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THE GROWING CHALLENGE FOR MARINE GOVERNANCE

Global environmental change

Paul G. Harris

The places that humans inhabit day to day are experiencing the effects of global environmental change. Many of those effects, such as the impacts of global warming and other manifestations of climate change on land-based ecosystems and human communities, are increasingly reported in the daily news. They include unusually widespread and massive wildfires, prolonged droughts, intense cyclonic storms, and heavy rains, flooding, and landslides, and much more. Other widescale environmental occurrences on land, such as deforestation and habitat destruction, diminution of biodiversity and agricultural productivity, omnipresent plastic rubbish, fetid waterways, and the spread of pathogens due to human activities, are also featured every day in news reports around the world. But what of the environments that few people experience directly on a regular basis, such as sparsely inhabited mountain ranges and remote polar landscapes? Widescale environmental changes are underway in those places, too, but they are less likely to receive much attention in the news. As the proverb intones, 'out of sight, out of mind'. Too often, this is also the case with environmental changes underway in the world's oceans and seas, which are profoundly affected by climate change, notably by warming and acidification, and by other impacts, such as widespread pollution and intensive extraction of marine living resources, the latter manifested in formerly vibrant fisheries in which sought-after species are now commercially extinct. It is not that millions of humans are not affected by these changes; they are, profoundly. It is that they are often those people who are, like the high seas, often invisible to those actors with the power to do something about it.

Global environmental change is thus creating new and profound challenges for the governance of marine environments and the people who depend on them for their well-being, and often for their survival. More attention needs to be directed toward the changes that are underway, and growing, and the associated challenges that result. This handbook tries to do just that, in the process offering a unique treatment of marine environmental governance in the Anthropocene – the current geological epoch characterised by unprecedented anthropogenic impacts on the earth and its ecosystems (see Biermann 2022). The chapters that follow explore challenges for governing the marine environment that arise from global-scale (or nearly global-scale) environmental changes. They survey many of the key issues arising from global environmental change and the multifarious actors and institutions involved in governing oceans and seas. Devoting more attention to the impacts of global environmental

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change on marine environmental governance is justified because humanity is extremely reliant on the oceans for resources and ecosystem services. As global environmental change intensifies, so, too, do the threats to those resources and services. Effective marine governance becomes more important, and more challenging, as time passes. With all of this in mind, this book is intended to be a useful resource for researchers, students and others interested in marine governance in the current era of accelerating global environmental change.

Global environmental change: challenges for oceans and seas

For the purposes of this book, global environmental change is defined broadly to include changes to environments that are occurring over wide geographic areas, such as ocean warming and changes to ocean chemistry as a result of carbon pollution, as well as those changes that are happening in many geographically removed places simultaneously, such as agricultural runoff leading to ocean dead zones (eutrophication) and decimation of fish numbers and varieties due to overfishing or habitat destruction in many locations across the world's ocean. Global environmental changes make marine governance more difficult: they make existing problems worse, thus increasing current governance challenges, and they create new challenges altogether, creating a need for not only more effective marine environmental governance but also completely new types and layers of governance. The result is often that existing institutions and mechanisms for managing the marine environment are found to be lacking in their capabilities, and increasingly that existing institutions and mechanisms do not exist and need to be created from scratch, or that uncoordinated existing marine governance regimes and schemes need to be synchronised with regimes and schemes from other issue areas. For example, fisheries regimes may need to be coordinated with regimes for regulating agricultural runoff or, as several chapters in this book make clear, the law of the sea regime may need to be coordinated with the climate change regime.

The environmental changes that are challenging marine governance are as varied as the oceans and seas. They include overexploitation of fish and other marine resources; widespread eutrophication caused by the runoff of pollutants from land environments; plastic pollution so extensive in marine ecosystems that it justifies its own term – the 'plastisphere' (Thomas 2021); coastal over-development and habitat destruction; intensifying shipping traffic in busy seaways and new ship traffic in relatively remote and vulnerable sea regions, among many other changes. The greatest challenge to marine ecosystems and their management is climate change (see Harris 2019). In 2019, the Intergovernmental Panel on Climate Change (IPCC) produced a special report describing the impacts of climate change on the oceans (and the cryosphere) (Intergovernmental Panel on Climate Change 2019). The list of those impacts is long and worrying. In its latest report on the science of climate change (Intergovernmental Panel on Climate Change 2021), the IPCC declared that human influence on the oceans is unequivocal, resulting in 'widespread and rapid changes' in marine and other biospheres (Intergovernmental Panel on Climate Change 2021: SPM-5). Ocean warming has already resulted in extensive coral bleaching and changes to fisheries. The heat content of the oceans and global mean sea-surface temperatures have increased. The oceans have warmed about 1°C since the second half of the nineteenth century, with much of that increase in recent decades (Intergovernmental Panel on Climate Change 2021: SPM-5). Marine heatwaves have become more common. Global mean sea level has risen substantially, partly due to the melting of land ice, such as that of the Greenland Ice Sheet, with major implications for coastal communities, low-lying countries, and small-island states. The extent of Arctic sea ice – its range throughout the year and its thickness – has decreased markedly,

and other changes to polar marine ecosystems are increasing, not least in the Southern Ocean around Antarctica. Acidification and other changes to ocean chemistry, such as increasing salinity and decreasing oxygen content of seawater, are affecting marine organisms. Changes to both ocean temperatures and salinity, among other factors, are affecting ocean currents, turnover, and upwelling.

Marine governance amidst global environmental change

All of these manifestations of global environmental change in oceans and seas, and indeed many other manifestations that are not mentioned here, present new challenges for *governing* the marine environment. Marine environmental governance can be broadly conceived of as marine policies and actions that prevent or limit adverse environmental outcomes and promote desirable ones (cf. Delmas and Young 2009: 6). Governance has always been difficult in the marine environment (see, e.g., Grip 2017), but global environmental change adds new layers of difficulty that cannot be ignored. This is especially true with respect to the most profound of all types of global environmental change: climate change. As the Intergovernmental Panel on Climate Change has observed, 'Impacts of climate-related changes in the ocean … increasingly challenge current governance efforts to develop and implement adaptation responses from local to global scales, and in some cases pushing them to their limits' (Intergovernmental Panel on Climate Change 2019: 29). Consequently, it is imperative to strengthen those and other governance efforts that are directly and indirectly related to the world's oceans and seas. How have governments, communities and other actors concerned about the marine environment responded to global environmental changes? How will, and how should, they do so in the future? The contributors to this book aim to answer these and many related questions. Their chapters are organised into sections that respectively focus on marine environmental governance with respect to (a) international law, regimes, and institutions (Part 2 of the book); (b) non-state actors (Part 3); (c) particular environments and regions (Part 4); and (d) emerging issues (Part 5). The following subsections highlight some of the ideas presented in each chapter.

International law, regimes, and leadership in marine environmental governance

The substantive chapters begin in Part 2 of the book, which focuses on international law, regimes, and institutions in marine governance amidst global environmental change. In Chapter 2, Erik van Doorn provides a foundation for most subsequent chapters with a detailed description of the law of the sea. He argues that marine governance is very largely premised on the law of the sea, which evolved through centuries to become customary international law. The importance of clarifying the law of the sea and adapting it to modern needs resulted in negotiation and agreement of the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Combined with existing practices, UNCLOS has subsequently affected the use of oceans and seas as the Anthropocene has become more evident there. The question is whether UNCLOS and the law of the sea more broadly are up to the task as global environmental changes become more intense, more widespread, and more influential in the marine environment. The likely outcome for marine environmental governance may be a combination of creative interpretation of existing law and creation of new formal and informal ('soft') law agreements and the evolution of practices by states, all of which are taken up in greater detail in several other chapters in this book.

One of the big challenges for marine environmental governance amidst global environmental change is the imperfect fit between regimes developed for ocean management and those created to manage global climate change. The nexus between these two regimes – or, more accurately, sets of regimes – is taken up by Rozemarijn J. Roland Holst in Chapter 3. Holst points out that, despite the many connections between oceans and climate – the bulk of carbon pollution and indeed heat from global warming have been absorbed by the oceans, for example – oceans and seas were, at least until very recently, largely absent from international negotiations on combatting climate change. Where oceans have found their way into international efforts to address climate change are in countries' so-called Nationally Determined Contributions – their action pledges – to the 2015 Paris Agreement on Climate Change. While the oceans regime is adaptive enough to incorporate considerations of climate change, Holst argues that cumulative impacts of climate change expose the weaknesses of approaching the management of different forms of ocean pollution independently. To be sure, there are opportunities to overcome this sectoral approach within both the oceans and climate regimes, but coordination is still lacking. Neither regime is up to the task of effectively managing ocean challenges exacerbated by climate change, so 'purposeful coordination' will become increasingly necessary and urgent.

By focusing on the problem of ocean acidification, in Chapter 4, Jennicca Gordon further explicates the important relations between the oceans and climate regimes, in the process especially highlighting the legal connections. Due to emissions of carbon dioxide from the burning of fossil fuels, changes in ocean chemistry are occurring at an accelerating rate. In particular, as the oceans absorb that carbon, they become acidic; today, they are almost one-third more acidic than 200 years ago. Impacts on marine organisms and ecosystems are increasingly apparent, ranging from adverse effects on plankton to reductions in shellfish harvests. Gordon argues that ocean acidification is creating specific new challenges for international law. While extant multilateral environmental agreements can serve as the basis for marine governance in this context, it is still unclear which should take the lead and what kind of new rules will need to be agreed upon to do so effectively. An obvious problem is that the cause of this problem – carbon emissions governed by the climate change regime – and the impacts – acidification of oceans and seas – are the subjects of different regimes. Gordon draws on the experience of the Convention on Biological Diversity to suggest avenues for strengthening the oceans and climate regimes so that they can more effectively respond to acidification. Connections across all three regimes – oceans, climate, and biodiversity – point to avenues for more effective marine governance of this aspect of global environmental change.

Marine governance will be conceived by some people as addressing the management challenges of the world's great oceans, but often it is about regional seas with proximity to large human populations. The latter are the objects of analysis in Chapter 5, by Luciana Fernandes Coelho and Nata Tavonvunchai. Coelho and Tavonvunchai maintain that regional seas programmes – formalised agreements among littoral states, often under the auspices of the United Nations or other international organisations – are important regimes for ocean governance at the regional level. In particular, in addition to their normal focus on addressing traditional forms of ocean pollution, regional seas programmes provide opportunities for storing carbon within marine habitats. They can do this by shifting focus towards ecosystem-based management of marine environments, in the process protecting those habitats, such as seagrass beds and mangroves, which absorb and retain on the order of one-half of all carbon stored in marine (including coastal) ecosystems. Coelho and Tavonvunchai argue that preserving these 'blue carbon' ecosystems can contribute to the management objectives

of both the oceans and climate regimes. A number of regional seas programmes have adopted ecosystem-based management schemes, the most prominent examples being marine protected areas and integrated coastal zone management. These schemes have the effect of promoting blue carbon storage without necessarily trying to do so specifically. This implies that more conscious efforts to protect, and eventually enlarge, blue carbon ecosystems would result in both more effective marine governance amidst climate change and more effective governance of the climate change problem itself, thanks to regional seas.

Adding to Coelho and Tavonvunchai's analysis of blue carbon and regional seas programmes, in Chapter 6, Gabriela A. Oanta explores the marine ('blue') dimensions of the European Union's (EU) European Green Deal, a nearly continent-wide initiative to realise environmental sustainability in general and carbon neutrality in particular. Towards that end, the European Green Deal has implied and explicit marine components – implied because maritime considerations matter for the programme's wider objectives and explicit because it includes specific maritime sectoral policies and the union's Integrated Maritime Policy. Oanta argues that the European Green Deal should be developed in ways that comport with the EU's policies that affect oceans and seas. In particular, she calls for policies and laws that move the union beyond its established Integrated Maritime Policy towards achieving coordinated climate-related objectives through the European Green Deal, the European Climate Law, and promotion of the broader blue economy.

Whether efforts to address the marine challenges of global environmental change are likely to be successful will, to a substantial extent, be a function of leadership by actors and institutions. Their strategies for leadership are examined in Chapter 7 by Małgorzata Zachara-Szymańska. Zachara-Szymańska defines leadership in terms of multilevel activity directed towards building capacities to act. She argues that leadership is central to marine environmental governance in identifying problems and building trust among actors that, without that leadership, might face difficulties in working collectively. Leadership, or the lack of it, can be exercised by individuals, such as national leaders, corporate executives, and activists, with roles in the regimes and institutions that formulate and implement marine environmental governance. Through their leadership, they can promote new rules and measures for action, build trust among the entities that must carry out action, and address fragmentation among those entities. Zachara-Szymańska explores several dimensions of leadership: structural leadership among states and international organisations, which is often premised on the distribution of material power; cognitive leadership, which is focused on how knowledge is created, distributed and transformed, in the process affecting conceptual frameworks that guide or at least affect policies; and relational leadership, a dimension that highlights the important interactions among actors that are central to whether marine environmental governance will be effective.

Non-state actors in marine environmental governance

International law and regimes are absolutely key to marine environmental governance. For example, the law of the sea has applied for centuries out of necessity, and as maritime affairs among states became more complex, it was codified and clarified in UNCLOS. But understanding marine environmental governance, not least in the context of global environmental change, also requires that we consider the many roles played by non-state actors. The chapters in Part 3 aim to do this, starting with Chapter 8 by Alice B.M. Vadrot. Vadrot's chapter focuses on experts and the scientific knowledge that they bring to bear in marine environmental governance. Her chapter introduces a number of prominent features of expertise and

science in marine governance. Indeed, without experts and the ideas that they bring to the process, it would be all but impossible to apprehend the environmental challenges of marine governance, including those manifested in global environmental change. At the same time, however, experts and the science that they produce are often 'shaped' by political, legal, and economic contexts. In short, much as other ideas in marine environmental governance may be 'constructed' by powerful social and other forces, so, too, may be the experts who produce the science that informs governance policy be influenced by those same forces.

Civil society, including nongovernmental organisations, publics, and individuals, are the subject of Chapter 9, by Andrea Quirino Steiner, Elia Elisa Cia Alves, and Luís Paulo Santana. The role of civil society in environmental governance generally increased markedly from the early 1990s as democracy took root in more countries (some of which have since experienced retrenchment towards less democratic, more authoritarian forms of rule). The growing influence of civil society has similarly been the case in marine governance. As Steiner, Alves and Santana note, civil society operates at all levels of governance – including the local, the regional, and the international – through a wide variety of actors – from individuals and nongovernmental organisations to social movements and informal networks. Civil society actors operationalise their influence on marine environmental governance through various means, including diplomacy, advocacy, education, and provision of technical information. They have done so in a wide range of issues areas, such as management of fisheries, conservation of biological diversity, 'policing' activities on the high seas, and surveying – and sometimes cleaning up – pollution. Civil society actors have been successful in influencing marine environmental governance on many occasions; at others, they have been less successful. Through case studies, Steiner, Alves, and Santana get to the bottom of how and why.

In Chapter 10, E. Carina H. Keskitalo, Dmitri L. Lajus, and Lars H. Gulbrandsen draw on the experience of certification by the Marine Stewardship Council (MSC) in Russia to illuminate 'private' marine environmental governance. Private governance comprises non-state actors playing roles in achieving policy outcomes. As Chapter 10 notes, private governance became prominent in forest stewardship over the last several decades, with nongovernmental 'certification' programmes used to identify the origins and environmental impact of timber products. Similar programmes have been applied to marine certification, notably in certifying the sustainability of fisheries. Doing this has not been without its difficulties, for example with respect to the location of authority and coordination among actors, and the impacts of climate change at sea are magnifying difficulties by exacerbating conflict among actors and making the past an unreliable guide to the future. Focusing especially on the MSC's efforts to implement its certification initiatives in Russia, Keskitalo, Lajus and Gulbrandsen's chapter demonstrates that effective marine governance, including in its private forms, will require improved understanding of the local and regional context in which it is applied.

Extending the analysis of private marine environmental governance amidst climate change, in Chapter 11, Nata Tavonvunchai explores blue carbon financing by private-sector investors. As Tavonvunchai notes, the gap between available funding for marine conservation and actual funding for it is enormous. Public-sector financing, whether from national governments or international organisations, is – and almost certainly will remain – inadequate. Consequently, increasing levels of private-sector financing will be essential if marine conservation is to be successful. Tavonvunchai's chapter looks in particular at efforts to sequester carbon in marine sediments and biomass, notably in saltmarshes, mangrove forests, and seagrass beds. Exploiting these forms of blue carbon storage has some potential attraction to private investors, including insurers, asset managers, investment funds, and multinational

corporations. A variety of funding models have been attempted and implemented, with 'blue carbon credits' being the most common. However, many blue carbon projects are relatively unattractive to private investors, while others that are attractive have met with varying degrees of success. To increase and improve outcomes that lead to marine conservation, greater emphasis is needed to value natural assets and to make investments that are centred on local communities.

Governing marine environments and regions

Part 4 of the book expands our perspective on marine environmental governance by way of several studies that examine particular marine environments and regions. In Chapter 12, Greg Johnson, Amanda Alva, and Kelly Dunning look at coastal environments associated with some of the communities and countries that are most dependent on the seas. Johnson, Alva, and Dunning are particularly interested in understanding decision-making related to coastal and marine governance that impacts communities and environments with high sensitivity and exposure to hazards associated with global environmental change. While they want to know what happens at the national level, they also explore the role of women, indigenous people, and other vulnerable populations in low-income parts of Africa, Asia, the Caribbean, and Latin America. Their analysis shows that substantial progress is being made to realise policies that effectively address marine pollution, overfishing, and other ecological stresses. This is being achieved through participatory, flexible institutions. That said, they also find that governance capacity and policy enforcement can be lacking and are made more challenging by the impacts of climate change, not least sea level rise and worsening tropical storms.

In Chapter 13, Tony George Puthucherril provides further examination of coastal and near-shore habitats, in the process describing the role of 'interactive' marine environmental governance amidst global change. Puthucherril builds on arguments from the previous chapter to remind us that coastal and near-shore environments are increasingly threatened due to human activities, such as pollution, extraction of resources, acidification of seawater and rising sea levels. New approaches to marine governance are needed to address these and other shoreline and near-shore environmental threats. Puthucherril argues that interactive governance and integrated coastal zone management are critical in this respect. Interactive governance is a process whereby problems are addressed through interactions among civil, public, and private stakeholders. Integrated coastal zone management is an iterative process involving informed participation and cooperation among actors. Using case studies from a number of countries, the chapter shows that both interactive governance and integrated coastal zone management provide promising avenues for more effectively protecting the integrity of coastal and near-shore environments in the long term.

Islands are among the geographic features of the world's oceans and seas that are most vulnerable to global environmental change, especially the consequences of global warming and climate change. In Chapter 14, Anemoon Soete looks at islands' vulnerabilities associated with rising seas, vulnerable shorelines, and territorial integrity. As Soete notes, the impacts felt by islands are both local and global: they are experienced locally, but they are intimately connected to issues that are affecting the global oceans, such as overexploitation of fisheries and illegal, unreported, and unregulated fishing. Most profoundly, islands are 'canaries in the coalmine' of climate change: they are directly impacted by changes to the seas and, especially in the case of low-lying islands, the threats that they face from climate change are potentially existential. These impacts are already being felt and will undoubtedly grow much worse in

the coming decades, raising profound questions of fairness given that the most vulnerable island countries are among those that have contributed the least to causing climate change. As the chapter reveals, these communities are already trying to address the many growing challenges that are being exacerbated by global environmental change. Their experiences point to the need for changes in extant practices of marine environmental governance and very likely entirely new approaches specifically suited to a future of continuous change.

Many of the world's island countries are ringed by, and often formed by, coral reefs, which are among the ecosystems that are suffering the most severely from climate change. Chapter 15, by Pedro Fidelman, is devoted to understanding some of the governance challenges associated with coral reefs, in the process highlighting the importance of interactions among the ecological and social aspects of marine governance. Fidelman points out that coral reefs around the world's oceans are degrading quickly as a consequence of global climate change and local factors, such as water pollution and overexploitation. Innovative marine governance is required to reverse the degradation, where possible, and to minimise the decline where it is not. That governance is so far lacking. Using Australia's Great Barrier Reef as a case study, Fidelman explores 'social-ecological reflexivity', an idea that he argues has the potential to bolster coral reef management and increase its chances of success. Combining social-ecological reflexivity with aspects of institutional analysis, he proposes a conceptual framework that illuminates the circumstances and conditions under which innovative governance for coral reefs affected by global change might be realised.

Many of the coral reefs that are threatened by climate change are found in Southeast Asia, the subject of Chapter 16, by Anastasia Kuswardani and Achmad Poernomo. Kuswardani and Poernomo examine fisheries and aquaculture in the region, which together are the primary sources of dietary protein for the majority of the people living there, and which make up large parts of the economies of the region's countries. Climate change has severely impacted Southeast Asian fisheries and aquaculture, in turn adversely affecting the livelihoods of people in fishing villages and beyond. Responses to the adverse changes to fisheries and aquaculture in the region vary from country to country, although there are some vehicles for cooperation, for example in the context of the Association of Southeast Asian Nations. Cooperation among the region's countries is vital given their many shared borders and marine ecosystems. Chapter 16 reviews the nature of the threat to fisheries and aquaculture in the region and explores the means by which countries there are managing the impacts of climate change.

Shifting hemispheres, in Chapter 17 Marko Joas, Henrik Ringbom, and Nina Tynkkynen look at the impact of global environmental change on the Baltic Sea. As a consequence of very complex ecological and societal characteristics, the Baltic Sea is a case study of multilevel and 'network-type' systems of marine environmental governance. As such, it can offer not only lessons for improved local management but also experiences that may be transferrable to other regions and ecosystems. In addition to describing the threats that global environmental change presents to the Baltic Sea, Joas, Ringbom, and Tynkkynen examine regulatory institutions for the sea and explore the evolution of the region's multilevel environmental governance system. They ask how approaches to marine environmental governance for this regional sea are challenged by climate change combined with existing ecological threats, notably eutrophication caused by pollutants entering the sea from the surrounding riparian system. Their chapter highlights the potential utility and adaptability of existing management systems for regional seas in a future characterised by global environmental change.

In contrast, in Chapter 18, Emma Avoyan and Jan van Tatenhove draw in existing experiences with managing the impacts of global environmental change on the Black Sea to

show where building on current practice may be less fruitful. The Black Sea is one of the most polluted of the world's seas, a situation that is being exacerbated by the effects of climate change. International cooperation among the littoral countries will be essential if the pollution aspects of decline are to be addressed. However, just that sort of cooperation is sorely lacking due to geopolitical disagreements, imbalances in resources and lack of willingness among the governments of surrounding countries. Effective marine governance will require major institutional reform and a reassessment by local governments of the importance of having a Black Sea that is environmentally healthy.

Moving farther from the tropics, Chapters 19 and 20 look at challenges to marine environmental governance in polar seas, beginning with an analysis by Nicole Wienrich, Hugh McDonald, Arne Riedel, Tim Packeiser, and Janos Hennicke of the challenges of extreme change in the Arctic and Southern Oceans. In both regions, warming seas, declining sea ice and acidification of waters are adversely affecting the distribution of marine species. Although the specific long-term impacts on fisheries are uncertain, the general increasing pace and scale of change appear to be inevitable. Due to the loss of sea ice, human activities in polar seas, such as shipping, fishing, tourism, and exploration for (and extraction of) hydrocarbons, are increasing and will accelerate in the future. Chapter 19 describes existing governance frameworks for polar seas and notes that ecosystem-based approaches are being promoted by the Arctic Council and the Antarctic Commission for the Conservation of Antarctic Marine Living Resources. Existing barriers to effective conservation of polar marine ecosystems include the desire among actors to exploit newly accessible resources, a lack of international cooperation, and a shortage of scientific information. Wienrich *et al*. argue that the use of more collaborative processes and the implementation of new management schemes, including area-based management measures, may help to overcome those barriers.

Chapter 20 by Benjamin Hofmann builds on the preceding chapter by focusing on the management of increased shipping activities in the Arctic Ocean, which is changing dramatically due to regional warming and declines in the extent and thickness of sea ice. Increased shipping, which has been made possible by climate change, poses new threats to Arctic Ocean ecosystems, including the growing danger of accidental spillage of fuel oil and emissions of black carbon – itself a contributor to climate change – into the atmosphere. In response to these threats, traditional state-based governance approaches, notably in the context of the International Maritime Organisation (IMO), are being supplemented by newer forms of transnational governance that involve nongovernmental and corporate actors. For example, the latter have pledged to end gradually the use of the most polluting fuels and to forgo trans-Arctic shipping along some routes. Hofmann argues that this combination of traditional approaches to marine environmental governance with newer innovative approaches can serve as an example for governing other marine environments affected by global change. In particular, he advocates innovative governance involving non-state actors in the region, which in turn can stimulate traditional state-oriented institutions to bring their resources to bear on addressing the impacts of global environmental change.

The final chapter in Part 4 of the book moves from littoral and regional seas to marine environments far from shores. In Chapter 21, Mitchell Lennan explores pelagic ecosystems and the expansive open oceans that cover half of Earth's surface. These areas are far from immune to the impacts of global environmental change, as exemplified by ocean warming and acidification. Those impacts, combined with others, such as deoxygenation, pollution, and overexploitation, undermine pelagic ecosystems. As those ecosystems suffer, they diminish the ability of the oceans to compensate for humanity's past and ongoing carbon dioxide emissions. Lennan describes the existing governance regime for the high seas, which he

characterises as fragmented and ad hoc. He uses an analysis of regional fisheries management organisations to illustrate governance efforts on the high seas. These organisations have the potential to aid in adapting to the movement of fisheries, which is likely to arise due to climate-induced environmental changes, through cooperative management and designation of marine protected areas. A legally binding agreement on protecting biodiversity beyond national jurisdictions would, Lennan argues, enhance the potential for more effective environmental governance on the high seas as the impacts of global environmental change become more pronounced.

Emerging issues in environmentally sustainable marine governance

Part 5 of the book shifts from a geographic orientation to a perspective that looks at particular challenges for marine environmental governance amidst global environmental change. In Chapter 22, Judith van Leeuwen, Tony R. Walker, and Joanna Vince examine uncertainty and 'multiplicity' in the massive and growing challenge for global marine governance of plastic pollution. They note that plastic pollution in oceans and seas is having long-term impacts on marine organisms and ecosystems, yet there are a few effective strategies for dealing with that pollution. Importantly, much of the problem originates on land; about four-fifths of the plastics in the world's oceans come from land-based sources. Responding to this problem has involved many different actors, both state and non-state, but attempts at effective governance have, for the most part, failed. In their chapter, van Leeuwen, Walker, and Vince highlight ongoing debates regarding the best means by which to manage marine plastic pollution effectively, and they describe the multiplicity of governance schemes across sectors, scales, and types of actors. They argue that these schemes have the potential to become more effective through experimentation, learning, and critical monitoring leading to transformative changes in the ways that plastics are produced, used, and discarded.

Building on Chapter 20's discussion of shipping in the Arctic Ocean, in Chapter 23, Judith van Leeuwen and Jason Monios look at maritime commerce and transport more broadly, in the process highlighting the imperfect match between the policies of the IMO and the challenges posed by climate change to the world's oceans. As the principal regulator of international maritime transport, the IMO is an obvious venue for devising policies for addressing climate-related challenges for shipping. However, as van Leeuwen and Monios argue, the IMO is not up to the task for a number of reasons. It has always advocated a staid approach to addressing environmental concerns related to shipping, relying, for example, on existing technologies rather than pushing members to adopt new ones. Although the IMO has called for improvements in the energy efficiency of ships, it has not embraced the decarbonisation of maritime transport. Indeed, greenhouse gas emissions from shipping continue to increase, and even the IMO does not expect them to fall before 2050. Because the IMO has lacked initiative and consequently lacks legitimacy in this issue area, actions to limit climate-changing pollution from shipping have fallen to often-fragmented schemes implemented by regional organisations, ports, and private actors. If van Leeuwen and Monios are right, pressure will build to coordinate global efforts to address the climatic impacts of shipping, and the IMO may eventually be forced to rethink its relatively go-slow approach.

When we think of large human-made objects floating on the world's oceans, we naturally imagine ships. However, as the impacts of climate change on the oceans, not least sea level rise, become more prominent in the future, it is likely that whole communities will

move to floating cities. These will often comprise large platforms floating on the sea surface, enabling them to rise as seas rise. A number of countries are considering the development of floating cities as strategies for adapting to climate change. The legal and regulatory issues that arise from the development of floating cities are taken up in Chapter 24, by Otto Spijkers and Chuxiao Yu. As Spijkers and Yu describe it, the development of floating cities is a realistic strategy for adapting to climate change, especially its impacts upon low-lying littoral communities. The technology for floating cities will be relatively easy to work out, but less simple may be the legal, regulatory, and international political considerations. Chapter 24 considers how and whether existing international law will be able to guide the governance of future floating cities. It evaluates how to classify floating cities in the context of international law and examines the consequences of those classifications, particularly in the context of UNCLOS.

Floating cities are one potential route to development in the marine context as the impacts of global environmental change manifest themselves. More broadly, we should consider the wider role that oceans and seas play in *sustainable* development. That is the question taken up in Chapter 25, by Shailly Kedia and Kapil Narula. Their chapter focuses on the United Nations' Sustainable Development Goals (SDGs), and the oceans-oriented SDG14 in particular. SDG14, the only one of 17 SDGs that is directly related to the world's oceans, aims to 'conserve and sustainably use the oceans, seas and marine resources for sustainable development' through realisation of numerous sustainability targets. The relationship between sustainable development and oceans is two-way. The oceans are threatened by environmentally unsustainable activities globally leading to ocean pollution, collapse of fisheries, ocean warming, acidification, and eutrophication, as noted in several of the chapters in this book. Alternatively, the oceans are vehicles for realising environmentally sustainable development. Put simply, environmentally sustainable development can help to protect oceans, and healthy oceans can help in the achievement of sustainable development. As Kedia and Narula show, implementing SDG14 will require proactively addressing the oceanic causes and impacts of global environmental change. Doing this is difficult due to gaps in marine environmental governance and a shortage of capacity – technology, funding, and so forth – in many of the countries that are most reliant on successful implementation of SDG14.

The final chapter in Part 5 and the penultimate chapter of the book considers the normative aspects of marine environmental governance, in the process highlighting the vitally important roles of ethics, justice and human rights, all of which will become more important and more challenged as environmental change is felt more forcefully around the world. In Chapter 26, Konrad Ott, Colin von Negenborn, and Nele Matz-Lück argue that the ethics of marine environmental change should provide the grounding for political and policy responses. They identify what they consider to be vital 'ethical building blocks' and consider how these might be translated into legal practice in the marine context. They ask whether human rights approaches and viewing the oceans as a legal entity have utility in marine environmental governance. Their analysis leads them to conclude that the notion of a 'covenant' of leading states, within the context of UNCLOS, has the potential to take seriously claims for environmental justice while having sufficient political viability to shape marine environmental governance amidst global environmental change. The initiative that they advocate, which they believe is implicit in SDG14, involves a 'global initiative for ocean recovery and restoration', aggressive cuts in carbon dioxide and other pollutants, expansion of marine protected areas and protection of coastal ecosystems, and the sustainable regulation of fisheries. Doing all of these things will promote ethics, justice and human rights while also realising the objectives discussed by other contributors to this book.

Conclusion

Taken together, the chapters reveal a picture of marine environmental governance in the new era of global environmental change. They highlight longstanding challenges of managing marine ecosystems, resources, and relationships with human users of the sea, whether they are individuals, civic organisations, or nation-states. More to the point, they show, first, how global environmental change is increasing and exacerbating those challenges and, second, whether existing mechanisms for marine environmental governance are and will be able to cope with that change. In most cases, they conclude that those mechanisms are not up to the task, indeed that they will sometimes be obstacles to more effective marine environmental governance in the future. At the very least, in nearly all cases existing mechanisms for marine environmental governance will need to evolve. Many of the chapters are helpful in that they point us to what it will take for that to happen. As such, the chapters in this book offer valuable lessons about marine environmental governance today and in the future – a future that will be characterised by environmental change of global proportions. An important question is whether the solutions that are identified and proposed can and will take root. Based on what the contributors to this book have determined and argued, the future prospects for effective marine governance look decidedly mixed, at best, given the mounting challenges of global environmental change. Might the experience of trying to develop an effective global regime to combat climate change offer any clues about the prospects for marine environmental governance? That is a question taken up in the final chapter.

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