliance Agreement), along with various agreements developed by the International Maritime Organisation (IMO).

UNCLOS focuses the world's attention on nations' rights and obligations in a competitive global environment dealing with over-exploitation of collapsing fish stocks, growing concern for the environment, and interest in seabed mining. It gives coastal States the right to exploit, develop, manage and conserve all resources within 200 nautical miles of their coasts. Beyond 200 nautical miles, however, for UNCLOS parties the High Seas are open to all States for fishing, though the exercise of the so-called 'freedom on the High Seas' is conditioned upon fulfilment of certain legal requirements as set out in UNCLOS. In particular, the freedom to fish on the high seas is constrained by obligations of UNCLOS parties to ensure sustainability and to protect and preserve the marine environment. (Articles 116-119 and 192).

UNCLOS also establishes responsibilities of States who authorise vessels to fly their flag and operate under their laws (the flag State), requiring flag States to exercise effective control over ships flying their flag by maintaining a 'genuine link' with such ships (Article 91). The UNFSA

A boarding party returns after apprehending an illegal fishing vessel near Heard Island. Photo: LSPH Damian Pawlenko.

Orange roughy, a slow-growing, long-lived fish found around the world. Photo: Elizabeth Foster.

and the Compliance Agreement elaborate on these obligations with respect to fishing activities, especially in requiring identification of the 'beneficial owner' of such ships (FAO 1993). The Compliance Agreement was intended to improve the effectiveness of regional fisheries agreements and to introduce reporting requirements to FAO in an attempt to increase public knowledge of fishing activities in international waters and of those responsible for them (United Nations 1995).

We eagerly await the final report and recommendations of the OECD-hosted, ministerially-led High Seas Task Force on illegal, unreported and unregulated (IUU) Fishing, due early in 2006. This is expected to have a range of practical and feasible proposals as to how governments can best progress in confronting the scourge of IUU fishing which is undermining the efforts of governments to conserve and manage the world's oceans. This Task Force is composed of ministers from the United Kingdom, Australia, Canada, Chile, Namibia and New Zealand and executive officers from the Earth Institute, IUCN – the World Conservation Union and WWF International. It is an exciting demonstration of the benefits of collaboration between different interests in finding effective solutions to shared problems.

The objective of the UNFSA is *to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks through effective implementation of the relevant provisions of UNCLOS* (United Nations 1995). It provides mechanisms for international co-operation on issues such as compliance and enforcement. The UNFSA invites States with a real interest in a region to develop regional fisheries management organisations (RFMOs) and sets out broad terms for their operation.

There is general agreement that regional bodies are best placed to actually regulate and control activities relating to the conservation and management of marine living resources and that RFMOs represent some early and encouraging steps towards such a goal, although failure to provide for global oversight and accountability is an emerging problem. The decision of the FAO's Committee on Fisheries (COFI) in March 2005 to support a review of RFMO arrangements (with respect to both their geographical coverage and their competency to effectively control relevant activities) is an excellent next step.

The results of the RFMO review should provide a useful gap analysis upon which concrete proposals for oceans governance reform can be soundly based. That such a review will take place in parallel with a formal review in May 2006 of the implementation of UNFSA is most timely. Together they can provide impetus for the improvement and reform of RFMOs, and perhaps the basis for evolving RFMOs into broader regional oceans management arrangements. Many view this as an essential next step in the unfolding governance reform agenda.

Improved ocean governance, especially of the high seas and distant water fishing activities, is widely recognised as fundamental to the conservation and management of marine living resources, especially in areas beyond national jurisdiction. There is a clear need to move away from traditional exploitative approaches of single stock management, towards integrated oceans management that delivers an ecosystem-based management approach to biodiversity conservation and sustainable use.

This approach needs to allocate access to resources fairly and equitably, combat IUU fishing, minimise or avoid bycatch and incidental mortality, eliminate marine debris, and focus marine scientific research. It also needs to ensure that all relevant States fully exercise their relevant responsibilities as flag States, coastal States, port States, market States, as well as exerting effective control over their nationals, both companies and people.

There are two major governance obstacles to the sustainable management of high seas resources through RFMOs. One is that there are no legal mechanisms to prohibit or prosecute fishing in RFMO-controlled waters by vessels flying the flag of non-member States, even if nationals of Member States are involved. The second is that in the absence of an agreed framework within which fair and equitable rules can be adopted for allocating mechanisms and management arrangements, the allocation of resources between States that are party to RFMOs is a constantly changing and never-ending battle between competing companies and countries.

RFMOs, based on regional inter-governmental agreements, are fora for States to operate in. However, fishing is done by companies, often multi-national companies, not States. Ensuring that companies are fairly, fully and enforcedly obliged to meet the responsibilities that governments take on in their dealings with each other is critical to the success of regional arrangements like RFMOs and any next generation of regional oceans management arrangements. Governments, as a matter of urgency, need to find ways to achieve an effective level of control over their nationals, as well as over their waters, ships, ports and markets, before regional conservation and management of the world's oceans can be effective – only then can High Seas MPAs become a genuine reality.

Australians have long been at the forefront of regional and multilateral international efforts to promote an increased understanding of integrated oceans management, especially on the high seas. For some years now, Australian fishers, conservationists and government officials have been at the centre of a broadening informal discourse on the future of high seas conservation and management and effective control of fishing activity. Australians recognise that governance is not an issue to be addressed solely by governments. Last year, WWF and the fishing industry held their own informal round table, bringing together fishers and fishing industry advocates from New Zealand and South Africa, senior WWF representatives from Europe and the United States, other NGOs and government officials. The resultant 'Manuka vision – a collaborative perspective on the future of high seas management' (named after a suburb within Australia's capital city, Canberra, where relevant discussions took place) is a start in providing a framework for industry and NGOs to focus governments' attention and efforts on practical and feasible reform. Copies of the Manuka Vision can be downloaded at www.daff.gov.au/manukavision.

The Manuka Vision supports the direction progressive governments have been taking in pursuing oceans governance reform to allow effective High Seas management. The Manuka Vision states 'Government, industry and NGO's collaborate so that by 2015 the high seas are managed to ensure that the integrity of healthy ecosystems is maintained; fisheries resources are

used sustainably and equitably with all States, fishing enterprises and other stakeholders acting responsibly; livelihoods and rights are preserved; populations of threatened species are protected and restored; and that this arrangement is secured for the benefit of present and future generations'. The Manuka Vision, in conjunction with its associated objectives and action plan, provide a practical and collaborative way forward and clearly articulate that on-going government, industry and NGO collaboration is required, in order to achieve the common vision of sustainably-used resources and protected biodiversity on the High Seas. It is our hope that our shared vision can be expanded to encompass other companies, other NGOs and other governments in the future.

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The economic rationale for marine protected areas in the High Seas

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There is a growing recognition that human activities that damage marine habitats can undermine ecological stability and the ecosystem services they facilitate. This awareness, combined with the deterioration in fisheries worldwide, has led to calls for action on developing marine protected areas (MPAs) at the World Summit on Sustainable Development (2002), IUCN's World Parks Congress (2003), IUCN's World Conservation Congress (2004) and in the United Nations General Assembly (UNGA).

This article outlines a framework for assessing the economic value of the world's oceans and highlights how human exploitation of marine environments exceeds what is socially optimal.

The oceans and seabed beyond national jurisdiction (the 'High Seas') pose special problems for governance because they are treated as global commons. The article finishes with a brief review of possible financing options for High Seas marine protected areas.

AN ESTIMATED 200 MILLION PEOPLE worldwide make their living directly or indirectly from fisheries, while millions more depend on additional uses of oceans and coasts. Despite this reliance, our understanding of marine ecosystems remains so rudimentary that, the director of the 10-year 'Census of Marine Life' project to document all known sea life, Jesse Ausubel, stated that we know more about the surface of the moon than we do about the oceans. This lack of understanding, together with the sheer vastness of the oceans, has fostered the common presumption that marine resources are inexhaustible. The collapse of fisheries and the mounting evidence of the declining state of the world's oceans have refuted this presumption.

Marine protected areas (MPAs) are one means of returning marine ecosystems to healthier states and conserving valuable marine habitats. This article looks at the economic rationale for MPAs, with a particular focus on the High Seas.

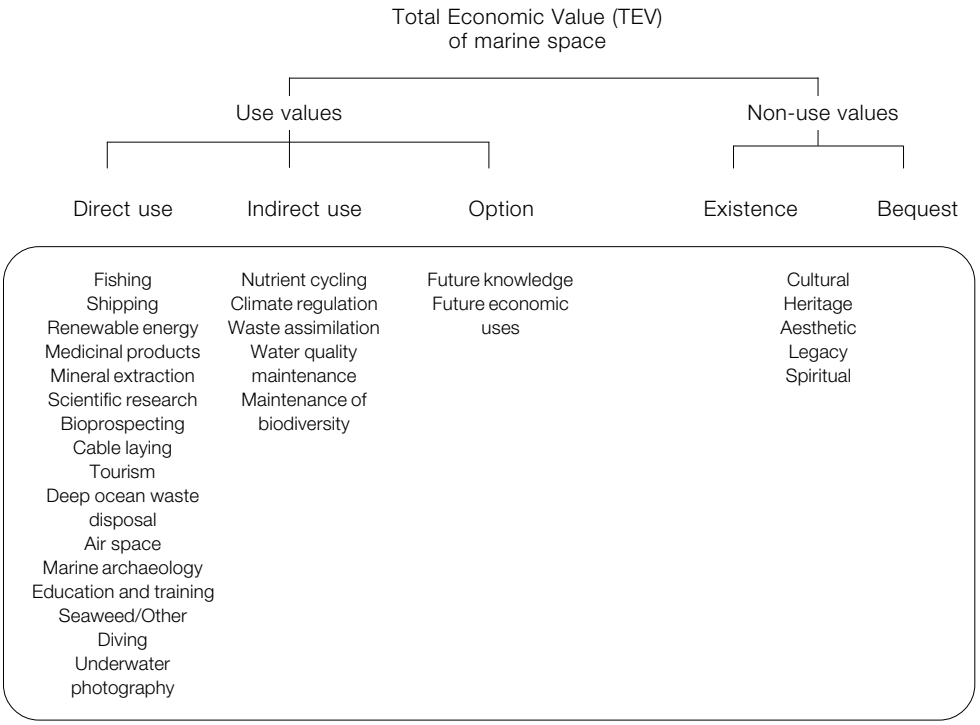
The current total area of MPAs is estimated to be below 1% of the total area of the seas, with only 0.01% protected from all fishing (Roberts and Hawkins 2000). The need to improve our stewardship of marine habitats and redress the severe under-representation of MPAs in the global network of protected areas is now widely recognised.

An important assertion underlying the support for MPAs is that, in addition to achieving conservation goals, they can improve fisheries management. In 2001, the American Association for the Advancement of Science released a statement, signed by 150 marine scientists, declaring that there is compelling scientific evidence that strictly protected marine reserves conserve both biodiversity and fisheries, and help replenish the seas. Effective protection increases biomass and average size of exploited fish species, as well as species diversity within the reserve, with these benefits transferred to fishing areas through adult spillover and larval export. Given the serious widespread losses that occur when a fishery collapses, MPAs are an important potential management tool for the long-term viability of the world's fisheries.

The true value of marine habitats to human society

A consequence of society's traditional view of the seas as containing limitless resources has been to undervalue them. Conventional economics has also undervalued the marine environment by valuing only the marketable resources it supports. As with many environmental assets, the true worth only becomes apparent when it is under threat or degraded. In reality, marine spaces have always generated benefits to human society in excess of the marketable economic activities they support. (See Figure 1, Total Economic Value (TEV) of the high seas.)

Figure 1. *Total Economic Value (TEV) of the high seas.*



Direct use values. The benefits derived from the direct use of the sea are generally well-understood. Examples of these uses range from fishing and oil drilling to energy, transport, and eco-tourism.

Indirect use values. The benefits derived indirectly from the sea are only just becoming apparent. Marine environments are, in economic jargon, 'multi-functional resources supplying tradable outputs and performing a large number of ecological functions.' These ecological functions not only support economic activity but also the planet's life-sustaining biological systems such as climate regulation, nutrient cycling and waste treatment, and the maintenance of biological diversity. Until our dependency on these services rendered by the sea are better understood, the value of maintaining biodiversity and biological resilience will continue to be routinely unrecognised or discounted.

Even if we recognise the importance of these ecosystem services, they may still be over-exploited because of their 'public goods' characteristics. A public good has two defining characteristics. Firstly, one person's use of it does not preclude anyone else's; secondly, it is impractical to exclude other people from using it. These two characteristics make such services not amenable to allocation through markets. Without effective regulation, such services will likely be undervalued and overexploited.

Option values. There is an option value in conserving marine habitats for economic reasons, given the high prospect of developing new resources or new opportunities to create wealth, that are yet unseen. Economic activity often impinges on biodiversity. When considering changes to habitats of which little is currently known, adopting a precautionary approach means recognising

these option values and the potential scale of permanent loss that may be associated with short-term economic gain.

Advances in food production and pharmaceuticals rely heavily on the natural genetic diversity of marine life because marine organisms have evolved complex chemical compounds and processes for defence and predation, or for survival in extreme environments such as deepsea hydrothermal vents. These compounds and their underlying genetic diversity have huge potential economic value that would be foreclosed by the loss of marine biodiversity. The scale of the loss can be gauged from a recent UN estimate that the combined market for products derived from genetic resources in the cosmetics and drug industries is worth approximately US$100 billion per year (Zakri and Johnston 2004).

Bequest values. These refer to the conservation of natural resources for future generations to enjoy. These values arise out of a concern for future generations and the uncertainty surrounding the supply of resources or the long-term consequences of altering the natural environment.

Existence values. Many people desire to see environmental resources conserved, even though they never intend to use them. Markets cannot capture the spiritual, cultural, or aesthetic regard in which people hold the natural world. It is hard to measure existence values and many people dispute whether it is right or meaningful to put monetary values on the existence of other species or aspects of the natural world. Nonetheless, the vast amounts of money contributed by millions of people worldwide to conservation indicate the high value we collectively place on nature.

Solutions to bird by-catch, such as the use of streamers, can be both effective and inexpensive.
Photo: Jim Enticott/rspb-images.com.

Critical marine issues

Overfishing. World fish consumption increased from 45 million tons in 1973 to more than 94 million in 2000, at which time the estimated first-sale value of the global catch amounted to US$81 billion. The UN Food and Agricultural Organisation's (FAO's) catch database of 116 epipelagic and deep-water species reveals that catches almost tripled from 3 million tons in 1976 to 8.5 million tons in 2000. The impact of this over-exploitation was uncovered by a recent study (Devine *et al*. 2006), which found that populations of five deep-water species had plummeted by between 87% and 98% between 1978 and 1994.

Further evidence of overfishing is summarised in the FAO's 2004 state of the world's fisheries report. The report states that about 16% of stocks or species groups are overexploited, with an increasing likelihood that stocks will decline further and catches will decrease unless remedial management action is taken. The FAO also reported that 8% of stocks have already become significantly depleted, while approximately 52% of the main fish stocks or species groups were fully exploited, producing catches that have reached, or were close to, their maximum sustainable limits. By the FAO's reckoning, nearly three-quarters of the world's marine stocks offer no expectations for further expansion.

To date, fisheries managers and multilateral fisheries conventions have largely ignored ecosystem concerns and have concentrated instead on regulating those species being targeted by specific fisheries. Many feel it is now time to take a more holistic, ecosystem-based approach to this problem. The seriousness of the situation is demonstrated by the fact that, for the first time, the FAO's Committee on Fisheries in 2005 recognised that MPAs can be a useful fisheries tool (COFI/2005/8).

Discards and birds and mammal bycatch. In commercial fishing, thousands of non-targeted species are caught. This bycatch is typically discarded dead at sea, and includes seabirds, marine mammals, turtles, juveniles of the targeted species, and even fish targeted by other fisheries. Based on a review of over 800 papers, Alverson *et al*. (1996) estimated that between 17.9 and 39.5 million tons of fish are discarded each year in commercial fisheries – roughly a quarter of the total catch. Economically this represents losses of millions, if not billions, of dollars. The economic losses associated with discards include the monetary value of: (1) marketable species that are too small or otherwise prohibited from landings; (2) species for which no current market exists, but are caught with commercial or recreational species; (3) species-specific fleet sectors discarding another fishery's target species; (4) marine mammals, turtles and birds for which society expresses high existence values; and (5) the opportunity cost of the effort expended in catching and disposing of bycatch. Additionally, there is a significant reduction in biological productivity of populations of discarded marketable species.

For seabirds, longlining is a problem as the more than one billion hooks set each year result in the death of more than 300,000 seabirds annually. Birds affected include some of the most charismatic and vulnerable species on the planet, such as albatross and petrel. Furthermore, the Cetacean Bycatch Resource Centre states that accidental capture and entanglement in fishing gear is the biggest threat to whales, dolphins and porpoises worldwide, killing more than 300,000 animals per year.

The seabed. Fishing alters marine ecosystems by removing a large fraction of the biomass, altering the food supply of the remaining marine predators. It also incurs further environmental costs in terms of physical damage done to the seabed. Recent scientific explorations of seamounts and cold-water coral reefs have revealed their unique and complex biodiversity, with as many as 50% of the species observed during recent seamount cruises being new to science (Rogers 2004). Seamounts are generally volcanic peaks that rise 100 m or more above the surrounding ocean floor. They are characterised by high levels of biodiversity and endemic fauna and serve

Some 100,000 albatrosses, such as this black-browed albatross, die each year on fishing hooks. They are being killed in such vast numbers that they cannot breed fast enough to keep up. This is putting them in real danger of extinction. Photo: Chris Harbard

as feeding grounds and sites of reproduction for many open-ocean and deepsea species of fish, sharks, mammals and seabirds. They are highly productive environments attracting many pelagic fish species and shoals of fish, shrimp and squid that feed above them.

The major threats facing seamounts and the wider benthic landscape is the practice of bottom trawling. This destructive technique can destroy bottom habitats, such as 8,000-year old cold-water coral reefs, in a single trawl. Yet bottom trawling on the high seas is almost completely unregulated. Any proper cost-benefit analysis would take full account of this external damage. MPAs are particularly suited to preventing this form of destruction, because they restrict gear and access to these threatened areas that do not move with changing ocean patterns.

Perverse subsidies and overcapacity. The ecological damage done through poor fisheries management has been compounded by subsidies that are provided by many nations to maintain fisheries-sector income. A World Bank paper estimated that worldwide fishery subsidies total between US$14.5 and $20.5 billion annually, conceding that even these figures 'probably err on the low side, perhaps by a considerable margin' (World Bank 1998). This is equivalent to about 25% of the annual value of the world's commercial marine fish catch and has fuelled overcapacity within the industry. The European Union (EU) alone spends around two-thirds of its fisheries budget subsidising commercial fleets. Subsidies include payments for national access to fish in foreign waters, direct grants, tax breaks for fuel, funds for the construction and maintenance of port facilities, and support for ship building and fish processing.

Illegal, unreported and unregulated (IUU) fishing. IUU fishing undermines the sustainability of fisheries. The FAO estimates that in some important fisheries, IUU fishing accounts for up to 30% of total catches. It occurs in both small-scale and industrial fisheries, in marine and inland water fisheries, as well as in zones of national jurisdiction and on the high seas (Doulman 2001).

Inappropriate gear. The negative impacts of overfishing are exacerbated by the use of fishing gear that fails to minimise environmental externalities for which the fishers are not held financially accountable. In some instances, it is apparent that inexpensive modifications to gear and techniques could reduce environmental damage by reducing the capture of undersized fish and the bycatch of birds and mammals.

Ever-increasing capacity for damage. Technological advances and economic growth have increased the scope and range of human impacts on the marine environment. The UN estimates that 90% of the ever-increasing volume of world trade is transported by ships while the doubling of large-scale fishing vessels, since 1970, has generated rapid growth in the number of fleets plying non-local waters. Technological advances in oil drilling, seabed mining and fishing also increase the pressure on deepsea habitats and species. Furthermore, rapid economic growth in countries has contributed to pollution and climate change that also affect the quality and resilience of the marine environment (UNEP 2002).

The particular problem of the High Seas: a global commons

While many of the foregoing issues are common to both waters within national jurisdictions and the High Seas, the global commons nature of the High Seas poses special problems for safeguarding their biodiversity. The problems posed by common access are straightforward. The absence of property/use rights or enforceable agreements means that it is in the financial interest of fishers to maximise their catch regardless of the overall status of the stock. The first step in solving the problem is to establish an enforceable regulatory framework.

Action to date: the United Nations Convention on the Law of the Sea (UNCLOS) as a foundation for regulation

In recent years, the issue of High Seas MPAs has received considerable attention. This has included recognition in the plan of implementation adopted by the 2002 World Summit on Sustainable Development; a call for urgent action to protect seamounts, cold-water corals, and other vulnerable high-seas features and ecosystems by the 2003 IUCN World Parks Congress; consideration by the CBD; but, most importantly, consideration in the framework of United Nations Convention on the Law of the Sea (UNCLOS).

These positive developments have been given impetus by IUCN and its World Commission on Protected Areas (WCPA) and WWF International, all of whom have identified the High Seas as a gap in a global representative system of marine protected areas. Threatened marine ecosystems, including those in the High Seas, will be a major issue in forthcoming years, as will MPAs – one of the key remedial options for addressing the threat.

The costs of financing High Seas marine protected areas

The 2003 IUCN World Parks Congress estimated that US$ 25 billion in additional annual support is required just to effectively maintain the current global system of protected areas. This stands in stark contrast to the actual worldwide expenditure of around US$ 6.5 billion a year (James *et al*. 1999). The recent adoption of a new programme of work on protected areas by the CBD necessitates a change in the scale and range of financing arrangements if it is to be successfully implemented.

It is critical that the full financial costs of individual MPAs be understood. These costs include establishment, administration, employment, monitoring and enforcement. On the basis of survey data on the financial requirements of 83 MPAs worldwide, Balmford and colleagues (2003) suggest that a global MPA network covering 30% of all the world's seas (both territorial waters and High Seas) might cost between US$ 5 billion and US$ 19 billion annually to run. This may seem expensive yet the higher figure is a mere 2% of annual global military expenditure and

equivalent to the annual amount the world spends on cosmetics or pet food. On the basis of the vast ecological functions the oceans afford us, let alone the direct economic benefits, the investment is worth it.

Financing mechanisms and sources

To find the money, the principles of UNCLOS reinforce the need for a shared approach, as does the principle of common but differentiated responsibilities. However, the failure of developed countries to fulfil intergovernmental commitments related to financing, such as those made in the CBD, is a major concern, and the need to explore a range of potential financing options is becoming widely recognised.

Multilateral agencies. The Global Environment Facility (GEF) focuses on global benefits and has a limited number of marine projects under its focal area on international waters. It is well placed to take on financing High Seas MPAs but the funding available through the GEF is woefully inadequate to address the needs for protected areas in developing countries let alone expand its activities. Still, given the supranational nature of the problem, it still has a role to play along with the World Bank and the regional development banks.

National governments. Many individual countries have contributed to the degradation of the marine environment, though no individual country can solve the problem by acting alone. However, an enforceable multilateral framework will ultimately depend on the support of individual countries. Many developed nations express, as part of their principles governing overseas assistance, a commitment to environmental sustainability, and they should ensure that their policies and activities, such as sectoral subsidies, support rather than undermine conservation efforts.

Charges for the use of global commons. Over the years, proposals have been made for global fundraising mechanisms and a number of novel, market-based financing mechanisms, in support of conservation, have been developed and implemented. There is a strong economic case for the introduction of charges to ensure that economic actors meet the full social costs of their activities. The conventional economic solution to public goods and externalities is to make the polluter or user pay through regulation, taxation, or market interventions. Conceivably, a variety of revenue sources can be generated from ocean activity. They could relate to extractive and bioprospecting activity on the ocean bed, fishing, overflights and shipping. Methods could include user charges and permits for commercial activities. The introduction of charges for the use of global commons has two beneficial outcomes: the revenue raised, and the incentive provided to reduce environmentally harmful activities. For all market-based approaches, appropriate legislation, regulation and governing authorities would need to be established for implementation.

Supranational tax. Taxation, a conventional national means of paying for public goods, has been proposed as a means of increasing financing for a number of global concerns. To this end, a number of national and supranational taxes have been mooted, including taxes on international currency transactions, on international trade and on international aviation to account for negative externalities that affect areas beyond national jurisdictions.

Mobilising private and voluntary support. The existence value placed on marine environments is apparent by the significant worldwide efforts made to conserve it. If MPAs provide the conservation results currently pursued by voluntary groups and individuals, then it is conceivable that a portion of resources needed to maintain a system of MPA beyond national jurisdiction

could come from a portfolio of well-designed and effective investment vehicles, private endowments, trusts and donations from stakeholders worldwide. The GEF states it will consider as an operational objective 'the demonstration and implementation of innovative financial mechanisms'. This could involve promoting the development and capitalisation of conservation trust funds and facilitating systems of payments for environmental services. Innovative public-sector initiatives and programmes, by providing the financial mechanisms and marketing the basic biodiversity characteristics of the High Seas, could increase the number of people willing to invest in its preservation.

The future of the High Seas

To date, domestic and oceanic fisheries provide a classic example of how not to manage communal goods. The difficulties in governing supranational space may seem intractable but the legislative building blocks are in place. The High Seas may represent the least explored region on the planet, yet the more we learn, the more the extent of human impact becomes apparent. Scientists are beginning to understand more how the oceans modulate climate change, provide vital ecosystem services and the range of proximate threats to marine biodiversity posed by economic activity. Perhaps one of the biggest drivers for improved management will be when this scientific understanding can be translated into impacts, which can be incorporated within the decision-makers' cost-benefit framework.

However, uncertainty can be no excuse for inaction. We may not be in a position to put dollar values on all the costs and benefits from our use of the oceans, but we now know more clearly than ever, the nature and extent of the damage we have already wrought. Whilst there is a pressing need to increase research efforts to better understand the biodiversity and functioning of marine space, we already have ample evidence of the damage done. This evidence alone justifies adopting effective management tools, such as MPAs, not merely to slow existing trends but to reverse them. Combined with the adoption of a precautionary approach and the 'polluter pays principle', the case for adopting MPAs on the High Seas is compelling.

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parks

Pelagic protected areas: the greatest parks challenge of the 21st century

ELLIOTT NORSE

".the animals which live in the watery depths, above all in ocean waters..are protected against the destruction of their species at the hand of man. Their reproductive rate is so large and the means which they have to save themselves from his pursuits or traps are such that there is no evidence that he can destroy the entire species of any of these animals."
Jean-Baptiste Lamarck, Zoological Philosophy (1809)

Open oceans are being drained of their large wildlife, and traditional management tools have proven woefully ineffectual in slowing this loss. To save pelagic megafauna targeted by fisheries (e.g. sharks, billfishes, tunas) and killed incidental to fishing (e.g. sea turtles, albatrosses and dolphins), protected areas merit serious examination. Oceanic megafauna have been considered poor candidates for protection within marine protected areas (MPAs) because these animals are highly migratory and their movements were little-known by scientists until very recently. However, fishermen have learned to find them, and new tools allow scientists to understand their movements as well. Because pelagic megafauna concentrate in specific places at certain times that can be predicted or observed, place-based approaches can be used to conserve them. The highly migratory nature of pelagic megafauna does not preclude the use of protected areas which are, indeed, used to conserve highly migratory non-marine species. Some of the hotspots where pelagic megafauna congregate can shift, predictably or unpredictably, and this poses a novel challenge, one that can be met by establishing MPAs with dynamic boundaries. New tools and management strategies could protect these important, vulnerable animals even in the remote vastness of the High Seas.

ONCE THERE WERE NO PARKS because nobody saw the need for them and there were no means of creating them. But since growing human populations have demanded more and more of the earth's resources, protecting places has become essential to maintaining the crucial services that biological diversity provides. Rulers have created protected hunting preserves for centuries, and nations have been establishing national parks since Yellowstone in the 19th century. In the 20th century, our vision expanded with the creation of the first protected areas in nations' coastal waters. A legacy of such forward-thinking decision making is that many species and ecosystems that would otherwise have disappeared are still with us. Still, if people had acted earlier and had effectively protected more places, far fewer species – such as Bornean orangutans *Pongo pygmaeus* – would now be in danger of extinction. Furthermore, far fewer vital ecosystem services – such as protection of coastlines by mangroves and coral reefs from devastating tsunamis – would now be gone when we most need them. The best time to establish protected areas is when the greatest range of options is still available. And that requires the capacity to see the big picture, particularly the kind of vision called foresight.

A 21st-century vision for the oceans

Now, as humans have depleted resources on land and in coastal waters, resource extraction has expanded far beyond the sea-cloaked shoulders of continents – which marine scientists call continental shelves and slopes – into the vast ocean basins. Humans are now profoundly changing the world's remotest places, the last frontiers on earth. To reduce and stop the harm we are causing, we need a new strategy for quick and effective action. Having saved some crucial remnants of the earth's biodiversity by protecting areas on land and in coastal waters during the last two centuries, we need to take the obvious next step in the 21st century: protecting places in the open oceans.

The enigmatic, vast, last conservation frontier

The need for place-based conservation in the open oceans is not easy to comprehend for several reasons.

The first is that the open oceans are so poorly explored that they are still revealing their secrets. How can they need conservation when scientists are still making major discoveries? It is true that the sunlit blue epipelagic zone and the cold, black depths beneath them are still *terra incognita* and that scientists continue to uncover the mysteries of marine species and ecosystems. The aptly named 'megamouth' shark, *Megachasma pelagios*, measuring over five metres long and belonging to a new family, was discovered in 1976. From a few bones found on islands off New Zealand and Chile, scientists know that somewhere out there is a beaked whale species *Mesoplodon traversii* that has never been seen by humans. Only in the last few years have scientists taken the first photographs of giant squid *Architeuthis dux* in their deepsea habitat, and realised that there is another squid *Mesonychoteuthis hamiltoni*, even bigger than giant squid. It is not difficult to miss really large animals in the vastness of the open oceans.

Similarly, it was not until 1977 that scientists first discovered deepsea hydrothermal vent ecosystems that have since been found around the world. No less remarkable was the discovery in the 1980s and 1990s of extensive *Lophelia pertusa* coral reefs in the deepsea off Norway and Ireland. Scientists are still far from finding many of the world's seamounts, active and extinct undersea volcanoes that can rise thousands of metres from the deep seafloor. Indeed, only a few hundred of the many thousands of seamounts have been studied by biologists, but these few studies, combined with general understanding of ocean currents, tell us that seamounts are the deep ocean equivalents of islands. They are markedly different from benthic habitats that surround them, and the species that inhabit them are often endemic (species found nowhere else) to individual seamounts, seamount clusters or chains. Their value in biological diversity is consequently immense.

Although systematic scientific exploration of the open oceans began in the 1800s, we are still learning that they are more complex and dynamic than anyone realised. The fact that scientists haven't fully explored oceanic ecosystems does not mean it would be wise to wait before we start protecting them. On land, we will probably never see scientists announce the discovery of

Indo-Pacific blue marlin Makaira mazara, *Hawaii, USA. Many large animals (megafauna) living in the upper layers of the open ocean are exquisitely adapted for moving long distances between scarce but rich concentrations of food animals, or between places where they feed and breed. Some migrate thousands of kilometres. Can protected areas be used to conserve them?* Photo: Masa Ushioda/coolwaterphoto.com.

bigfoot, chupacabras and mokele-mbembe, but a few large species continue to be found in the last-remaining unexplored ecosystem remnants. They include the recently discovered saola or Vu Quang ox *Pseudoryx nghetinhensis* in Vietnam and the Chacoan peccary *Catagonus wagneri* in Paraguay. Nobody would argue that the existence of as-yet undescribed species or unexplored ecosystems on land is a valid reason for waiting to protect imperiled places. To avoid losing biodiversity and the services it provides, the opposite argument makes much more sense, both on land and the sea.

A second reason why place-based conservation in the open ocean strikes some people as peculiar is that the oceans' immensity leads some to assume that they are an invulnerable cornucopia. After all, the Pacific Ocean alone would be larger than all of the continents even if there were two Australias. Moreover, fishes have long been regarded as being so fecund that many societies made them symbols of fertility, and scientists have opined that this makes them extinction-proof. Even Rachel Carson the marine biologist whose paeans to the sea brought her public acclaim in the 1950s, before she catalysed the revolution in environmental thinking with her 1962 book *Silent Spring*, largely overlooked human impact on the sea. Because relatively few people venture even tens of metres below the oceans' surface and fewer still read the rapidly growing scientific literature on marine conservation, many assume that oceans are inexhaustible. Indeed, it was only in the 1990s (Norse 1993; Marine Conservation Biology Institute 1998) that hundreds of scientists began calling attention to their severely declining health. Decision makers have scarcely begun to heed these calls for action.

The oceans' immensity no longer protects them. Seafarers and scientists now see the sea's face pockmarked with floating trash. There are measurable amounts of synthetic toxic chemicals in even the remotest places in the oceans. Shipping, oil exploration and sonar now generate such a cacophony, in what Jacques-Yves Cousteau once (1956) called *The Silent World*, that intense sounds have apparently killed whales in the Bahamas and the Canary Islands. We increasingly

Leatherback sea turtle Dermochelys coriacea *hooked on longline off North Carolina, USA. Leatherbacks migrate long distances between places where they feed and beaches where they nest. These movements make them highly vulnerable to being caught and drowned by pelagic longlines set for tunas and swordfish. Scientists now project that leatherbacks will be extinct in the Pacific Ocean within the next few decades.* Photo: © Herb Segars/gotosnapshot.com

see changes that portend devastating impacts in the near future from global warming. But by far the biggest human impact in the open oceans to this point is commercial fishing. Landmark scientific studies by Pauly *et al*. 1998, Watling and Norse 1998, Hutchings 2000, Jackson *et al*. 2001, Watson and Pauly 2001, Myers and Worm 2003, Lewison *et al*. 2004b and Devine *et al*. 2006, show that both the magnitude of impacts from fishing and the vulnerability of marine species and ecosystems are far greater than had been thought. The cornucopian view of the oceans is wrong.

A third reason why the concept of protecting places in the open oceans might seem strange is sensory. People's senses do not equip them to perceive the oceans' heterogeneity. We think of the land as a patchwork of places, but perceive the fluid medium above the seafloor as so interconnected and featureless that anything happening anywhere affects everywhere. Yet scientists know that the inscrutably wavy surface of the oceans conceals remarkable biological and geological heterogeneity. New scientific tools, including images showing phytoplankton abundance patterns in surface waters taken by orbiting satellites show that oceans have distinct places and, in marked contrast to places on land, some of these places move.

In this article, I explain why we need a far more expansive conservation vision for the open oceans, one commensurate with the growing understanding of our present and future impacts. An obvious starting place would be protecting seamounts, which are clearly definable biological hotspots rising above the seafloor. But we need to go further and identify the most important hotspots in the water column (the pelagic realm), and then to act decisively to protect them.

Although establishing a comprehensive and effective system of protected places in the open oceans will undoubtedly be a long, ongoing process – as protecting places on land and in coastal waters is – the confluence of rapidly growing need and opportunity suggest that we cannot afford to wait.

Conservation in the biggest ecosystem on earth

The marine environment covers more than twice the area of terrestrial and freshwater ecosystems combined, and constitutes perhaps 99% of the volume of the biosphere that is permanently inhabited by animals and plants (Norse 1994). The vast majority of attention to the sea concerns estuaries, enclosed seas, continental shelves and/or areas within nations' Exclusive Economic Zones (EEZs), where productivity of living things is highest, human impacts are greatest and research from shore-based facilities is easiest. However, these areas make up only a minority of the marine realm. Some 64% of it is high seas, beyond individual nations' jurisdictions.

Oceans are home to myriad species, perhaps millions of them, from seabirds flying above the waves and insects skating on the tropical sea surface to fishes and invertebrates dwelling in hadal 11-kilometre depths in the deepest ocean trenches. They range from microscopic bacterioplankton to gigantic blue whales *Balenoptera musculus*. More than 98% of marine animal species are benthic, living in, on or immediately above the seafloor (Thurman and Burton 2001). Nonetheless, the water column well above the seafloor is home to thousands of species. The large animals in these upper layers – the oceanic pelagic megafauna – are not only ones people care about, but ones which form the basis for some of the most important fisheries, and which are the top predators in these ecosystems.

In comparison with the sediment-and plankton-rich brown waters of estuaries and green waters usually overlying continental shelves, the blue surface waters and black depths of the open oceans are a much thinner broth. The upper epipelagic layer of the open oceans is low in nutrients and hence less productive of organic material per unit area. Phytoplankton there are eaten by zooplankton whose faeces sink below the epipelagic zone to the seabed, averaging nearly 4,000 metres below. This 'rain of poops' and other organic material, including dead whales and sunken wood, provides all of the food in the deepsea except for the food produced at hydrothermal vents and cold seeps.

Since hungry mouths intercept food particles as they sink, food becomes scarcer with increasing depth. Immediately below the epipelagic zone is the mesopelagic zone, where fishes, squids and crustaceans hide from predators in darkness during the day, but ascend into the relatively food-rich epipelagic zone under cover of night. Deeper still are bathypelagic and abyssopelagic zones. Perhaps the most abundant fishes in the world are bathypelagic bristlemouths in the genus *Cyclothone*. After eliminating all the sea's other, more desirable fishes, we could eat *Cyclothone* if only they weren't highly dispersed (making the energy cost of catching them prohibitive), less than five cm long, and possessing oily, soft and fast-rotting flesh. Fortunately, this makes them and other, less-abundant deepsea pelagic fishes that share these attributes safe from fishing pressure for the foreseeable future.

So the pelagic waters of the open oceans are averagely low in food resources and in large animals, but there are important exceptions. One is waters overlying some seamounts. In other places, upwelling of deeper, nutrient-rich waters into the well-lighted epipelagic zone provides a basis for much higher than average phytoplankton production. Another exception is convergence zones, where water masses of differing density meet and floating objects aggregate (Hyrenbach *et al*. 2000). Such areas of higher productivity are fairly localised, making these oasis-like hotspots in the desert-like open oceans particularly important to conserve. Moreover, some areas of the open oceans have much higher megafaunal species diversity than others (Worm *et al*. 2005).

Many oceanic hotspots, including seamounts, mid-ocean ridges and banks, are raised topographic features with their own distinctive and imperiled communities of life (see Earle, this issue). However, the pelagic realm is home to remarkable megafauna, including sharks, tunas, billfishes, sea turtles, seabirds and cetaceans. Some, including whale sharks *Rhyncodon typus*, manta rays *Manta birostris*, leatherback turtles *Dermochelys coriacea* and blue whales feed mainly on zooplankton, but most megafauna are predators of fishes and squids. New tagging technologies have made it increasingly clear that many oceanic megafauna migrate vast distances through desert-like low-nutrient waters to certain places where food can be far more concentrated. Food-rich places may be more or less permanently located above certain seamounts or occur where water masses converge, or, they may be ephemeral, appearing for weeks or months, and then disappearing. In either case, the story seems to be the same: blooming plankton populations provide food for large schools of small pelagic fishes and squids that, in turn, attract pelagic megafauna that congregate at these features to feed and (in some cases) breed (Block *et al*. 2005). Thus, while big oceanic wildlife are thinly spread on average, abundance at these pelagic hotspots can be very high.

Fishermen know this, and focus their efforts on finding the places where their target species concentrate. Indeed, commercial and even recreational fishermen can now subscribe to services that send them frequent faxes or e-mails showing the best places to fish, based on interpretations of satellite oceanography (for example, www.roffs.com/commercial/about.htm). Large marine animals now face human predators with up-to-date information and safer, faster industrial fishing vessels that use global position systems and fish-finders to determine where to place their drift gillnets, 100-kilometre longlines or huge purse seines. Refuges are no longer available even in the vast open oceans, so oceanic fishing is now like shooting fish in a barrel.

Not surprisingly, populations of many target species have been severely reduced. Species that are caught by accident are at even greater risk. Baum and Myers (2004) recently reported that oceanic whitetip sharks *Carcharhinus longimanus* – perhaps the most abundant large animals on earth – experienced population reductions of 99.7% in the Gulf of Mexico after tuna longlining began there in the 1950s.

Conservation efforts in open oceans thus far have mainly been focused on: 1) ending the killing of great whales including sperm whales *Physeter macrocephalus*, right whales *Eubalaena* spp. and rorquals such as blue and humpback *Megaptera novaeangliae* whales; 2) regulating the catch of wildlife species that are targeted, including neon flying squids *Ommastrephes bartrami*,

Dolphins attacking baitball. Long-beaked common dolphins Delphinus capensis *trap great masses of South American sardines* Sardinops sagax *against the sea surface off South Africa, where they are eaten by the dolphins and other large predators, including sharks, fur seals and seabirds. Protecting dense concentrations of small pelagic fishes at oceanographic discontinuities and along their migratory pathways can be used to conserve pelagic megafauna in coastal waters and on the high seas.* Photo: © Doug Perrine/SeaPics.com

Pacific salmon *Oncorhynchus* spp., bigeye *Thunnus obesus* and other tunas, and swordfish *Xiphias gladius*; and 3) reducing bycatch of sharks, sea turtles, dolphins, porpoises, petrels and albatrosses caught incidental to oceanic longlining, driftnetting, purse seining and pair trawling.

Global bodies such as the International Whaling Commission (IWC) and regional fishery management organisations (RFMOs) such as the International Commission for the Conservation of Atlantic Tunas (ICCAT) have hardly proven to be conservation success stories. After achieving mixed success for several decades, IWC-pushed by Japan, Iceland and Norway – is now moving toward renewal of commercial whaling. ICCAT has presided over the steep decline of northern bluefin tunas *Thunnus thynnus* and swordfish. Species-specific high seas conservation has been conspicuously ineffectual, even compared with conservation within nations' EEZs. Many pelagic megafauna are in steep decline: Thresher sharks *Alopias* spp. in the Northwest Atlantic declined 80% between 1986 and 2003 (Baum *et al*. 2003); white marlin *Tetrapterus albidus* are being considered for listing under the US Endangered Species Act; nesting Pacific leatherback sea turtles have declined over 95% in the last two decades (Lewison *et al*. 2004a) and have a 50% chance of extinction within 10–30 years; a number of large tubenose seabirds, including southern giant petrels *Macronectes giganteus* and wandering albatross *Diomedea exulans* are in severe decline. The rapid disappearance of pelagic megafauna leads one to wonder whether there might be a better way to conserve them on the high seas.

A novel solution: protecting places in the open oceans

Traditional responses to the disappearance of pelagic megafauna include reducing fishing pressure or modifying gear. Unfortunately, the open oceans are the least-protected places on earth, and few measures have proven effective there because international regulatory institutions are particularly weak. Modifying fishing gear – for example, through use of streamer lines (Morgan and Chuenpagdee 2003) and circle hooks (Epperley and Boggs 2004) – can bring about significant reductions in bycatch mortality, but these measures are far from universal at present. The disappearance of pelagic megafauna calls for a new tool: protecting places in the pelagic realm through temporary closures and permanent marine protected areas (MPAs), including no-take marine reserves (Norse *et al*. 2005).

Marine protected areas are usually seen as tools best used for conserving species that move relatively little after early life history stages. Because many epipelagic megafauna are highly migratory, moving hundreds or thousands of kilometres between places where they apparently feed or breed, some scientists think that protected areas cannot be effective conservation tools. They reason that these species would spend too much time being vulnerable to fishing outside the MPAs unless they encompass populations' entire ranges, which, in many cases, means an entire ocean basin. Clearly, humankind is not yet ready to make such extensive commitments to save pelagic megafauna except in very specific cases such as the IWC's Indian Ocean Whale Sanctuary. However, there are ways that far smaller protected areas could be strategically placed to conserve highly migratory large epipelagic animals.

This strategy depends on the fact that key activities occur in more or less predictable (or detectable) places that comprise a small fraction of the total open ocean habitat. In terrestrial, riverine and coastal ecosystems there are ample precedents for conserving places crucial for highly migratory species including breeding aggregations, calving grounds, stopover feeding grounds and even migratory corridors. This is true even for heavily exploited species. Canada and the USA, for example, have used breeding habitat protection in the Prairie Pothole provinces and States to ensure continued large populations of ducks that are hunted by the millions. There is no inherent reason why we could not protect the places where pelagic wildlife are most concentrated and, hence, most vulnerable.

To do that, we need to understand that the sea is not the same as the land in all ways. In some cases – for example, above shallow seamounts – oceanic hotspots stay put. But other hotspots can move at least tens of kilometres in a day, which makes conservation on the high seas an unprecedented challenge. Protecting these crucial ecosystem features requires that we envision a new kind of protected area, one that moves as hotspots move. Using tools such as satellite pop-up tags, we can compare species' distributions with satellite oceanography data to discern patterns. Because such data are expensive to collect, establishing key correlations between species' distributions and oceanographic features will allow oceanographic data to be used as proxies for concentrations of species of particular concern, which is likely to be far less expensive.

Nesting canvasback duck Aythya valisineria. *Many species of ducks are highly migratory, but are effectively conserved by protecting the places where they nest, even though they may be hunted away from their breeding grounds. Protecting key feeding and breeding grounds can be used to conserve other highly migratory species, such as pelagic megafauna on the high seas.* Photo: Ducks Unlimited BC Canada.

If megafauna and commercial fishermen can locate moving hotspots in a dynamic ocean, so can those working to conserve oceanic wildlife.

Using static or dynamic protected areas to conserve epipelagic megafauna on the high seas will require more than a sound conceptual framework; it will also require political regimes capable of ensuring that neither legal nor illegal fishing undermines places meant to protect oceanic hotspots. At present, such regimes do not exist. Moreover, strong rules are not enough; effective enforcement is crucial on the high seas, far from shore-based and even ship-based observers. We will need to integrate new enforcement technologies, including vessel monitoring systems, event data recorders, radar satellite observation (which can pierce clouds and darkness) and satellites that use visual wavelengths whose high resolution images are capable of identifying individual fishing boats with the accuracy required in courts of law.

In a world where many nations are failing to protect marine animals within their EEZs, protecting pelagic megafauna might seem hopelessly farfetched. But new technologies have yielded crucial information about the movements of these species. More visionary thinking about MPAs that are either fixed or move as their habitats move, as well as about new integrated systems of enforcement tools, make this a real possibility. Compared with the increasing acceptance of protected areas on land and in nearshore waters, the idea of protecting oceanic megafauna on the high seas is surely the toughest conservation sell on earth. Whether or not humankind will do this is not a question of science or technology, but of political will.

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parks

Challenges of marine protected area development in Antarctica

SUSIE M. GRANT

Recent experience in Antarctica provides a useful case study on the challenges of developing marine protected area (MPA) systems on the High Seas. This article provides an overview of the legal framework in which Antarctic MPAs can be designated, the protected areas existing within that framework, and the shortcomings of the current designations. The challenges facing MPA development in Antarctica include the sparseness of biological data with which to identify areas for protection, the need for decisions to be made within a consensus-based system of international governance, and the problem of enforcement. Further challenges include the need for co-ordination of protected area strategies between the different instruments of the Antarctic Treaty System, and with global recommendations on the development of High Seas MPAs. Approaches being taken to address these challenges include recent work by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to identify specific conservation objectives for MPAs, priorities for the types of areas to be considered for protection, and the types of scientific information required. Finally, this paper offers some recommendations on how lessons learned in Antarctica might be applied to the establishment of High Seas MPAs elsewhere.

ANTARCTICA is the world's last great wilderness – a vast, ice-covered continent surrounded by one of the most inhospitable, yet most productive, marine regions on earth. This unique area is under pressure from climate change, overfishing and increasing human activities such as scientific research and tourism. Continuing progress towards the protection of its species, habitats, and ecological processes is an important component of efforts to protect high seas areas worldwide.

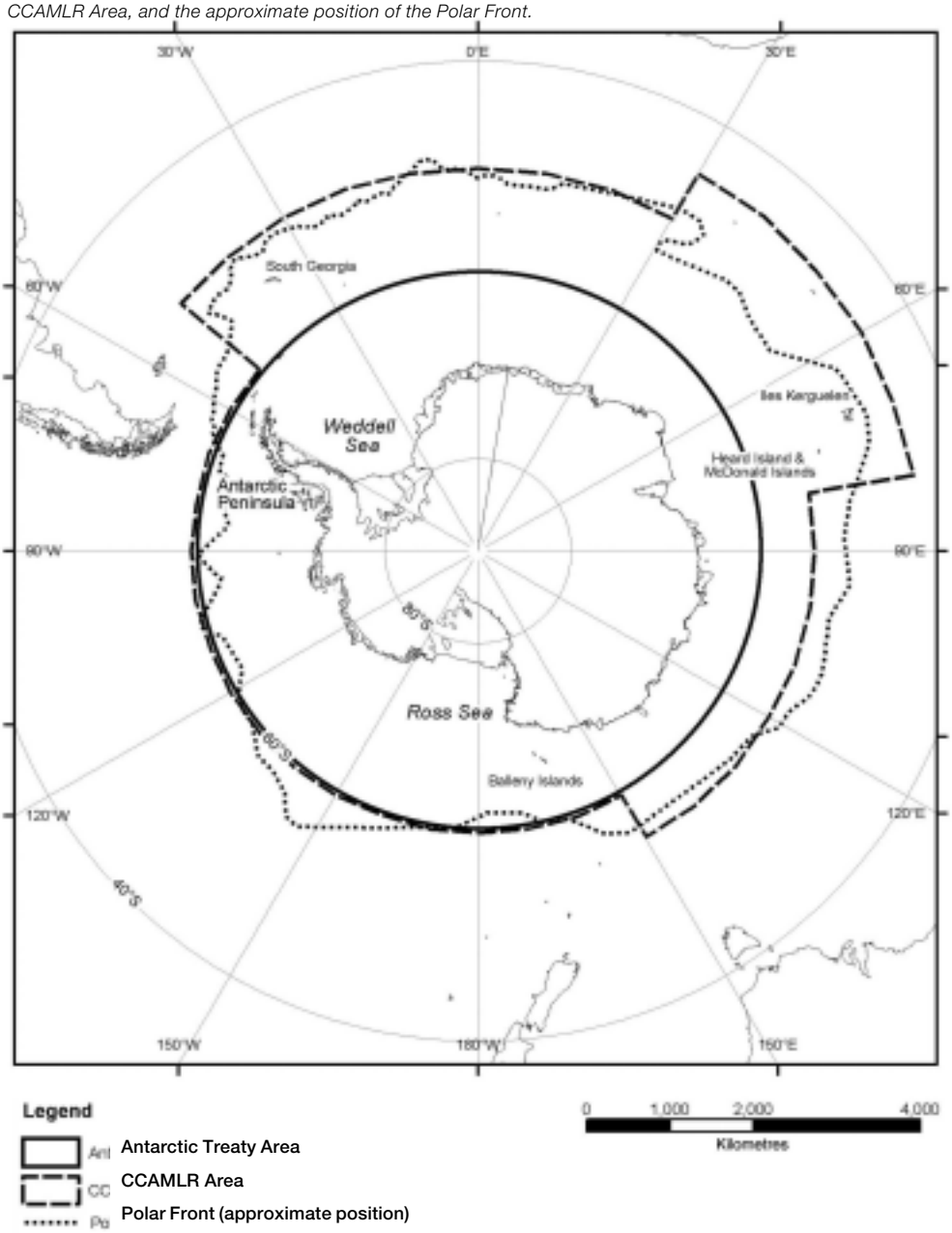
The Southern Ocean comprises 10% of the world's oceans, bounded to the south by the Antarctic continent, and to the north by the Antarctic Polar Front where the westerly flowing Antarctic Circumpolar Current forms an oceanographic boundary separating colder, more productive Antarctic waters from warmer waters to the north (Figure 1). The Polar Front is the northern limit of Antarctic krill *Euphausia superba*, the keystone species of the Antarctic marine ecosystem. Thus, it also defines an important ecological boundary, with only the most mobile birds and marine mammals migrating across it. Primary productivity in the Southern Ocean is highly seasonal, and herbivores including copepods, salps and euphausiids, especially Antarctic krill, are important components of the marine ecosystem as prey species. Predators include whales, seals, penguins and other seabirds, as well as fish and squid. Abundant populations of these predators are present in the Southern Ocean, many of which have been major targets for commercial exploitation both historically and at the present time. The marine benthic fauna of the Southern Ocean has a high degree of endemism, as well as high species richness within some taxa (Clarke and Johnson 2000). Benthic organisms have developed a variety of adaptations to extreme temperature conditions and the seasonal availability of food, forming unique and diverse communities (Clarke 1986). The cumulative effect of pressures, including climate change, pollution and the direct and indirect effects of fishing and other human activities, are the major threats to the Antarctic marine ecosystem (Clarke and Harris 2002).

This article gives an overview of the frameworks currently in place for the development of marine protected areas (MPAs) in Antarctica. A brief summary is given of the legal systems under which MPAs can be designated, the protected areas existing within those systems, and the shortcomings of the current designations. The challenges facing MPA development in Antarctica, and the new approaches now being taken to address these challenges are discussed. Finally, recommendations are made on how lessons learned in the Antarctic might be applied to high seas marine protection elsewhere.

Legal framework: the Antarctic Treaty System

The Antarctic marine environment is afforded protection under the instruments of the Antarctic Treaty System (ATS). The ATS can be defined as the Antarctic Treaty itself, together with its associated instruments: the Convention on the Conservation of Antarctic Seals (CCAS), the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol). The latter two instruments have the most relevance for the development of MPAs.

Figure 1. *Map of Antarctica and the Southern Ocean showing the boundaries of the Antarctic Treaty Area and the CCAMLR Area, and the approximate position of the Polar Front.*



The Antarctic Treaty and the Madrid Protocol apply to the entire area south of 60° S, however CCAMLR covers a wider marine area, extending from the continent to a line just north of an approximation of the oceanographic and ecological boundary formed by the Polar Front (Figure 1). One of the major challenges facing MPA development in Antarctica is this difference in jurisdictional area between the Madrid Protocol and CCAMLR, and the related problem of harmonising protected area strategies between the two instruments. All of the Antarctic Treaty Area and the vast majority of the CCAMLR Area fall on the high seas (Note 1). Both of these instruments specifically preserve the rights of States parties on the high seas, and concerns over the potential impact of MPAs on traditional high seas freedoms such as fishing and navigation, have been one of the factors hampering the development of Antarctic MPAs to date.

The ATS provides a high level of environmental protection, with signatory parties enacting domestic legislation to implement regulations agreed under each instrument. However, both the Antarctic Treaty and CCAMLR operate under a consensus-based system, whereby there must be agreement amongst all of the parties before any regulation or recommendation can be adopted. This often slows decision-making and limits progress. An additional challenge is the problem of enforcement, particularly with regard to nations that are not party to the Antarctic Treaty or CCAMLR. Although inspection and reporting systems are in place to ensure that signatory parties comply with the requirements of these conventions, there is no mechanism to enforce the observance of regulations by non-signatory nations.

Despite these issues, the instruments of the ATS provide the legal framework for a higher level of environmental protection, and a more robust framework for marine protected area development, than exist in any other high seas area, except perhaps the Mediterranean. The following sections describe the provisions available under the Madrid Protocol and CCAMLR for marine area protection and management.

The Madrid Protocol

The Madrid Protocol provides the basic framework for environmental protection and conservation in both terrestrial and marine areas south of 60° S. Annex V on Area Protection and Management sets out a protected area system with guidelines for the types of areas to be designated, management plan requirements and conditions for designation and use. The two main tools for area protection and management are: Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs).

ASPAs correspond to IUCN Category 1a (Strict Nature Reserve) protected areas, and require a permit for entry and other activities. The Madrid Protocol requires that ASPAs should be designated to protect:

- areas kept inviolate from human interference so that future comparisons may be possible with localities that have been affected by human activities;
- representative examples of major terrestrial ecosystems, including glacial and aquatic, and marine ecosystems;
- areas with important or unusual assemblages of species, including major colonies of breeding native birds or mammals;
- the type locality or only known habitat of any species;
- areas of particular interest to on-going or planned scientific research;
- examples of outstanding geological, glaciological or geomorphological features;
- areas of outstanding aesthetic and wilderness value; and
- sites or monuments of recognised historic value.

(Madrid Protocol, Annex V, Article 3.2)

Note 1. Sub-Antarctic islands north of 60°S but within the CCAMLR area are an exception to this rule (for example, Île Kerguelen (France) and Heard Island and McDonald Island (Australia) shown in Figure 1). These islands have Exclusive Economic Zones (EEZs) governed under their respective national jurisdictions, and are therefore not high seas areas. CCAMLR regulations still apply in these areas in addition to any EEZ regulations.

Marine Antarctic Specially Protected Area (ASPA No. 161), Terra Nova Bay, Ross Sea, Antarctica. Photo: Susie Grant.

There are currently six marine ASPAs (as well as nine terrestrial areas with small marine components), covering a total marine area of approximately 1,800 km^2, or 0.012% of the marine area south of 60° S. These are some of the few high seas MPAs currently in existence worldwide, however the majority are *ad hoc*, coastal areas of limited extent. None are located in areas in which there is any fishing activity, and none have been designated as 'representative examples of major marine ecosystems'. Only small areas of scientific interest have been protected to date, such as the 30 km^2 marine ASPA No. 161 at Terra Nova Bay, Ross Sea, designated in 2003 to protect an area of long-term scientific research with high species and habitat diversity. A permit is required for entry and for all scientific activities taking place in the ASPA, and there are also restrictions on shipping activities within the area.

ASMAs correspond to IUCN Category IV (Habitat/Species Management) protected areas ('managed mainly for conservation through management intervention, so as to ensure the maintenance of habitats and/or to meet the requirements of specific species', IUCN 1994). ASMAs are designed to help manage and co-ordinate activities, and have a non-mandatory code of conduct for multiple uses such as tourism, scientific research, shipping and research station logistics. These areas do not require a permit for entry, and the level of protection is lower than that provided by an ASPA designation. Nevertheless, raising the standard of activity management in such areas is likely to provide improved environmental protection. Three current ASMAs include marine components (although one of these has not yet been formally adopted), but this tool has the potential for much wider use to strengthen management and provide codes of conduct in areas of intensive use.

The ASPA and ASMA tools were designed to provide a simple system of protected area tools to cover both the marine and terrestrial environments. However, the system remains poorly developed in terms of its geographic coverage, and there are no sites providing 'representative examples of major ecosystems' or 'areas kept inviolate from human interference'. Much of the work to improve and further develop the system has to date focused on the terrestrial environment, or has made little distinction between marine and terrestrial protected areas (e.g. Njåstad 1998, Valencia 1999). There has been inadequate consideration of marine protected areas as a separate issue, for which 'marine-specific' strategies, objectives, criteria and procedures must be developed. Furthermore, the Madrid Protocol does not have the authority to manage harvesting of marine living resources (for example by implementing a marine ASPA) without the approval of CCAMLR, and interaction between the two instruments on this issue has so far been lacking.

The Convention on the Conservation of Antarctic Marine Living Resources

The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) was adopted in 1982, having been developed in response to increasing concerns over the possible effects of krill harvesting on the entire marine ecosystem, and the need for effective management

and sustainable use of Antarctic marine living resources (Everson 1977, Kock 2000). It has a wider conservation mandate than any other Regional Fisheries Management Organisation (RFMO), and is a pioneer of the ecosystem approach to fisheries management. The Convention applies to all Antarctic marine living resources, which are defined as: 'the populations of fin fish, molluscs, crustaceans and all other species of living organisms, including birds, found south of the Antarctic Convergence' (CCAMLR, Article I). The objective of CCAMLR is 'the conservation of marine living resources', and for the purposes of the Convention, the term 'conservation' includes rational use (CCAMLR, Article II). The Convention establishes a Commission and a Scientific Committee to oversee its implementation.

Conservation Measures defined by CCAMLR include closed seasons, catch and effort limits for particular species, restrictions on the number of vessels permitted to fish in each season, gear restrictions, limits on by-catch of other fish species, and measures to mitigate the effects of fishing on associated and dependent species, including seabirds. The entire area covered by the Convention can be classified theoretically as an IUCN Category IV (Habitat/Species Management) protected area, because of the level of management it provides. However, CCAMLR also has a variety of area-based management tools that provide further protection. The Commission is able to designate closed areas for the purposes of scientific study or conservation, including special areas for protection and scientific study. Closed areas have to date been implemented only on a species-specific basis, although two areas off the Antarctic Peninsula remain closed to all fin-fishing to allow stock recovery. Other closed areas include regions closed to fishing for named species over seasonally-defined periods, and areas where fishing is prohibited in depths of less than 550 m in order to protect benthic habitats. Areas may also be closed immediately once catch limits or by-catch limits for fish or seabirds have been reached. Where these closed areas are not seasonal or temporary, they could meet the IUCN definition of MPAs.

Additional tools include geographically defined units used to assist with the implementation of fisheries management measures. Small Scale Research Units (SSRUs) are used to apply catch restrictions and research requirements for new and exploratory fisheries for toothfish *Dissostichus* species, defining catch limits of zero (thus effectively closing the area to fishing for these species) in several locations. Small Scale Management Units (SSMUs) are used to facilitate management of the krill fishery, and aim to distribute fishing effort and reduce the potential for localised depletion of krill populations and impacts on land-based predators.

Despite the availability of this range of protection and management tools, CCAMLR has not made any specific 'marine protected area' designations, and no areas of fishing activity have been permanently closed to all types of living resource extraction. However, recent discussions on the development of MPAs within the CCAMLR context have progressed this issue considerably.

Recent progress on the development of Antarctic MPAs under CCAMLR

Discussions on MPAs within CCAMLR had previously focused mainly on procedures for development, review and adoption of MPAs in collaboration with the Antarctic Treaty. Formal consideration of how CCAMLR itself should address MPA development had not yet been undertaken. However, in September 2005, CCAMLR Members held a workshop on marine protected areas, with the aim of:

- reviewing current principles and practices related to the establishment of MPAs;
- discussing how MPAs could be used to contribute to furthering the objectives of CCAMLR; and
- discussing the types of scientific information that may be required for the development of MPAs.

The convening of this workshop was a major step forward for Antarctic marine protection, as well as an important milestone in work towards high seas MPAs worldwide. The workshop

identified specific conservation objectives for MPAs, priorities for the types of areas to be considered for protection, and the types of scientific information required for the development of representative MPAs. The following sections summarise the major outcomes from this workshop, and the measures subsequently agreed to by the CCAMLR Scientific Committee and Commission meetings in October 2005.

Review of current principles and practice

The workshop initially reviewed the concept of MPAs within the context of the objectives and obligations of CCAMLR, and agreed that MPAs encompassed a range of mechanisms that could be used to help meet CCAMLR objectives. In relation to existing provisions under CCAMLR, it was agreed that the Convention Area as a whole would qualify as an IUCN Category IV protected area (Habitat/Species Management Area: protected area managed mainly for conservation through management intervention). Within this, it was agreed that additional protection, (including strictly protected – IUCN Category I – MPAs where appropriate) could be established where necessary in accordance with criteria to be developed and agreed.

Although CCAMLR has designated closed areas to support its precautionary approach to managing fin-fisheries, these have not been established for broader purposes relating to MPAs. However, the workshop recognised that this existing framework provides a useful starting point for the development of MPAs. The potential benefits of MPAs for biodiversity conservation, minimisation of impacts of harvesting on non-target species, and protection (including restoration) of stocks and life history stages of target species were noted, and the workshop recognised that CCAMLR had a particular responsibility for participating in international discussions on the use of MPAs to achieve such objectives. It was recognised that many (if not most) CCAMLR Members have existing commitments to the establishment of representative networks of MPAs (for example in respect of the Convention on Biological Diversity, World Summit on Sustainable Development, World Parks Congress etc.). The need to develop a strategic approach to MPA design and implementation throughout the CCAMLR area was highlighted, as was the need for any regime for protection of the marine environment to be harmonised with measures taken under the Antarctic Treaty and the Madrid Protocol.

Types of areas to be considered for protection

Discussion of the types of areas to be considered for protection focused on the agreed conservation outcomes of maintenance of biological diversity and ecosystem processes. It was agreed that attention may need to be given to, *inter alia*, the protection of:

- representative areas;
- scientific areas to assist with distinguishing between the effects of harvesting and natural ecosystem changes, and to provide opportunities for understanding of the Antarctic marine ecosystem in areas not subject to human interference; and
- areas potentially vulnerable to impacts by human activities, to mitigate those impacts and/or ensure sustainability of the rational use of marine living resources.

Such areas could be designated using the existing CCAMLR provisions for closed areas. In addition, the potential need for interim protection to be afforded to areas identified as candidate sites, but where more information is required before a conclusion on protection can be reached, was recognised. Existing area-based tools would also remain available for the designation of closed areas specifically for achieving fisheries objectives.

Types of scientific information required for development of MPAs

During the workshop, consideration was given to the types of scientific information that would be required for the development of a system of MPAs within the CCAMLR area, and in particular

to assist with the identification of biophysical regions. Data types that might be used in a process to determine key bioregions were identified as: physical oceanographic data such as bathymetry, sea temperature and salinity, ice conditions, currents and upwelling areas, information on the distribution, abundance and movement of biota, as well as information on existing and potential pressures such as fishing patterns, by-catch statistics, pollution and shipping activity. Key tasks to be undertaken using such data collated for both coastal and oceanic provinces include:

- development of a broad-scale bioregionalisation for the Southern Ocean;
- delineation of fine-scale biogeographic provinces; and
- determination of a procedure for identifying areas for protection to further CCAMLR conservation objectives, including areas requiring interim protection.

These positive workshop outcomes indicate an increasing willingness by CCAMLR Members to take action to develop and test new approaches for establishing high seas MPAs that further the objectives of CCAMLR. Further work on this issue in the coming years has the potential to make a significant contribution to debates on high seas MPAs worldwide.

Conclusions

There is an urgent need for a more strategic approach to achieve an effective and co-ordinated Antarctic MPA system, and the recent progress made by CCAMLR is an encouraging step towards this goal. However, further work is necessary to improve harmonisation between the instruments of the ATS with regard to MPA development, and to bring together fisheries protection objectives with wider conservation objectives. The protected and managed area tools available under the Madrid Protocol have not yet been utilised to their full potential in terms of their customisation for MPAs with a variety of objectives, and these may be most effective if applied in conjunction with tools developed under CCAMLR. Priorities for future work on MPA development within the CCAMLR context include wide consultation with appropriate interest

Weddell seal resting at Edmonson Point, Ross Sea, Antarctica. Photo: Susie Grant.

groups and stakeholders, and the development of flexible decision-making and review procedures. To achieve maximum benefits, MPAs must be implemented within, and contribute to, a wider framework of sustainable fisheries management. There is a particular need for the development of new strategies for the protection of large marine ecosystems in the Southern Ocean (Ainley 2002), which may be best achieved through this type of combined approach.

A strategic approach to developing an MPA system for Antarctica should also include the application of recommendations or measures under instruments with global purview. Recommendations embodied in international agreements such as the Convention on Biological Diversity (CBD), as well as outcomes from, for example, the World Summit on Sustainable Development and the World Parks Congress, should be considered within the frameworks of the ATS to ensure that Antarctic marine ecosystems are included in a global, representative system of High Seas MPAs. Relevant principles and requirements include the formulation of guidelines and criteria for MPA establishment, the consideration of marine protection as a separate, but linked, issue to protection of other environments, and the development of more specific commitments on a timeframe in which an MPA system should be achieved.

Despite the necessity for improvements, there remains considerable potential for approaches developed within the ATS, and CCAMLR in particular, to contribute towards high seas MPAs strategies elsewhere. The concept of MPAs established under fisheries management frameworks (such as CCAMLR) but within a wider conservation context (such as that provided by the Antarctic Treaty with the Madrid Protocol) may be particularly applicable for high seas MPAs worldwide. Following the models established by CCAMLR, other RFMOs might be used or adapted for similar roles. For high seas MPAs to be fully effective, they must be complemented by comprehensive, ecosystem-based fisheries management, as well as a suite of other environmental protection measures, in the surrounding oceans.

Continuing work by CCAMLR on developing and testing MPAs will be an important contribution to global debates on high seas marine protection, particularly towards further work on MPA development related to fisheries management (COFI 2005), and the commitment to establish representative networks of MPAs by 2012 as set out by the World Summit on Sustainable Development. Establishment of an Antarctic MPA system is still at an early stage, but recent progress indicates the continuing potential for the Antarctic Treaty System to demonstrate leadership in the development of a wider strategy for high seas MPAs.

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Conservation on the High Seas – drift algae habitat as an open ocean cornerstone

ARLO H. HEMPHILL

In the race to protect unique and vulnerable ecosystems beyond national jurisdiction, one of the most critical open ocean habitats is potentially being overlooked, despite its presence on the ocean's surface. Open ocean (i.e. pelagic) drift algae habitat is found in most of the temperate and sub-tropical regions of the world's ocean. Drifting on oceanic currents, this habitat provides essential nursery, resting, spawning and grazing habitat for a range of commercially important as well as unusual fishes, invertebrates, sea turtles and seabirds. Often accumulating along frontal boundaries, this habitat demarcates 'oases' of open ocean productivity and diversity. However, pelagic drift algae habitat is facing its share of anthropogenic impacts, including direct harvest for algin production, medicinal extracts and livestock fodder. In the USA, recent measures have been implemented to protect this important habitat, but conservation measures on the High Seas are still lacking. While traditional forms of protected areas might do well to protect drift algae epicentres like the Sargasso Sea, a new concept of marine protected area (MPA) is required to protect the transient nature of most pelagic drift algae concentrations and associated oceanographic processes. Drift algae may, in fact, provide a visual cue for enabling the demarcation of dynamic MPAs, thereby acting as an umbrella for the protection of a broader suite of pelagic habitats.

A CRITICAL MARINE HABITAT is being overlooked in the race to protect unique and vulnerable ecosystems of the planet's high seas. Drifting algae provide an important open ocean habitat for both unusual and commercially important fishes, invertebrates, sea turtles, and seabirds, serving as an irreplaceable nursery and grazing area for many species in stages of their lifecycles. In the global effort to advance a network of high seas marine protected areas (MPAs), attention to unique, vulnerable and largely unknown deepsea ecosystems such as seamounts, hydrothermal vents, deep coral reefs and 'black smokers' should not detract from much needed protection for the surface (or epipelagic) zone.

The open ocean water column is often thought to be nearly devoid of structural habitat complexity, an attribute believed to contribute to high levels of biodiversity within ecosystems such as rainforests and coral reefs. In reality, physical complexity exists in the pelagic water column, but is often manifest in oceanographic features such as oceanic fronts and eddies (spiraling offshoots of great ocean currents), and areas of sharp horizontal temperature, density or salinity gradients (thermo-, pycno- and haloclines). These oceanographic features, which may be persistent or temporary, not only act as boundaries between habitats but also as sources of upwelling, bringing nutrients (and therefore food) to distinct, and often predictable, areas of the ocean's surface waters.

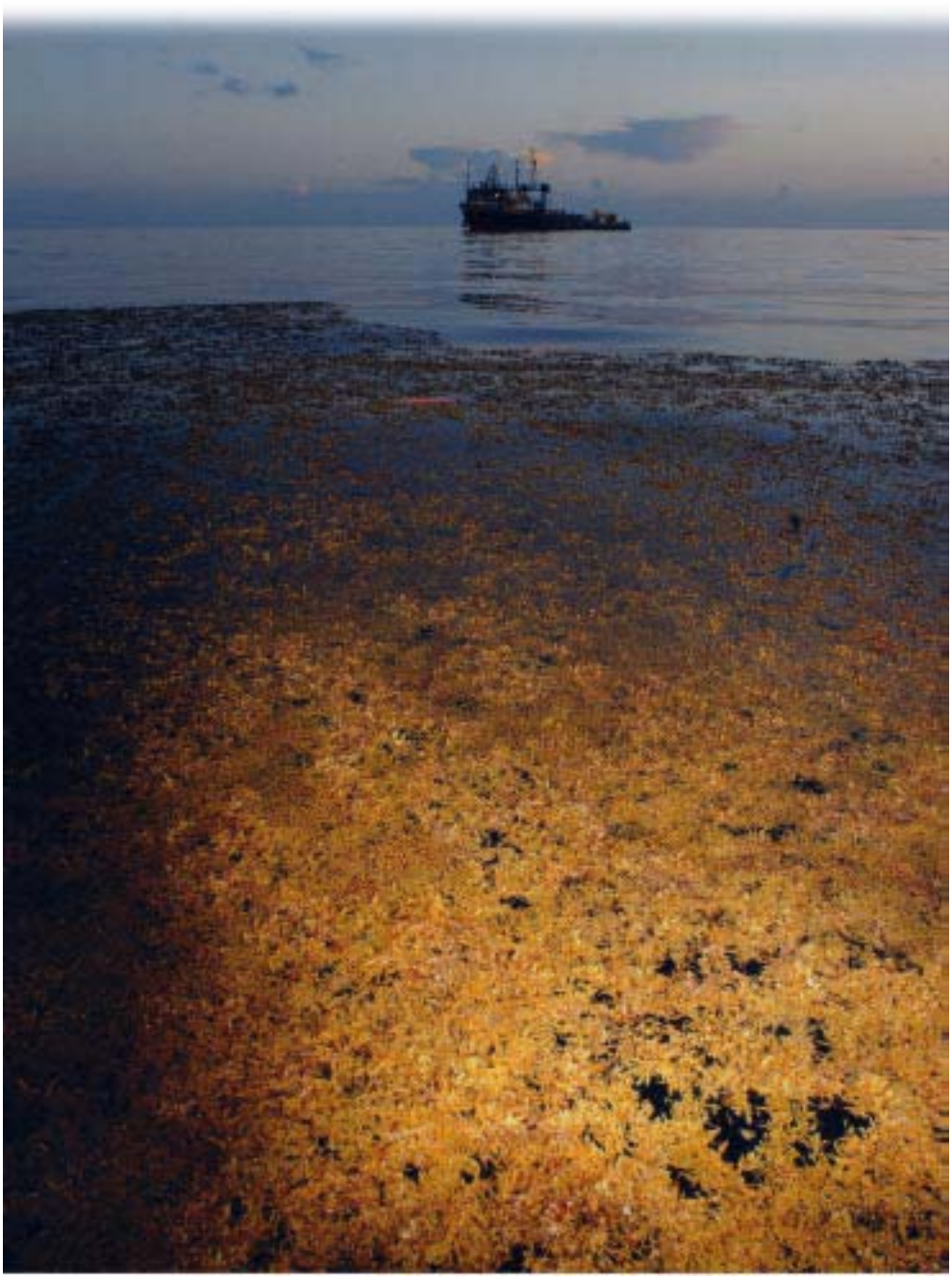
Within the epipelagos, habitat complexity can also be found in a more familiar form: as vegetation, in the form of drift algae. Unfortunately, this drift algae habitat is usually thought of as prime fishing grounds, an unlimited harvestable product, or a nuisance to be avoided and discarded. This article demonstrates not only the ecological value of these habitats, but how placing strict international protections on them may safeguard a greater suite of high seas oceanographic features. They may also provide obvious visual cues for dynamic and transient protected areas (see Norse, this issue).

The ecological importance of pelagic drift algae

Drift algae, like its tropical marine vegetation-dominated counterparts the mangroves and seagrass beds, is a critically important nursery habitat for juvenile fishes and sea turtles, a grazing area for larger predators, and a resting area for seabirds. Drift algae and associated flotsam, such

as seagrasses and vegetation of terrestrial origin, are found in most tropical and temperate regions of the ocean. In shallow water areas where attached marine algae provide the dominant habitat biomass (e.g. kelp beds), some of these algae inevitably become detached and take on a new life, providing structural habitat as they drift around in oceanic currents. Species of kelp *(Macrocystis* spp.), and other brown algae (*Hizikia*, *Myagropsis* and *Cystoseira)*, normally attached

Sargassum – *pelagic drift algae habitat – a unique and vulnerable ecosystem.* Photo: Sylvia A. Earle.

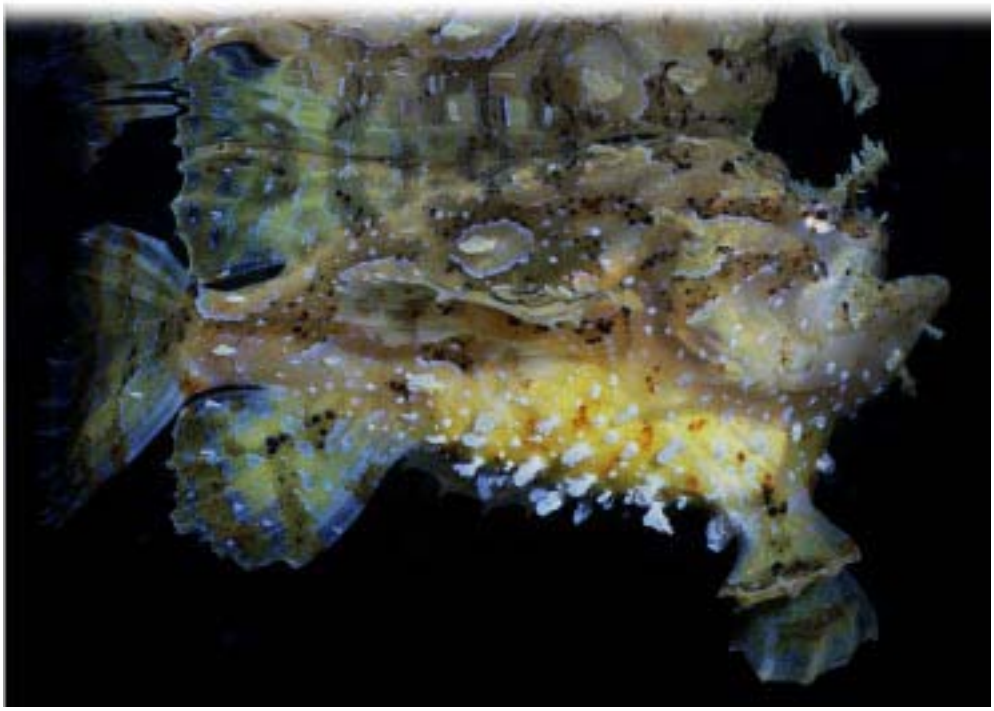


to the seabed, along with seagrasses and vegetative debris of terrestrial origin, are well documented as regularly undergoing this transformation into pelagic habitat (e.g. Hirosaki 1960, Kingsford and Choat 1985). However, one genus of brown algae – *Sargassum* – has taken this role to the next step. In the Atlantic, two species of *Sargassum*, *S. natans* and *S. fluitans*, have become holopelagic – drifting continuously within the North Atlantic gyre system, never attaching to the seafloor during their lifecycle (Parr 1939).

Depending upon the region of the ocean and daily oceanographic conditions such as prevailing winds, drift algae can appear as occasional clumps supporting sparse associated fauna, or as expansive mats several kilometres in length, supporting a complex of associated plants and animals. It also forms windrows (elongated lines of algae on the surface) that are associated with upwelling nutrients and serve as 'oases' of abundant life in the open ocean.

Globally, at least 280 species of fish are known to be associated, at some point in their lifecycle, with drift algae (Hemphill *et al*. 2003). Many of these, such as the Atlantic tripletail *Lobotes surinamensis*, and various species of filefish (especially *Stephanolepis* spp.) appear to be nearly completely dependent upon drifting algae for refuge as juveniles. Numerous species of young jacks (*Carangidae*) are especially abundant, indicating that drift algae carries a resident plankton population capable of sustaining these voracious predators (Coston-Clements *et al*. 1991). Even fishes generally associated with coral reefs, such as the sergeant major *Abudefduf saxatilis* and balloonfish *Diodon holocanthus*, can be found with great regularity as juveniles drifting within pelagic *Sargassum* of the Florida Current and Gulf Stream. Pelagic predators such as dolphinfish *Coryphaena hippurus*, a highly sought-after game fish, utilise mats of drift algae as primary hunting grounds and are thought to be entirely dependent upon the algae in portions of its range (Manooch *et al*. 1984). Some fishes, notably flyingfish (*Exocoetidae*), even use drift algae as a substrate for laying their eggs (Breder 1938). And at least two fishes, the sargassum frogfish

Many permanent residents of drift algae, such as this sargassum frogfish Histrio histrio*, have developed unique colouration and appendages for camouflage within the algae.* Photo: Wolcott Henry.



Histrio histrio and the sargassum pipefish *Syngnathus pelagicus*, are endemic to pelagic *Sargassum*.

However, drift algae is not the domain of fish alone. A host of attached plants, fungi, invertebrates and non-fish vertebrates depend on this habitat. At least 100 invertebrates can be found in the Atlantic *Sargassum* complex, living either permanently attached or free-swimming amidst the fronds of drifting algae (Coston-Clements *et al*. 1991). Conspicuous invertebrate inhabitants include swimming crabs, shrimps, nudibranchs, polychaetes and the sargassum snail *Litiopa melanostoma*. As with fishes, numerous crustaceans will utilise the habitat as a nursery, while a few, such as the sargassum swimming crab *Portunus sayi*, will remain permanent residents. Many of these permanent inhabitants have developed unique adaptations, such as unusual shapes and colourations enabling them to camouflage in the drifting plants.

Additionally, non-fish vertebrates, such as four species of turtle – loggerhead *Caretta caretta*, green *Chelonia mydas*, Kemp's ridley *Lepidochelys kempi* and hawksbill *Eretmochelys imbricata* – are known to utilise drift algae as hatchlings. It is here that they forage and seek refuge during their 'lost year' (Carr 1987). Seabirds also rely on drift algae habitat. In the South Atlantic Bight, 26 species of seabird have been observed to feed and roost on *Sargassum* 'reefs'. Three of these – white-tailed tropicbirds *Phaethon leptures*, masked boobies *Sula dactylatra* and bridled terns *Sterna anaethetus* – are found there in significantly higher abundances than the surrounding open ocean habitat without algae (Haney 1986).

Although much is understood about drift algae habitats, much more remains unknown. This is particularly the case for egg and larval stages of fishes and invertebrates, the life history of hatchling sea turtles, estimates of drift algae biomass, population dynamics, and the effect of drift algae loss on fish and sea turtle populations (Coston-Clements *et al*. 1991). Nearly nothing is known on the impacts of removing either the drift algae itself or living marine resources from within the habitat.

Drift algae, physical oceanography and biodiversity

As previously mentioned, there are various physical oceanographic features that contribute to habitat complexity in the pelagic zone in ways that are different from terrestrial ecosystems. Some of these, such as fronts and eddies, are intricately linked to drift algae habitat. Fishermen and scientists alike know that drift algae can frequently aggregate into windrows in response to wind forcing (Langmuir 1938) or from shear currents along frontal boundaries (Stommel 1965).

Oceanic fronts are the meeting point between two dissimilar bodies of water, and are usually marked by steep gradients in sea surface temperature and chlorophyll. The hydrographic forces that cause the accumulation of drift algae along these fronts also cause the aggregation of many species. These frontal zones, along with warm- and cold-core eddies are especially important for pelagic diversity as they concentrate food supply, enhance local production and increase habitat heterogeneity (Oschlies and Garçon 1998). In short, they are "islands" of high biological productivity with immense concentrations of fish and invertebrate larvae. With such plentiful supplies of food available, they are sought out as 'stepping stones' in the basin-scale migrations of large pelagic tunas, turtles and whales (Etnoyer *et al*. 2004), making them areas of special concern to management and conservation.

Although the quantity of pelagic drift algae varies considerably among different regions of the ocean, when present it provides not only a habitat, but also a strong visual cue to the presence of a frontal system. This would suggest that by protecting the easily visible drift algae, one might also simultaneously protect highly productive convergence front habitat. Although fronts can be located quite easily using satellite technology, this technology is not available on all vessels, and where available, can be rendered ineffective by cloud cover. Drift algae, easily spotted from vessels even in poor weather conditions, could thus potentially serve as an umbrella for protecting a broader suite of pelagic habitats.

Progress in conservation of pelagic drift algae

Drift algae habitat is under increasing anthropogenic pressure from four distinct activities:

1. commercial take of drift algae;
2. commercial and recreational fishing in direct association with algal mats;
3. pollution; and
4. vessel traffic through drift algae habitat.

In recent years, drift algae, particularly *Sargassum*, has been subject to direct human take. *Sargassum* is rich in a number of elements, including calcium, potassium, sodium and iodine (Laihao *et al*. 2001). It is used in many parts of the world as food, livestock fodder, fertiliser, medicine, tea, and is extracted commercially for the production of algin and sodium alginate (Wang and Chiang 1994, Kaladharan and Kaliaperumal 1999). In addition to current take, the UN Food and Agriculture Organisation (FAO) (Naylor 1976) has highlighted the potential for development of 'standing stocks' of *Sargassum*, *Cystoseira* and *Macrocystis* in the waters of the Sargasso Sea, southern Italy, Yugoslavia, the Patagonian Sea, the North American Pacific Northwest, California, the Humboldt Region (Chile/Peru), and the entirety of the Indian Ocean coastal areas, particularly Tanzania, Oman, India, Sri Lanka, Australia and the islands of Kerguelen.

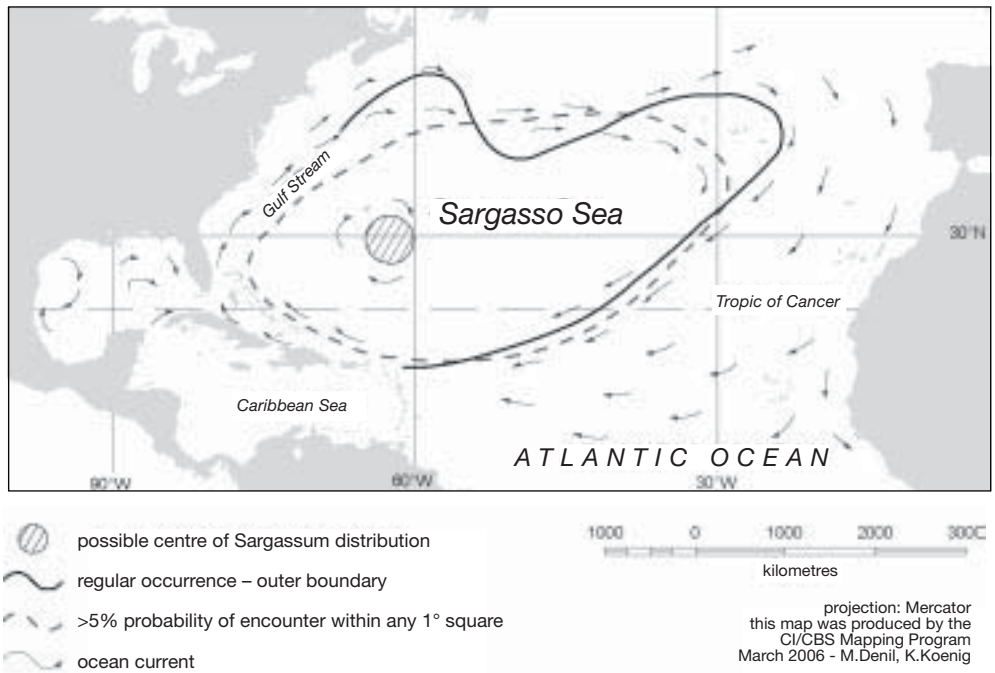
In terms of attached populations of marine macro-algae, conservation legislation has been adopted in a number of countries including Japan, Denmark, California (US), France and Chile, as a result of harvesting pressure. In terms of drift algae, most existing measures for its conservation have originated from the south-eastern United States, since, although encountered within national jurisdiction in many regions of the world, it seldom reaches the great biomass encountered here. The National Coalition for Marine Conservation (NCMC 2005), a US-based advocacy group, claims that many in the fishing community feel that the abundance of large game fish such as marlin, sailfish and tuna is directly associated with the abundance of *Sargassum* habitat and are prepared to take measures to protect it. In fact, *Marlin* magazine (Ferrell 2001) has stated that the habitat 'might just represent the most important offshore environment on earth'.

In 2003, the US National Marine Fisheries Service issued a rule to implement a *Sargassum* Fisheries Management Plan (FMP) (Department of Commerce 2003). The plan establishes areas closed to harvest, sets quantity and time limits on harvest elsewhere, and requires an observer be present onboard any vessel taking *Sargassum* (SAFMC 2002). Other US regulations that consider the conservation of *Sargassum* habitat include the Fisheries Management Plans for Billfish and other Highly Migratory Species, which identify offshore concentrations of *Sargassum* as 'essential fish habitat' – protected under the Magnuson-Stevens Fishery Conservation and Management Act (US Public Law 104–208) (NCMC 2005a).

In 2005, international concern for drift algae was expressed via a resolution of the International Commission for the Conservation of Atlantic Tunas (ICCAT). The resolution calls for the protection of pelagic *Sargassum*, recognising the importance of this open ocean habitat as critical nursery and feeding grounds for marlin, swordfish and tuna. It also charges ICCAT's scientific committee with assessing the ecological value of *Sargassum* to tunas and other highly migratory species. Member countries are asked to report to the Commission on any activities that may impact pelagic *Sargassum* within the convention area, with particular emphasis on the Sargasso Sea, the centre of distribution and abundance for Atlantic *Sargassum* that circulates between 20° and 40° N latitude and between 30° W longitude and the western edge of the Florida Current/Gulf Stream.

Steps are being taken within ICCAT toward the conservation of the Sargasso Sea. However, ICCAT, as a fisheries management organisation, has jurisdiction over pelagic *Sargassum* as a habitat only with relation to impacts caused by commercial fishing activities. Threats posed by commercial take of the algae, recreational fishing, pollution or vessel traffic must still be addressed.

The Sargasso Sea. Source: Adapted from Dooley, 1972.



The way forward? A potential framework for conservation

Since Regional Fisheries Management Organisations (RFMOs) are not the appropriate mechanism for protecting high seas marine habitats from a broader range of threats and human uses beyond fishing, there exists only a very limited set of international legal instruments that may govern the growing number of potential impacts on drift algae habitat. First and foremost is the 1982 UN Convention on the Law of the Sea (UNCLOS), the basic international mechanism for governing all activities on the ocean. Provisions of UNCLOS most relevant to this issue are those in Part VII relating to co-operation in the conservation of marine living resources of the high seas (Articles 116–119) and the obligation in Part XII to protect and preserve the marine environment.

Another international legal instrument, the Convention on Biological Diversity (CBD), invokes general obligations for the conservation of biodiversity. Some particularly relevant aspects of the CBD are those found in Articles 3–5, i.e. the obligations of parties to conserve biodiversity with respect to activities under their control beyond limits of national jurisdiction.

As many commercially important fish species are associated with drift algae habitats, the UN Fish Stocks Agreement (FSA), and its provisions for international co-operation, biodiversity protection and ecosystem-based and precautionary approaches to the conservation and management of straddling and highly migratory fish stocks, is also applicable. Additionally, Article 5(f), which calls on States to minimise impacts on associated endangered species, is of particular relevance to the use of drift algae as a nursery habitat for hatchling sea turtles.

MPAs can offer a comprehensive and integrated approach to protecting drift algae and associated oceanic fronts and eddies. The concept of MPAs beyond national jurisdiction has been under discussion since the 1991 meeting 'Wild Ocean Reserves', hosted by the US National Oceanic and Atmospheric Administration (NOAA). The meeting explored this new approach to conserving unique ocean resources by refining the High Seas reserve concept, outlining economic and management issues, and identifying mechanisms and considering implications of

international law for establishing such reserves. Since then, there has been a series of good work analysing both the 'where' and the 'how', including the IUCN/WWF/WCPA strategy for a network of High Seas MPAs (Gjerde and Breide 2003).

Likewise, options for governing and establishing MPAs beyond national jurisdiction, have undergone considerable analysis and evolution. At the *Defying Ocean's End* Conference, held in Los Cabos, Mexico in 2003, the concept of a 'policy enclosure' of the high seas commons emerged as a highlight of the meeting's outcomes (Gorina-Ysern *et al*. 2004). Moving away from a single-sector or single-fishery approach, this 'World Ocean Public Trust' would provide a framework based on UNCLOS for biodiversity conservation beyond national jurisdiction. Under the World Ocean Public Trust, all ocean uses would be sustainable, the *ecosystem approach* and *precautionary approach* would be applied, and the conservation of biodiversity would be maintained as a priority on at least equal footing with other potential ocean uses (Gorina-Ysern 2004). At a recent meeting, under UN auspices, on conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, a variation on the World Ocean Public Trust concept was finally put forward for discussion by the Natural Resources Defense Council, WWF, Conservation International, Greenpeace, and the Marine Conservation Biology Institute. A new UNCLOS implementing agreement, under which high seas MPAs would be a component, was proposed.

At the *Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction* held in New York at UN headquarters on 13–17 February 2006, many States, led by the European Union, recognised that additional mechanisms may be required to address the long-term protection of high seas ecosystems and biodiversity. The European Union has also formally proposed a new Implementing Agreement to UNCLOS to promote the integrated management of human activities and the establishment of marine protected areas.

A tree trunk floating in the open ocean has assumed the role of drift algae, attracting a mixed school of chubs Kyphosidae, *jacks* Carangidae, *and triggerfishes* Balistidae. Photo: Sterling Zumbrunn, Conservation International.

With such momentum, the establishment of a comprehensive network of high seas MPAs may indeed become a reality. However, can this same mechanism address habitats such as oceanic fronts, which are ephemeral in both space and time? The traditional protected area concept cannot be easily applied to this type of process without establishing them on a geographic scale that may defy practical implementation and political will. However, known patterns or regions of oceanic fronts and eddies could be protected as dynamic or transient protected areas.

To accomplish this, a process could be implemented to identify and establish large-scale multiple use management areas in oceanic regions of high convergence activity such as the persistent frontal zones of the North Pacific Transition Zone and the area of warm-core ring frequency of the South Atlantic Bight, and adjacent areas of the Gulf Stream. Under non-frontal oceanographic conditions it could be business as usual, with sustainable uses proceeding without interruption. However, the transient fronts and eddies of the management area would receive a higher grade of protection. Compliance and enforcement of such a regime could be simplified by automatically conveying drift algae and associated flotsam the highest degree of protection as this would often, although not always, protect the front by default.

The biggest problem with this approach is that sub-tropical and temperate frontal systems are not always blessed with abundances of drift algae. Drift algae abundance is variable both regionally and temporally, as heavy wind conditions might blow drift algae onward despite the presence of a strong oceanic front. The abundance of *Sargassum* in the Western North Atlantic far exceeds typical drift algae present in the eastern Pacific. However, despite low abundances, sparse windrows of *Macrocystis* and associated flotsam are generally present on strong fronts such as the ones that regularly occur near the Channel Islands (Wallace J. Nichols *pers. comm.*). The key to regulating this discrepancy could be in the spatial degree of protection, for example, regulating activities within a certain distance of drift algae.

The strict protection of drift algae and the regulation of activities within a certain distance of it could thus protect a significant number of fronts and eddies. However, this still would not cover them all. There would still be some need to protect and regulate fronts themselves, independent of and in unison with the presence of drift algae habitat. Fishermen already utilise commercial satellite-based sea surface temperature (SST) and chlorophyll maps to focus fishing efforts. Enforcing agencies can do the same. Nevertheless, heightened protection for drift algae habitat would protect the very cornerstone of the pelagic ecosystem, while offering a visual cue that could aid in regulation and enforcement of a broader protection scheme.

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parks

Conservation and management of vulnerable deep-water ecosystems in areas beyond national jurisdiction: are marine protected areas sufficient?

DAVID LEARY

This article is premised on the view that marine protected areas (MPAs) can be an effective tool to conserve and sustainably manage specific areas of the oceans beyond national jurisdiction, and that the efforts of like-minded States should be encouraged.

The article first describes the progress of MPAs created for deep seabed ecosystems. It then takes a wider perspective and argues that, on their own, MPAs will not be sufficient to ensure the sustainable management of the High Seas and deep seabed beyond national jurisdiction. When designing an effective international regime for the sustainable management of this vast area, a range of complex issues need to be addressed. The ecosystems associated with deepsea hydrothermal vents are used here as a case study. The article describes the debate over whether deep seabed living resources beyond national jurisdiction should be considered as part of the Common Heritage of Mankind [sic] under the United Nations Convention on the Law of the Sea (UNCLOS). It also observes that this debate may not be easily resolved. Instead, the article outlines a proposal that may at least serve as a suitable compromise: to link the granting of intellectual property rights for deepsea genetic resources to a trust fund for sustainable development. Such a trust fund could be managed by existing institutions such as the Global Environment Facility and some of the revenue could help cover the costs of operating MPAs beyond national jurisdiction. A further issue that needs to be addressed is the potential environmental impact of marine scientific research (MSR), and whether and how the impacts of MSR should be regulated. It is argued that self regulation by the scientific community will not be sufficient. The article outlines a proposal for the regulation of MSR, which includes an environmental impact assessment process modeled on the Antarctic regime.

THE GROWING INTERNATIONAL INTEREST in the potential role of marine protected areas (MPAs) as a tool for sustainable management of marine areas beyond national jurisdiction, reflects the success of MPAs as a tool for the sustainable management of marine areas within national jurisdiction. The success of many (but not all) MPAs within national jurisdiction suggests that well planned, funded and managed MPAs can be an effective tool for managing a range of activities affecting marine environments.

Recently, MPAs have been established in the deepsea. One such example is the Tasmanian Seamounts Reserve located 170 km south of Hobart in Australia's Exclusive Economic Zone (EEZ). Designated under the provisions of the Environment Protection and Biodiversity Conservation Act (Cth) 1999, the surface waters to a depth of 500 metres are managed as an IUCN Category VI MPA, allowing for some tuna and other near-surface fishing activities and the waters from a depth of 500 metres to 200 metres below the seabed are managed as an IUCN Category Ia strict nature reserve. (Please refer to the IUCN *Guidelines for Protected Area Management Categories* – www.iucn.org/themes/wcpa/pubs/guidelines.htm#categories).

MPAs as a tool for the sustainable management of vulnerable deepsea habitats such as seamounts have not been confined to Australia. New Zealand has protected at least 19 seamounts using marine reserves or MPAs, with some areas closed to fishing, while others are managed for a range of activities. In North America, the USA has implemented measures to protect seamounts off the coast of Alaska and shallow seamounts associated with the Cordell bank off the coast of California, to mention but a few (Johnston and Santillo 2004).

MPAs have also been established in relation to other deepsea habitats. One significant MPA worth noting is the Endeavour Hydrothermal Vent MPA which lies in water 2,250 m deep, 250 km south-west of Vancouver Island off Canada's west coast, within Canada's EEZ. The

Launch of ROPOS remotely-operated submersible from the Research Vessel Thomas G. Thompson, at a hydrothermal vent site near the Maug Islands, in the Mariana Island Arc, South-west Pacific. Photo: Kim Juniper, University of Quebec at Montreal.

establishment of the Endeavour Hydrothermal Vents MPA constituted a significant step forward in the conservation and sustainable management of deepsea habitats. It was one of the first MPAs at a great depth which attempted to reconcile the conflicting objectives of deepsea conservation and continued access to hydrothermal vents for scientific research (Leary 2003).

The Endeavour MPA is divided into four zoned management areas with intensive scientific research restricted to two of these zones, the Mothra and the Main Endeavour sites. A third zone, the High Rise Field, is reserved for research associated with long-term monitoring of the ecosystem and for projects focused on education and outreach. The fourth zone of the MPA, known as Salty Dawg, is an area where only observation-based or other less intrusive study techniques are permitted (Leary 2003).

Although MPAs have only recently been extended to vulnerable deep-water habitats such as seamounts and hydrothermal vents within national jurisdiction, experience to date suggests MPAs can be just as effective as an environmental management tool in the deepsea as they are elsewhere in the ocean. There are of course obstacles to the effective management of deepsea MPAs, not the least of which is effective policing of activities that occur on or above the deep seabed, but these obstacles are not insurmountable and the growing trend towards the use of MPAs as a tool for the sustainable management of deepsea habitats is an encouraging development. As such, the efforts of like-minded States who wish to create mechanisms for the establishment of MPAs for vulnerable deep-water ecosystems beyond national jurisdiction should be encouraged.

Deepsea hydrothermal vents: a case study on the need for MPAs plus Integrated oceans governance

While MPAs beyond national jurisdiction can be an effective tool, they should not be viewed in isolation. A range of other issues will need to be addressed. These include the impact of activities occurring beyond the MPA, as well as legal issues surrounding the potential regulation and benefit sharing of the fruits of bioprospecting for deep seabed genetic resources beyond national jurisdiction. So far, governments have not discussed in detail how to deal with such issues. The

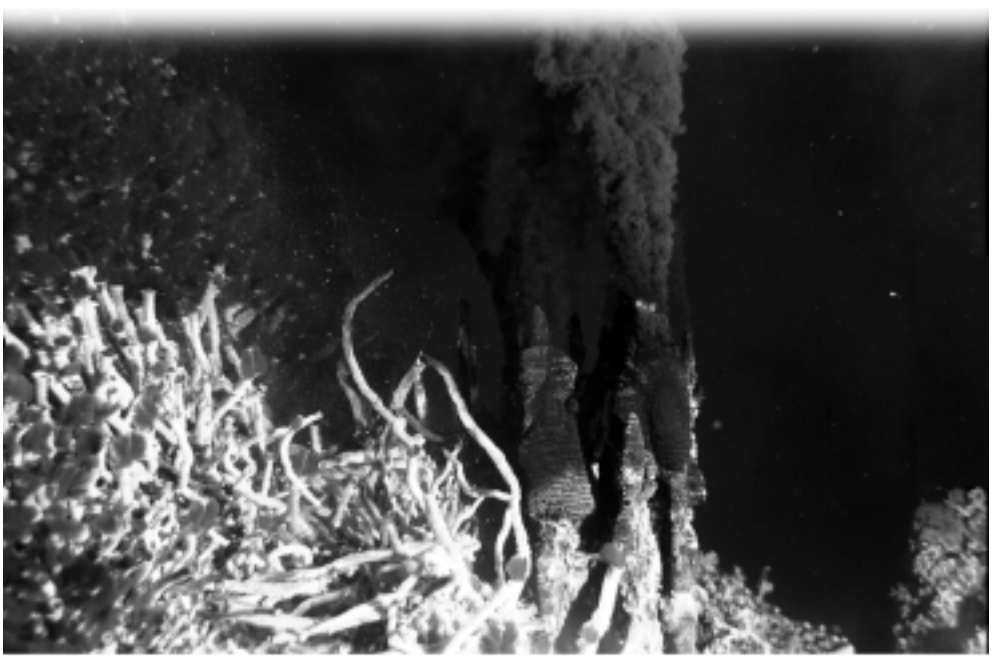
effectiveness of MPAs will also hinge on how speedily the international community addresses the need for a more integrated approach to oceans governance.

Examination of the example of deepsea hydrothermal vents illustrates the complexity of the issues at stake. The unique biological communities associated with hydrothermal vents are of intense interest to science for their intrinsic values and for the potential that the microorganisms associated with these ecosystems offer for developments in biotechnology. Rich deposits of gold, copper and other minerals associated with hydrothermal vents are also of increasing interest to the mining industry. Mining, bioprospecting, marine scientific research (MSR) and other emerging activities such as tourism at hydrothermal vents pose as yet unquantified threats to deepsea hydrothermal vent ecosystems. With the exception of deepsea mining, which is explicitly addressed in the United Nations Convention on the Law of the Sea (UNCLOS), these activities are largely unregulated in areas beyond national jurisdiction under international law (Glowka 1999).

The most immediate legal issue relates to the extent of regulation of the exploitation of genetic resources derived from living organisms associated with hydrothermal vents. The question raised especially by representatives of Latin American countries is whether or not deepsea genetic resources should be regarded or subsequently designated as the Common Heritage of Mankind [sic], like the mineral resources of hydrothermal vents under UNCLOS. UNCLOS designated the seabed area beyond national jurisdiction and its mineral resources as the Common Heritage of Mankind. The central elements of the Common Heritage of Mankind regime are:

1. non-appropriation of the deep seabed beyond national jurisdiction;
2. common management through an International Seabed Authority of the mineral resources of the deep seabed beyond national jurisdiction; and
3. benefit sharing of the profits (Frakes 2003).

Black smoker chimney and Ridgeia tubeworm colony at the Endeavour Hydrothermal Vents Marine Protected Area (Juan de Fuca Ridge) in the north-east Pacific Ocean. Photo: Verena Tunnicliffe, University of Victoria.



However, the resources which fall under the benefit sharing regime created by UNCLOS are limited to mineral resources. A dispute is now emerging as to whether a broader definition of 'resources' should apply, so that the living resources of the deep seabed area would also be considered as the Common Heritage of Mankind and their exploitation subject to the Common Heritage of Mankind regime established by UNCLOS.

How far the Common Heritage of Mankind does or should extend beyond mineral resources is emerging as a very controversial international debate. However, this debate could go on for years, without productive results, while bioprospecting is already taking place in the deep seabed of the Area. In essence this debate is really about whether the benefits (including profits) derived from exploiting deepsea genetic resources should be shared by the international community and not just by the biotechnology companies who develop such new technology. As these profits are made from products sourced from the global commons, questions are now being asked as to whether such companies should share such profits with the global community, and particularly developing countries. A further complicating factor is the legitimate concerns of biotechnology companies that a cumbersome bureaucratic regulatory regime might impose unnecessary burdens on MSR and bioprospecting. Thus, there is a need for a more practical approach.

A compromise approach that may provide for equitable utilisation and sharing of benefits associated with the genetic resources of hydrothermal vents, without unduly regulating the biotechnology industry or discouraging marine scientific research, is clearly necessary. This article proposes one possible approach that does not require recourse to the concept of the Common Heritage of Mankind.

Many different proposals have been put forward for the sharing of oceans resources over time. These include a Global Commons Trust Fund, which essentially makes the use of commons resources dependent on dedicating part of the benefits to the protection of commons areas themselves (Stone 1993a). However, there are problems with the way such an idea has been developed in the past. Firstly, as Stone (Stone 1993b) explains, such a concept is based on the notion that the commons areas are the Common Heritage of Mankind. However, as noted above, the debate over the Common Heritage of Mankind may make agreement on this basis impractical. A way around this obstacle may be to link the Global Commons Trust Fund concept to the grant of patents in relation to the biotechnology derived from such commons resources, in this case patents derived from hydrothermal vent micro-organisms. While the micro-organisms from which biotechnology is derived are sourced beyond national jurisdiction, the exclusive monopoly to exploit such biotechnology is granted by individual States. If one addresses an act by a State, the status of these resources beyond national jurisdiction as the Common Heritage or otherwise does not have to be an issue.

The grant of a patent by a State could be made conditional on payment of a royalty to the Global Commons Trust Fund. A good bench-mark figure for royalties may be similar amounts already paid or agreed under access and benefit sharing arrangements within national jurisdiction. These figures may be a useful guide as they already take into consideration the return on investment required to justify undertaking research and development in relation to new biotechnology in the first place. Although costs of accessing genetic resources may be greater in the deepsea, these figures may be a useful guide. The fact that the actual sample extraction and much of the scientific research associated with product development is carried out by publicly funded academic and research institutions such as universities is also a factor that should be taken into account.

It would be preferable that any such royalty be linked to the actual sale of products derived from deepsea genetic resources. Linking the royalty payable to actual product sold would enable research on new uses of deepsea genetic resources to be carried out, without the added expense or burden of a tax on what may well turn out to be a speculative exercise

that yields no results. No doubt other factors need to be considered in determining an appropriate royalty.

The question remains what institution could act as the trust fund trustee and be responsible for the disbursement of its funds? One option, the International Seabed Authority, is sure to be objected to by many developed countries such as the United States. There are a number of other options worth considering. Several international institutions already play a role in funding sustainable development. These include the Global Environment Facility and the various regional development banks such as the Asian Development Bank. Their experience in dealing with the sustainable management of ocean space within national jurisdiction might make them suitable for also administering funds and implementing measures for the sustainable management of ocean space beyond national jurisdiction.

The royalties from the exploitation of the genetic resources of deepsea hydrothermal vents, and indeed other deepsea genetic resources taken from areas beyond national jurisdiction, could then be utilised to fund conservation and management measures such as MPAs beyond national jurisdiction.

Should the environmental impact of scientific research in the deepsea beyond national jurisdiction be regulated?

Questions also arise as to what extent MSR beyond national jurisdiction should be subject to regulation. MSR has been identified as the most immediate threat to hydrothermal vent ecosystems (Dando and Juniper 2001). However, it is unclear whether the scale of the environmental impact of MSR warrants regulation. Clearly further comprehensive scientific research is required before we can clearly determine if regulation is required, and if so, what form it should take. With this qualification in mind the following discussion considers a number of possible options.

The regulation of MSR is not a new issue and has already been subject to considerable debate during the negotiations of UNCLOS. During those negotiations significant concerns were expressed by a range of countries about the impact of regulation of MSR in areas beyond national jurisdiction. The main thrust of such arguments was that too much regulation and a bloated international bureaucracy posed a very real threat to further advances in marine science. These arguments are as equally valid today as they were 30 years ago. Similarly, given the amount of MSR conducted in the world's oceans today, its complexity and the vast amount of data that is being collected, it would be difficult for any one international institution to regulate MSR. Simply to assess applications for approval to conduct MSR, let alone to police compliance with any international regulatory regime, would require vast amounts of human resources, technical and scientific skills, and money to operate effectively.

What other alternatives therefore are worth considering? One possibility is self regulation by the scientific community. Some sectors of the scientific community have indeed already made efforts in this direction. One such effort was the proposed InterRidge Code of Conduct for MSR at hydrothermal vents (Juniper and Glowka 2003). In its initial form it was proposed that the Code would consist of a concise statement of principles applicable to MSR and tourist activities, plus a set of Operating Guidelines applicable to organisations and individuals operating generally and at specific sites.

While the idea of a Code of Conduct is worth encouraging, a number of difficulties with this proposal are worth noting. Firstly some provisions of the draft code only require scientists to comply with existing laws, which they are already obliged to do. More significantly, there are no effective international legal rules that apply in areas beyond national jurisdiction beyond the general provisions of UNCLOS. In that respect the proposed Code of Conduct is no more than an aspirational or rhetorical statement. What is the point of scientists committing to abide by international law when essentially international law says that their activities beyond national jurisdiction are unregulated?

The proposed Code of Conduct also lacks any sanction or alternatively any incentive for researchers to comply. Apart from the obvious ethical imperatives that underlie the proposed code, why would scientists adhere to it when there is no sanction or adverse consequence for failing to either sign up to it or to adhere to it? Those scientists who already recognise the need for their activities to be sustainably managed will probably already be trying to minimise the environmental impact of their research. Instead, it is the scientists who fail to recognise the need for regulation, that may need to be regulated or monitored and this will be difficult to achieve through a voluntary Code of Conduct. Having said that, one strength of the proposal is that it calls for the establishment of certain benchmarks and standards against which sustainable MSR could be assessed. This latter idea has merit and could be one way to involve the scientific community in designing sustainable management regimes for their research.

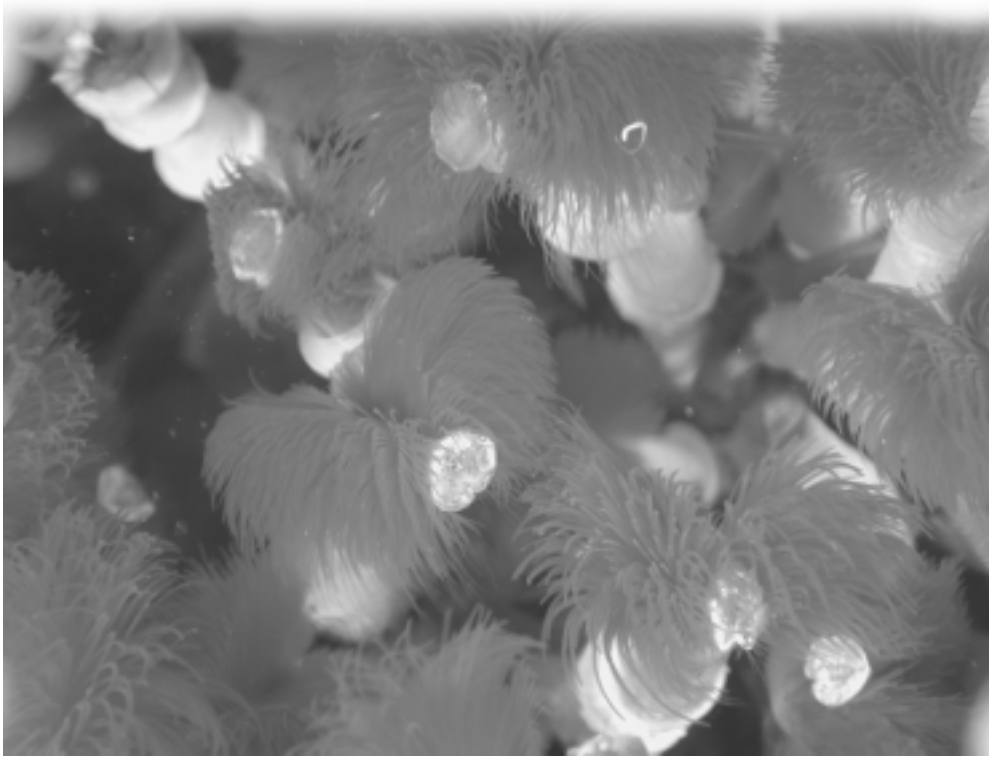
Environmental impact assessment for activities beyond national jurisdiction

Another alternative worth considering is the creation of an environmental impact assessment regime for activities beyond national jurisdiction such as MSR. This would clearly complement and be an essential counterpart of any regime established for high seas MPAs. As experience in national waters has shown, activities beyond MPA boundaries may negatively impact wildlife and water quality inside protected areas.

Numerous binding international legal instruments, soft law documents and other quasi-legal instruments already include mechanisms and requirements for environmental impact assessment. A recent review by Tanaka (2004) identifies many examples. These include:

1. the United Nations Environmental Programme's Goals and Principles of Environmental Impact Assessment (UNEP Guidelines), which provide a set of non-binding guidelines to adequately assess environmental impacts at national, regional, and international levels;

Close-up of tubeworms, showing gill filaments used for gas exchange. Photo: Ian MacDonald, Texas A&M University.



2. the Convention on Environmental Impact Assessment in a Transboundary Context adopted at the United Nations Economic Commission for Europe, which was modeled on the UNEP Guidelines;
3. the subsequent 1997 EC Directive (Council Directive 97/11/EC, 1997 OJ (L73) 5);
4. the lending decision-making processes of the World Bank and regional development banks; and
5. the Madrid Protocol to the Antarctic Treaty, which provides for detailed environmental impact assessment of all activities in Antarctica. It is clear that environmental impact assessment is now a widely utilised mechanism under international law and is also found in many domestic legal systems.

The Madrid Protocol to the Antarctic Treaty provides the most interesting example of how an environmental impact assessment regime can be utilised to manage the environmental impact of scientific research in areas beyond national jurisdiction. The significant innovation introduced by the Madrid Protocol was a graduated scheme of environmental impact assessment for activities in Antarctica. Under this regime activities undertaken in the Antarctic Treaty area pursuant to scientific research programmes, tourism and all other governmental activities are subject to prior assessment of the impacts of those activities on the Antarctic environment or on dependent or associated ecosystems. The nature of the environmental impact assessment required varies depending on whether those activities are identified as having:

a) less than a minor transitory impact;
b) a minor or transitory impact; or
c) more than a minor or transitory impact.

There are three important benefits to the process established by the Madrid Protocol. Firstly, it allows parties to make informed decisions with respect to any proposed activity, as decisions are made only after rigorous scientific scrutiny. Secondly, it introduces transparency and accountability into the process through its requirements for wide public circulation of environmental evaluations of major projects. Thirdly, it rests responsibility for implementing the requirements for impact assessment on the parties, though decisions are taken only after full consideration, review and the advice of the Committee for Environmental Protection, a permanent body established pursuant to the Madrid Protocol.

A regime applicable to MSR in areas beyond national jurisdiction could be modeled on the provisions of the Madrid Protocol and implemented via domestic law.

Compliance with an environmental impact assessment regime could be enhanced by making government funding for scientific research conditional on adequate environmental impact assessment and sustainable research practices for scientific research in areas beyond national jurisdiction, as already occurs in some countries. In Canada, for example, Federal Government funding for scientific research is linked to an environmental impact assessment process under the Canadian Environmental Assessment Act 1992. Most MSR conducted by Canadian researchers based in universities and other research institutions is funded by grants provided by the Natural Sciences and Engineering Research Council of Canada (NSERC). The NSERC routinely screens all applications for funding to determine whether the environmental assessment processes required by this Act applies to the activities for which funding is sought. If the legislation is triggered then the NSERC is prohibited from releasing funding unless the provisions of the legislation have been complied with.

Conclusion

The experience of MPAs within areas of national jurisdiction show that MPAs are one significant tool which, if managed effectively, can assist humanity to sustainably manage marine

environments and ensure that the wonders of the ocean survive for future generations. Recent developments within national jurisdiction, especially with respect to seamounts and hydrothermal vents, show that MPAs can be effective in managing vulnerable deepsea habitats. There is now an urgent need for the creation and effective management of MPAs in areas beyond national jurisdiction. But in moving forward the global agenda to establish MPAs beyond national jurisdiction, governments will also need to address the many other complex issues such as bioprospecting and the environmental impacts of marine scientific research and other current and emerging activities. This article has offered some suggestions on how some of these issues may be addressed either as part of a regime for high seas MPAs or in parallel to such a regime.

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Résumés

Protection de la dernière frontière de la Terre : pourquoi avons-nous besoin d'un système global de réseaux d'aires marines protegées en Haute mer

DAN LAFFOLEY

Cet article identifie les hautes mers comme la dernière grande frontière de la Terre. Il insiste sur le fait que nous sommes à présent dans une situation critique oùnous pouvons éviter les erreurs qu'a commises l'humanitédans les zones maritimes relevant de la juridiction nationale et àterre. Nous en savons suffisamment pour établir un système représentatif global des réseaux de aires marines protégées (AMP). De tels réseaux doivent être incorporés dans la gestion intégrée de l'écosystème océanique. Il est de notoriété commune que, tandis que les AMP sont des moyens et non des fins en soi, elles sont essentielles pour la protection de la biodiversitémaritime et pour parvenir àdes pêcheries durables.

Les aires marines protegées d'Haute mer à l'horizon : cadre légale et récentes avancées

KRISTINA M. GJERDE ET GRAEME KELLEHER

Près des deux tiers des océans s'étendent au-delàdes mers territoriales et des zones économiques exclusives (ZEE) des nations côtières. L'extension du concept d'aire marine protégée (AMP) des eaux nationales àcette zone –l'Haute mer - est une tâche complexe. Une coopération globale est essentielle, car les efforts en vue d'établir des niveaux de protections plus élevés doivent respecter la loi internationale. De nombreux gouvernements reconnaissent àprésent les AMP de l'haute mer et les réseaux de AMP comme des instruments clés pour la protection de la biodiversitéde l'haute mer, la création des pêcheries durables et la préservation de la structure, les fonctions et les processus associés de l'écosystème. Toutefois, il reste beaucoup de travail pour développer des mécanismes de désignation, de création et de gestion des AMP de l'haute mer et des réseaux. Dans le même temps, des menaces comme la pêche au chalut au fond de l'haute mer dans des zones vulnérables devront être abordées afin que toutes les activités soient conduites sur une base durable assistée par une science solide.

Cet article fournit une vue d'ensemble du cadre légal pour les AMP d'Haute mer, résume les récentes avancées réalisées et identifie des futures étapes essentielles pour la mise en place de réseaux représentatifs des AMP dans l'Haute mer.

Une gouvernance des océans améliorée pour conserver la biodiversité d'Haute mer

ELIZABETH FOSTER, TIA FLOOD, ALISTAIR GRAHAM ET MARTIN EXEL

La mise en place d'aires marines protégées (AMP) dans les océans au-delàde la juridiction nationale (Haute mer) pour la conservation de la biodiversitéest un engagement qui a été pris par les gouvernements en 2004 lors de la conférence des parties (CdP) de la Convention sur la DiversitéBiologique (CDB) et en 2002 lors du Sommet mondial pour le développement durable (Plan de mise en œuvre de Johannesburg). Cependant, les AMP d'Haute mer restent des outils visionnaires pour une conservation efficace de la biodiversité, étant donnéles dispositions de gouvernance des océans. Les dispositions de gouvernance pour les AMP d'Haute mer sont faibles. Tout bénéfice écologique attendu de la mise en place des AMP serait sapépar l'absence d'un cadre de gestion convenu et de mesures de conservation effectives et applicables. Une gouvernance efficace devrait inclure des mesures de suivi, de contrôle et de surveillance, en particulier par rapport àla prévention de toute pêche non règlementée. Les coûts économiques de la gestion peuvent être considérables. Cet article soutient l'existence d'un besoin pressant d'améliorer les dispositions de gouvernance des océans comme préude àla mise en place des AMP d'Haute mer. Il existe également un besoin d'améliorer les mesures de gestion nécessitant un contrôle règlementaire afin de justifier les coûts de gestion àtravers une efficacitéaméliorée.Les organismes régionaux de gestion des pêches (RFMO) fournissent des exemples de mesures concrètes prises dans l'optique d'une gestion durable des ressources naturelles en fonction des dispositions de gouvernance existantes. La « Manuka Vision » décrite ici offre un exemple de la manière dont l'industrie, les organisations non gouvernementales (ONG) et les gouvernements peuvent s'associer pour développer des visions et des approches partagées pour se charger des insuffisances de la gouvernance d'Haute mer. Cet article est tiréde ces expériences et offre des idées pour des dispositions de gouvernance rentables qui pourraient tracer la voie vers la mise en place des AMP d'Haute mer efficaces.

Les raisons économiques des aires marines protégées dans l'Haute mer

PAUL MORLING

Il est de plus en plus reconnu que les activités humaines qui endommagent les habitats marins peuvent saper la stabilité écologique et les services de l'écosystème qu'ils favorisent. Cette conscience, combinée àla détérioration des pêcheries du monde entier, a conduit àdes demandes d'action pour le développement des aires marines protégées (AMP) lors du Sommet mondial pour le développement durable (2002), le Congrès mondial sur les parcs de l'UICN (2003), le Congrès mondial de la nature de l'UICN (2004) et l'Assemblée Générale des Nations Unies (AGNU).Cet article expose un cadre pour l'évaluation de la valeur économique des océans du monde et met en évidence la manière dont l'exploitation humaine des environnements marins dépasse les valeurs socialement optimales. Les océans et les fonds marins au-delàde la juridiction nationale (l'Haute mer) posent des problèmes spéciaux en matière de gouvernance, car ils sont traités comme un « bien commun ». L'article s'achève par une courte revue des options de financement possibles pour les AMP d'Haute mer.

Aires pélagiques protégées : le plus grand défi des parcs du XXIe siècle

ELLIOTT A. NORSE

L'Haute mer est vidée de sa grande faune et les outils de gestion traditionnels ont tristement démontréleur inaptitude à freiner cette perte. Pour sauver la mégafaune pélagique ciblée par les pêcheries (par exemple, les requins, les aiguilles de mers, les thons) et tuée par accident lors de la pêche (par exemple, les tortues de mer, les albatros et les dauphins), des aires protégées méritent un examen sérieux. La mégafaune océanique a été considérée comme un candidat mal placéen matière de protection au sein des aires marines protégées (AMP), car ces animaux sont des grands migrateurs et leurs déplacements étaient encore très récemment peu connus par les scientifiques. Cependant, les pêcheurs ont appris àles trouver et de nouveaux outils permettent également aux scientifiques de comprendre leurs déplacements. Puisque la mégafaune pélagique se concentre dans des lieux spécifiques àcertaines périodes qui peuvent être prévues ou observées, des approches basées sur les lieux peuvent être utilisées pour les protéger. La nature fortement migratoire de la mégafaune pélagique n'exclue pas l'utilisation des aires protégées qui sont en effet utilisées pour protéger les grands migrateurs qui ne sont pas des espèces marines. Certains des points chauds de biodiversitéoùse rassemble la mégafaune pélagique peuvent se déplacer, de manière prévisible ou non, et cela représente un nouveau défi qui peut être remportégrâce àla mise en place des AMP ayant des frontières dynamiques. De nouveaux outils et de nouvelles stratégies de gestion pourraient protéger ces animaux importants et vulnérables même dans l'immensitéla plus reculée de l'Haute mer.

Les défis du développement de aires marines protégées en Antarctique

SUSIE M. GRANT

De récentes expériences en Antarctique fournissent un cas d'étude utile sur les défis du développement de systèmes de aires marines protégées (AMP) dans l'Haute mer. Cet article apporte une vue d'ensemble du cadre légal selon lequel peuvent être conçues les AMP en Antarctique, des zones protégés existantes au sein de ce cadre légal et des points faibles des désignations actuelles. Les défis que rencontre le développement des AMP en Antarctique incluent la raretédes données biologiques avec lesquelles identifier les zones àprotéger, le besoin de décisions devant être prises dans un système de gouvernance internationale basésur le consensus et le problème de l'application. Des défis ultérieurs incluent le besoin de coordination des stratégies pour les aires protégées entre les différents instruments du Traitésur l'Antarctique et avec les recommandations pour le développement des AMP d'Haute mer. Les approches entreprises pour s'occuper de ces défis comprennent le récent travail de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR) pour identifier des objectifs de conservation spécifiques pour les AMP, des priorités pour les types de zones àprendre en compte pour la protection et les types d'informations scientifiques requises. Enfin, cet article offre quelques recommandations pour l'application des leçons apprises en Antarctique lors de la mise en place des AMP d'Haute mer dans d'autres régions.

Conservation de l'Haute mer – l'habitat d'algues en dérive comme base de l'haute mer

ARLO H. HEMPHILL

Dans la course àla protection des écosystèmes uniques et vulnérables au-delàde la juridiction nationale, l'un des habitats océaniques des plus essentiels est potentiellement délaissé, malgrésa présence àla surface de l'océan. L'habitat d'algues en dérive de l'Haute mer (pélagiques) se trouve dans la plupart des régions tempérées et subtropicales des océans du monde. Dérivant sur les courants océaniques, cet habitat fournit un habitat essentiel de nourricerie, de demeure, de frai et de nourriture pour une gamme de poissons, d'invertébrés, de tortues de mer et d'oiseaux marins d'importance commerciale, mais aussi inhabituels. Souvent accumuléle long des frontières frontales, cet habitat démarque des oasis de productivitéet de diversitéde l'Haute mer. Toutefois, l'habitat des algues en dérive pélagiques fait face àsa part d'impacts anthropogènes, incluant la récolte directe pour la production d'algine, les extraits médicinaux et le fourrage du bétail. Aux États-Unis, des mesures récentes ont été mise en place pour protéger cet habitat important, mais il manque toujours des mesures de conservation pour l' Haute mer. Tandis que les formes traditionnelles des aires protégées peuvent convenir àla protection des épicentres d'algues en dérive comme la Mer des Sargasses, un nouveau concept d'aire marine protégée (AMP) est nécessaire pour protéger la nature transitoire de la plupart des concentrations d'algues dérivantes pélagiques et des processus océanographiques associés. Les algues en dérive peuvent en effet fournir un indice visuel pour permettre la démarcation des AMP dynamiques, agissant ainsi comme un parapluie de protection pour une plus large suite d'habitats pélagiques.

Conservation et gestion des écosystèmes vulnérables des eaux profondes dans les zones au-delà de la juridiction nationale : les aires marines protégées sont-elles suffisantes ?

DAVID LEARY

Cet article est introduit sur le point de vue que les aires marines protégées (AMP) peuvent être un outil efficace pour conserver et gérer durablement les zones spécifiques des océans au-delàde la juridiction nationale et que les efforts des États du même avis devraient être encouragés.

Cet article décrit tout d'abord le progrès des AMP créées pour les écosystèmes des eaux profondes marines. Il prend ensuite une plus large perspective qui soutient que, pour leur part, les AMP ne seront pas suffisantes pour assurer la gestion durable de l'Haute mer et des fonds marins au-delàde la juridiction nationale. Lors de la conception d'un régime international efficace pour la gestion durable de cette vaste zone, il faut se charger d'une gamme de problèmes complexes. Les écosystèmes associés aux sources hydrothermales océaniques profondes sont utilisés ici comme étude de cas. L'article décrit le débat sur le fait que les ressources vivantes des fonds marins au-delàde la juridiction nationale doivent ou non être considérées comme faisant partie de l'héritage commun de l'humanité[sic] selon la Convention des Nations Unies sur le droit de la mer (UNCLOS). Il remarque également que ce débat pourrait ne pas être facilement résolu. En revanche, l'article expose une proposition qui pourrait au moins servir de compromis adéquat : lier la garantie des droits de propriété intellectuelle pour les ressources génétiques sous-marines àun fonds de confiance pour le développement durable. Ce fonds de confiance pourrait être gérépar des institutions existantes comme le Fonds pour l'Environnement Mondial (GEF) et certains des revenus pourrait aider àcouvrir les coûts de fonctionnement des AMP au-delàde la juridiction nationale. Un problème supplémentaire devant être régléest l'impact écologique potentiel de la recherche scientifique marine (RSM) et comment les impacts de la RSM doivent être régulés (le cas échéant). Il est soutenu qu'une autorégulation par la communautéscientifique ne sera pas suffisante. L'article expose une proposition pour la régulation de la RSM incluant un processus d'évaluation de l'impact écologique modelésur le régime de l'Antarctique.

Resumenes

Proteger la última frontera de la Tierra: por qué necesitamos un sistema global de redes de áreas marinas protegidas en Alta Mar

DAN LAFFOLEY

En este artículo se identifica el Alta Mar como la última gran frontera de la Tierra. Se hace hincapiéen que actualmente nos encontramos en un momento decisivo en el que podemos evitar los errores que la humanidad ha cometido en las zonas marinas que caen dentro de la jurisdicción nacional y en la tierra. Se dispone de la suficiente información como para poder establecer un sistema mundial representativo de redes de áreas marinas protegidas (AMPs). Estas redes deberían incluirse en la gestión integrada del ecosistema oceánico. Se reconoce que, aunque las AMPs son herramientas y no fines en si mismos, son esenciales para proteger la biodiversidad marina y para tener una industria pesquera sostenible.

Perspectivas de las áreas marinas protegidas en Alta Mar: marco legal y avances recientes

KRISTINA M. GJERDE Y GRAEME KELLEHER

Casi dos tercios de los océanos se encuentran fuera de las aguas territoriales y zonas económicas exclusivas (ZEE) de las naciones costeras. La extensión del concepto de áreas marinas protegidas (AMPs) desde las aguas nacionales a esta zona –el Alta Mar –es una tarea compleja. Es esencial la cooperación mundial, ya que los esfuerzos para establecer unos niveles más altos de protección para zonas concretas deben ajustarse al derecho internacional.

Muchos gobiernos reconocen hoy en día que las AMPs en Alta Mar y las redes de AMPs son instrumentos fundamentales para proteger la biodiversidad en Alta Mar, para tener una industria pesquera sostenible, y para preservar la estructura, las funciones y los procesos de los ecosistemas. Sin embargo, se requiere mucho trabajo para desarrollar mecanismos de designación, creación y gestión de AMPs y sus redes en Alta Mar. Simultáneamente, habráque hacer frente a amenazas como la pesca de arrastre en zonas vulnerables del Alta Mar para que todas las actividades se lleven a cabo de manera sostenible y con un apoyo científico sólido.

En este artículo se proporciona una perspectiva general del marco legal para las AMPs en Alta Mar, se resumen los progresos realizados recientemente, y se identifican algunos de los siguientes pasos fundamentales hacia el establecimiento de redes representativas de AMPs en Alta Mar.

Mejora de la gobernanza de los océanos para conservar la biodiversidad en Alta Mar

ELIZABETH FOSTER, TIA FLOOD, ALISTAIR GRAHAM Y MARTIN EXEL

El establecimiento de áreas marinas protegidas (AMPs) en los océanos fuera de la jurisdicción nacional (Alta Mar) para la conservación de la biodiversidad es un compromiso que los gobiernos adquirieron en la Conferencia de las Partes en la Convención de Diversidad Biológica de 2004, y en la Cumbre Mundial de Desarrollo Sostenible de 2002 (Plan de Acción de Johannesburgo). Sin embargo, dadas las actuales disposiciones de gobernanza de los océanos, las AMPs en Alta Mar son, de momento, herramientas para una conservación eficaz de la biodiversidad a las que sólo se aspira .

Las disposiciones de gobernanza para las AMPs en Alta Mar no son muy sólidas. Cualquier beneficio que se pueda esperar del establecimiento de las AMPs se vería debilitado por la ausencia de un marco de gestión acordado y eficaz, y de medidas de conservación aplicables. Una gobernanza efectiva tendría que incluir disposiciones para el seguimiento, control y vigilancia, especialmente a fin de impedir la pesca no regulada. El coste económico de la gestión sería considerable. En este artículo se arguye que existe una necesidad urgente de mejorar las disposiciones de gobernanza de los océanos antes de establecer AMPs en Alta Mar. También es necesario mejorar aquellas medidas de gestión que requieren un control regulador para justificar los costes de gestión a través de una eficacia mejorada.Las Organizaciones Regionales de Ordenación Pesquera (RFMO) proporcionan ejemplos de pasos concretos dados hacia la gestión sostenible de los recursos naturales en el marco de las actuales disposiciones de gobernanza. La "Visión de Manuka" descrita en el presente artículo muestra cómo la industria pesquera, las organizaciones no gubernamentales (ONG) medioambientales y los gobiernos pueden unirse para desarrollar visiones y enfoques compartidos que aborden las deficiencias de la gobernanza de las zonas de Alta Mar. A partir de estas experiencias, el artículo sugiere algunas ideas sobre disposiciones de gobernanza rentables, que podrían allanar el terreno para el establecimiento de AMPs efectivas en Alta Mar.

Razones económicas para el establecimiento de áreas marinas protegidas en Alta Mar

PAUL MORLING

Cada vez hay un mayor reconocimiento de que las actividades humanas que dañan el hábitat marino pueden debilitar la estabilidad ecológica y los servicios del ecosistema que dicho hábitat facilita. Esta concienciación, combinada con el deterioro de la industria pesquera en todo el mundo, ha llevado a la petición de medidas para desarrollar áreas marinas protegidas (AMPs) en la Cumbre Mundial de Desarrollo Sostenible (2002), en el Congreso Mundial de Parques de la UICN (2003), en el Congreso Mundial de la Naturaleza de la UICN (2004) y en la Asamblea General de las Naciones Unidas (AGNU).En este artículo se esboza un marco para calcular el valor económico de los océanos y se hace hincapiéen cómo la explotación humana de los entornos marinos es superior a lo socialmente óptimo.Los océanos y el fondo marino fuera de la jurisdicción nacional (Alta Mar) plantean problemas especiales para la gobernanza ya que se consideran bienes comunes. Este artículo finaliza con un breve estudio de las posibles opciones de financiación para las AMPs en Alta Mar.

Zonas pelágicas protegidas: el gran reto del siglo XXI

ELLIOTT A. NORSE

Los océanos están perdiendo su variada fauna silvestre, y las herramientas de gestión tradicionales han demostrado ser lamentablemente inútiles en la ralentización de esta pérdida. Para salvar la megafauna pelágica objetivo de la industria pesquera (por ejemplo, tiburones, agujas, atunes) y la que muere accidentalmente como consecuencia de la pesca (por ejemplo, tortugas de mar, albatros y delfines), las áreas protegidas merecen un examen serio. La megafauna oceánica no se ha considerado como una candidata adecuada para recibir protección dentro de las áreas marinas protegidas (AMPs) porque estos animales son sobre todo especies migratorias y sus movimientos eran poco conocidos para los científicos hasta hace muy poco. Sin embargo, los pescadores han aprendido a encontrarlas, y nuevas herramientas también permiten que los científicos entiendan sus movimientos. Como la megafauna pelágica se concentra en lugares concretos en ciertos momentos que pueden predecirse u observarse, pueden utilizarse métodos basados en esos lugares para conservarlas. La naturaleza altamente migratoria de la megafauna pelágica no descarta el establecimiento de zonas protegidas que, de hecho, se utilizan para conservar especies migratorias no marinas. Algunos de los puntos de mayor concentración de megafauna pelágica pueden cambiar de forma predecible o impredecible, y esto plantea un nuevo reto al que se puede hacer frente mediante el establecimiento de AMPs con límites dinámicos. Nuevas herramientas y estrategias de gestión podrían proteger a estos importantes y vulnerables animales incluso en la remota inmensidad de la Alta Mar.

Los retos que supone el desarrollo de una área marina protegida en la Antártida

SUSIE M. GRANT

La experiencia reciente en la Antártida proporciona un estudio de caso útil sobre los retos que supone el desarrollo de sistemas de áreas marinas protegidas (AMPs) en Alta Mar. En el presente artículo se proporciona una perspectiva general del marco legal en el que pueden designarse AMPs antárticas, de las áreas protegidas existentes dentro de ese marco, y de los puntos débiles de las actuales designaciones. Los retos a los que hay que enfrentarse a la hora de desarrollar una AMP en la Antártida incluyen la escasez de datos biológicos con los que identificar las áreas que han de protegerse, la necesidad de tomar decisiones dentro de un sistema de gobernanza internacional basado en el consenso, y el problema de la aplicación. Además, existen otros retos, como la necesidad de coordinación de las estrategias de áreas protegidas entre los diferentes instrumentos del Sistema del Tratado Antártico, y con las recomendaciones mundiales sobre el desarrollo de AMPs en Alta Mar. Los enfoques que se están adoptando para hacer frente a estos retos incluyen el trabajo reciente de la Comisión para la Conservación de la Fauna y la Flora Marinas del Antártico (CCAMLR), que consiste en identificar objetivos concretos de conservación para las AMPs, prioridades para decidir que zonas deben recibir protección, y el tipo de información científica que se necesita. Finalmente, en este artículo se ofrecen algunas recomendaciones sobre cómo las lecciones aprendidas en la Antártida podrían aplicarse al establecimiento de AMPs en otros lugares.

Conservación en Alta Mar – el hábitat de las algas flotantes como base del mar abierto

ARLO H. HEMPHILL

En la carrera para proteger ecosistemas únicos y vulnerables fuera de la jurisdicción nacional, posiblemente se esté pasando por alto uno de los hábitats oceánicos más importantes a pesar de su presencia en la superficie del océano. El hábitat oceánico (es decir, pelágico) de las algas flotantes se encuentra en la mayoría de las regiones más templadas y subtropicales del océano. Empujado por las corrientes oceánicas, este hábitat proporciona un lugar esencial de cría, reposo, puesta y alimento para una serie de peces, invertebrados, tortugas y aves marinas, tanto especies importantes desde el punto de vista comercial como otras especies menos comunes. Acumulándose a menudo a lo largo de límites frontales, este hábitat demarca "oasis" de productividad y diversidad oceánica. Sin embargo, el hábitat pelágico de algas flotantes se enfrenta también al impacto antropogénico, incluidos la recolección para la producción de ácido algínico, extractos medicinales y pienso para ganado. En EE.UU., recientemente se han implementado medidas para proteger este importante hábitat, pero todavía faltan medidas de conservación en Alta Mar. Aunque las formas tradicionales de áreas protegidas podrían servir para proteger los epicentros de algas flotantes como el Mar de los Sargazos, se requiere un nuevo concepto de área marina protegida (AMP) para proteger la naturaleza transitoria de la mayoría de las concentraciones pelágicas de algas flotantes y los procesos oceanográficos asociados. Las algas flotantes pueden, de hecho, proporcionar una referencia visual para posibilitar la demarcación de AMPs dinámicas, actuando como una sombrilla para la protección de una gama más amplia de hábitats pelágicos.

Conservación y gestión de ecosistemas vulnerables de aguas profundas en zonas fuera de la jurisdicción nacional: ¿son suficiente las áreas marinas protegidas?

DAVID LEARY

El presente artículo se basa en la opinión de que las áreas marinas protegidas (AMPs) pueden ser una herramienta eficaz para conservar y gestionar de manera sostenible zonas concretas de los océanos fuera de la jurisdicción nacional, y de que deberían alentarse los esfuerzos de los Estados con ideas afines.

El artículo describe en primer lugar el progreso de las AMPs creadas para los ecosistemas del fondo marino profundo. Después, desde una perspectiva más amplia argumenta que, por sí mismas, las AMPs no serán suficiente para garantizar la gestión sostenible del Alta Mar y del fondo marino profundo fuera de la jurisdicción nacional. A la hora de diseñar un sistema internacional eficaz para la gestión sostenible de esta vasta zona, es necesario abordar una serie de cuestiones complejas. Los ecosistemas asociados con las chimeneas hidrotermales de las profundidades marinas se utilizan aquí como estudio de caso. En el artículo se describe el debate sobre si los recursos vivos del fondo marino profundo fuera de la jurisdicción nacional deberían considerarse como parte del Patrimonio Común de la Humanidad [sic] en virtud de la Convención de las Naciones Unidas sobre el Derecho del Mar (UNCLOS). También se observa que este debate podría no resolverse fácilmente. En el artículo, se presenta una propuesta que podría al menos servir como un compromiso adecuado: combinar la concesión de derechos de propiedad intelectual para los recursos genéticos de las profundidades marinas a un fondo para el desarrollo sostenible. La gestión de este fondo podría estar al cargo de instituciones como el Fondo Mundial para el Medio Ambiente (GEF) y parte de los ingresos podría ayudar a cubrir los costes de desarrollo de AMPs fuera de la jurisdicción nacional. Otra cuestión que hay que abordar es el posible impacto medioambiental de la investigación científica marina, y si el impacto de dicha investigación debe regularse y cómo. Hay quien argumenta que la regulación por parte de la propia comunidad científica no sería suficiente. En el artículo se presenta una propuesta para la regulación de la investigación científica marina, que incluye un proceso de evaluación del impacto medioambiental basado en el sistema del Antártico.

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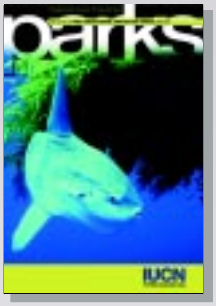

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