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Striking an Equitable Balance under the Biodiversity Agreement

The Elusive Case of New Technologies, Marine Genetic Resources and the Global South

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3.1 Introduction

The technical and scientific capability to explore the ocean is intrinsically linked with human endeavor in the marine environment. In ancient times, the ineffectiveness of rudimentary salvage technologies in recovering lost cargo from the deep influenced the codification and application of the law of obligations and the rules on jettison under Roman law.[1] Today, state-of-the-art technologies are opening up new frontiers in marine science and improving the pathways for states and intergovernmental organizations to undertake evidenced-based decision-making in ocean affairs.[2] As a result, intergovernmental cooperation and ocean science diplomacy underpin many aspects of the international regulation of industries that are science and technology dependent such as fisheries, shipping and seabed mining.[3] The technological revolution has gathered pace with the advent of the information era, the increased coverage and resolution of satellite remote-sensing technologies, and artificial intelligence and robotics, as well as with the launch of autonomous submersibles that are capable of exploring and mapping the seafloor in distant ocean regions.[4]

The social and economic consequences of these advancements are manifold but mostly benign, with the Organisation for Economic Co-operation and Development (OECD) forecasting that every sector of the ocean economy will be affected by technological innovation by 2030.[5] However, there are growing international awareness and concerns about a handful of powerful transnational corporations and their subsidiaries in highly industrialized countries asserting market dominance in offshore industries, especially in sectors with high entry costs, such as marine

[1] Reinhard Zimmermann, The Law of Obligations: Roman Foundations of the Civilian Tradition 407 (1996).

[2] Oscar Pizarro & Leonard Pace, *Editorial: Emerging Technologies with High Impact for Ocean Sciences, Ecosystem Management, and Environmental Conservation*, 8 Frontiers in Marine Sci. (2021).

[3] Harriet Harden-Davies, *The Next Wave of Science Diplomacy: Marine Biodiversity beyond National Jurisdiction*, 75 ICES J. Marine Sci. 426, 428 (2018).

[4] Mark Anderson, *Bon Voyage for the Autonomous Ship Mayflower*, ieee Spectrum, Jan. 3, 2020. On the use of new technologies for sample collection and collection by industry, also *see* Alex Rogers et al., Marine Genetic Resources in Areas *beyond* National Jurisdiction: Promoting Marine Scientific Research and Enabling Equitable Benefit Sharing, 8 Frontiers in Marine Sci. (2021).

[5] Organisation for Economic Co-operation and Development, The Ocean Economy in 2030 14 (2016) (hereinafter OECD).

biotechnology.[6] The oligopoly risks are obvious and in many ways run counter to international commitments to transfer marine technology to developing countries and to build their research capacity in marine science.[7]

In light of these developments, the discussion in this chapter is predicated on the view that new technologies are transforming the world of ocean exploration but at the same time that they have the potential to exacerbate existing inequalities under the United Nations (UN) Convention on the Law of the Sea (UNCLOS).[8] In doing so, they are also exposing fundamental weaknesses in the rules on marine scientific research and technology transfer set forth in Parts XIII and XIV of UNCLOS.[9] As seen elsewhere in this volume, a major cause for concern is that emerging technologies are easily outpacing the codification of new normative rules in the law of the sea.[10]

A case in point arises with respect to the application of new technologies in the search for novel genetic material belonging to organisms that live in the deep ocean. The areas of interest were first discovered in the 1990s and are primarily hydrothermal vent sites associated with tectonic and volcanic activity in the Atlantic, Pacific, Indian and Arctic Oceans.[11] Research at such sites holds great promise for scientists to gain a better understanding of biological and chemical processes such as chemosynthesis, as well as the origins and functioning of life in extreme environments.[12] The exploration of marine genetic features of plants, animals and microorganisms can also lead to innovative discoveries of biotechnological and biopharma importance of commercial value.[13] These features may include chemical compounds, genes and their products, or, in

[6] John Virdin et al., *The Ocean 100: Transnational Corporations in the Ocean Economy*, 7 Sci. Advances 1, 9 (2021).

[7] G. A. Res. A/RES/70/1, ¶ 14.a (Sept. 25, 2015).

[8] United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397 (hereinafter UNCLOS).

[9] See discussion on unfinished business and inherent biases *infra*.

[10] *See e.g.*, Chapters 8 and 10.

[11] Evan Lubofsky, The Discovery of Hydrothermal Vents: Scientists Celebrate 40th Anniversary and Chart Future Research, Oceanus, June 11, 2018.

[12] Jesús M. Arrieta, Sophie Arnaud-Haond & Carlos M. Duarte, *What Lies Underneath: Conserving the Oceans' Genetic Resources*, 107 Proc. Nat'l Acad. Sci. U.S. Am. 18318, 18319 (2010).

[13] Robert Blasiak et al., The Ocean Genome: Conservation and the Fair, Equitable and Sustainable Use of Marine Genetic Resources 14–17 (2020); *see also* Fernando de la Calle, *Marine Genetic Resources: A Source of New Drugs, the Experience of the Biotechnology Sector*, 24 Int'l J. Marine & Coastal L. 209–20 (2009).

some cases, the physical properties of the material in question.[14] One other consequence of the rapid progress in deep ocean exploration and monitoring technologies at such sites is that there is greater international awareness that most of the work related to marine genetic resources is carried out by a small number of companies and countries in the Global North and that much of the field work is a high seas freedom from a law of the sea perspective.[15]

In response to these and related concerns regarding the regulatory gaps appertaining to the deep ocean environment under the law of the sea, the topic of the conservation and sustainable use of Marine Biodiversity of Areas beyond National Jurisdiction has come to the fore of intergovernmental treaty-making efforts under the auspices of the UN General Assembly over the past two decades.[16] Since 2018, these deliberations have come to a hiatus at an intergovernmental conference tasked with elaborating the text of an international legally binding instrument under UNCLOS.[17] They in turn brought into sharp relief some daunting legislative challenges that need to be overcome if the law of the sea is to provide a sophisticated and equitable framework that balances the interests and needs of both developed and developing countries in the conservation and use of biodiversity for the benefit of present and future generations.

3.2 Significant and Substantial Legal Issues

The prospect of new scientific discoveries is exciting on many levels but it also raises significant issues about how emerging technologies have the potential to influence the progressive development and codification of the law of the sea. With this in mind, the following discussion highlights

[14] Blasiak et al., *supra* note 13, at 21–22.

[15] United Nations, Division for Ocean Affairs and the Law of the Sea, The Second Global Integrated Marine Assessment: World Ocean Assessment 21, 506 (2021).

[16] For developments in the treaty-making process, *see, e.g.*, David Freestone, *The UN Process to Develop an International Legally Binding Instrument under the 1982 Law of the Sea Convention: Issues and Challenges*. Conserving Biodiversity in Areas Beyond National Jurisdiction 3–46 (David Freestone ed., 2019); David Leary, *Agreeing to Disagree on What We Have or Have Not Agreed On: The Current State of Play of the BBNJ Negotiations on the Status of Marine Genetic Resources in Areas beyond National Jurisdiction*, 99 Marine Pol'y 21–29 (2019); J. Ashley Roach, *BBNJ Treaty Negotiations 2019*. Marine Biodiversity Beyond National Jurisdiction 25–89 (Myron H. Nordquist & Ronán Long eds., 2021).

[17] G. A. Res. 72/249, ¶ 1 (Jan. 19, 2018).

global inequalities to explore and benefit from the ocean and argues that this stems in several important respects from fundamental lacunae in the provisions on marine scientific research and technology transfer in UNCLOS.[18] The discussion traces intergovernmental efforts to negotiate a new marine biodiversity treaty at the UN and showcases how existing and emerging technologies are central to designing functional and reasonable solutions that will attract consensus support from the plenipotentiaries on key strands of the treaty-making deliberations that are still open prior to final sessions of the intergovernmental conference. Through the lens of emerging technologies, the chapter reviews several aspects of the draft treaty, namely: the use and meaning of terms and objectives; normative principles and approaches; monitoring and the sharing of benefits from marine genetic resources; along with the establishment of new institutions and a clearing-house mechanism for technology transfer and capacity-building purposes.[19]

In doing so, the discussion draws attention to the positions adopted by several delegations on some of the most contentious issues concerning technology under negotiation at the intergovernmental conference, especially as they pertain to the interests and needs of the small island developing states and least developed countries in the Global South.

[18] The shortcoming in UNCLOS are well documented in the specialist literature on marine scientific research and the law of the sea, *see, e.g.*, Alfred H. A. Soons, Marine Scientific Research and the Law of the Sea (1982); United Nations, Division for Ocean Affairs and the Law of the Sea, Marine Scientific Research: A Revised Guide to the Implementation of the Relevant Provisions of the United Nations Convention on the Law of the Sea (1991); Montserrat Gorina-Ysern, An International Regime for Marine Scientific Research (2004); Florian H. Th. Wegelein, Marine Scientific Research: The Operation and Status of Research Vessels and Other Platforms in International Law (2005); Kristin Bartenstein & Shotaro Hamamoto, *Part XIV, Development and Transfer of Marine Technology*. United Nations Convention on the Law of the Sea: A Commentary 1605–1807 (Alexander Proelss ed., 2017); Nele Matz Luck et al., Part XIII, Marine Scientific Research. United Nations Convention on the Law of the Sea: A Commentary 1605–1807 1605–1763 (Alexander Proelss ed., 2017).

[19] U.N. Doc. A/CONF.232/2020/3, Intergovernmental Conference on an International Legally Binding Instrument under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction, Revised Draft Text of an Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (2019), annex (hereinafter Revised Draft Text).

The chapter also flags a number of potential amendments to the draft treaty text with a view to advancing a more even-handed approach to marine genetic research and the transfer of technology under the law of the sea, as well as to future-proof the agreement in light of technological, environmental and legal developments over time. As will be seen, the chapter advocates that the final sessions of the intergovernmental conference presents a once-in-a-generation opportunity to effect real change and to ensure a more equitable balance of interests in the law of the sea that advances peace, stability, prosperity and genuine international cooperation in the conservation and sustainable use of marine biodiversity.

Before turning to these issues, it is first necessary to set the scene by making a few general observations from historical, geographical and scientific perspectives about global disparities in technical capabilities to explore the deep ocean and to benefit from research on marine genetic resources in areas beyond national jurisdiction.

3.3 North–South Capabilities and Disparities

One may start with the term "capabilities," which, when used in this chapter, is a sweeping and poorly defined reference to the differences between developed and developing states. In practice, what counts in any specific situation is the level of scientific knowledge and technical capability available to a given state or research entity in the relevant scientific and technical fields.[20] That said, technical and scientific capability has long since been a dynamic feature and driver of ocean exploration. One can point to the extraordinary skill and knowledge of Polynesian navigators who explored the South Pacific in one of the earliest of human migrations across the ocean.[21] Indeed, the draft text of the agreement provides for the utilization of the traditional knowledge of indigenous peoples in decision-making processes, the first such reference in a law of the sea instrument, which ought to make future decision-making more

[20] A similar point is made by the International Tribunal for the Law of the Sea (ITLOS) Seabed Dispute Settlement Chamber in related to seabed mining. Responsibilities and Obligations of States with Respect to Activities in the Area, Case No. 17, Advisory Opinion of Feb. 1, 2011, ITLOS Rep. 10, ¶ 162 (hereinafter Advisory Opinion of Feb. 1, 2011).

[21] Geoffrey Irwin, The Prehistoric Exploration and Colonisation of the Pacific 5–6 (1992).

inclusive and reflective of the links between nature and community values.[22]

In Europe, innovations such as the magnetic compass, the astrolabe and developments in nautical cartography went hand-in-hand with the projection of naval imperial power overseas along with the search for new navigational routes during the Age of Exploration.[23] These early navigational instruments also facilitated the setting down of demarcation lines in ocean space including the division of the world into two spheres of influence by Portugal and Spain under the Treaties of Tordesillas and Saragossa in 1494 and 1529, respectively.[24] Technical innovation influenced the cannon-shot rule for determining the seaward limit of the territorial sea and the emphasis on what states do in practice, which shaped the rise of positivism in the law of the sea and in international relations pertaining to ocean affairs since the Treaty of Westphalia in 1648.[25] In the late nineteenth century, astounding scientific discoveries were made through the use of relatively simple mechanical devices to collect sediment and biological samples from the deep sea during the course of the *H. M. S. Challenger* expedition, technologies that are still used today.[26] International collaboration in the development of new tools in fisheries science took a major step forward with the establishment of the International Council for the Exploration of the Sea in Copenhagen in 1902.[27]

After World War II, the United States took the lead in developing ocean technologies and the rapid pace of technological change continued to have a notable bearing on developments in the law of the sea pertaining to seabed resources, including the proclamation by President Truman in 1946 claiming that the resources on the continental shelf contiguous to the United States belonged to the United States.[28] Indeed, technological

[22] Revised Draft Text, *supra* note 19, arts. 5(i), 10, 46(b), 49(2); *see* Clement Yow Mulalap et al., *Traditional Knowledge and the BBNJ Instrument*, 122 Marine Pol'y (2020).

[23] David Woodward, *Cartography and the Renaissance: Continuity and Change*. The History of Navigation 3, 15, 17 (2007).

[24] Lawrence A. Coben *The Events That Led to the Treaty of Tordesillas*, 47 Terrae Incognitae 142–62 (2015),

[25] Yoshifumi Tanaka, The International Law of the Sea 27 (2019).

[26] Margaret Deacon, Tony Rice & Colin Summerhayes, Understanding the Oceans: A Century of Ocean Exploration 25–69 (2001).

[27] Convention for the International Council for the Exploration of the Sea, Sept. 12, 1964, 24 U.S.T. 1080, 652 U.N.T.S. 237.

[28] U.S. Presidential Proclamation 2667, Policy of the United States with Respect to the Natural Resources of the Subsoil and Sea Bed of the Continental Shelf, 10 Fed. Reg. 12,305 (1945).

capability and the exploitability test in accessing such resources was codified subsequently as one of criteria to define the seaward limit of the continental shelf under the 1958 Convention on the Continental Shelf.[29] In the late 1960s, the United States ably demonstrated its ocean technology capabilities by using salvage and sonar technologies to recover parts of a lost Soviet submarine in the Pacific Ocean.[30] There were also spin-off technologies from the NASA space program and from the deep-water oil and gas drilling programs in the Gulf of Mexico and elsewhere. In parallel with the on-going development of deep-water extraction technologies for hydrocarbons and minerals, the adoption of unliteral seabed mining measures by the United States and other industrialized countries influenced the revision of multilateral arrangements on seabed mining under UNCLOS and the 1994 Implementation Agreement.[31] The mining industry tested deep-water technologies in the Clarion Clipperton Fracture Zone in the 1970s with mixed success.[32] Many other aspects of international law pertaining to deep ocean science remained unresolved, including the rules on collecting oceanographic data.[33] The first discovery of hydrothermal sites near the Galapagos Islands by a team from Woods Hole Oceanographic Institute in 1977 heralded a new era in the study of marine organisms for their unique molecular properties including the commercial benefits that may be derived from marine genetic resources.[34] This period was also the beginning of international scientific concerns about the impact of technologies on deep-water habitats and the need for responsible research practices at sites that were often new to science and poorly understood.[35]

[29] Convention of the Continental Shelf, art. 1(i), Apr. 29, 1958, 15 U.S.T. 471, T.I.A.S. No. 5578, 499 U.N.T.S. 311.

[30] Frederic A. Eustis, *The* Glomar Explorer *Incident: Implications for the Law of Salvage*, 16 Va. J. Int'l L. 177 (1975).

[31] G. A. Res. 48/263, ¶ 5 (Aug. 17, 1994).

[32] Denis Arrow, *The Proposed Regime for the Unilateral Exploitation of Deep Seabed Mineral Resources by the United States*, 21 Harv. Int'l. L.J. 337 (1980).

[33] UNESCO, Safety Provisions of Ocean Data Acquisition Systems: Aids and Devices, not in force (1972); *see* Nikos Papadakis, *Some Legal Problems Associated with the Ocean Data Acquisition Systems, Aids and Devices*, 5 Int'l Relations 825–37 (1975).

[34] On existing and other potential benefits, Blasiak et al., *supra* note 13, at 12–20.

[35] *See, e.g.*, InterRidge, Statement of Commitment to Responsible Research Practices at Deep-Sea Hydrothermal Vents (2006).

In the 1980s and 1990s, there were several important transnational initiatives to improve global cooperation in marine science including the Census of Marine Life, a major baseline study on marine biodiversity undertaken by scientists from eighty countries, which saw the development of new internet tools for taxonomy and metadata analysis.[36] Improvements in North–South and triangular cooperation were facilitated by the implementation of ocean mapping programs including tools to map the seafloor, which brought their own challenges in relation to interpretation and implementation of UNCLOS.[37] In recent years, further progress was made in technological innovation under the seabed mining regime including the training of scientist from developing countries in environmental monitoring and other deep-water technologies.[38] The availability of new technologies also boosted the scope for greater participation by women scientists in ocean science.[39] With the arrival of the digital era, different maritime sectors continue to develop technical and science-driven solutions to the many challenges encountered in the law of the sea and ocean affairs.

Despite this progress, disparities in technical capabilities remain pronounced worldwide, especially in scientific disciplines that are skill-intensive and dependent upon access to research vessels and expensive technologies to undertake research at sea. This is also true in relation to the access to remote-sensing technologies and autonomous platforms, as well as shipborne technologies and submersibles for many of the tasks in deep ocean exploration.[40] The latter can collect water, geological,

[36] Paul V. R. Snelgrove, Discoveries of the Census of Marine Life: Making Ocean Life Count 49–52, 75 (2010).

[37] Larry Mayer & J. Ashley Roach, *The Quest to Completely Map the World's Oceans in Support of Understanding Marine Biodiversity and the Regulatory Barriers We Have Created*. Marine Biodiversity Beyond National Jurisdiction 149, 153–54, 163–66 (Myron Nordquist & Ronán Long eds., 2021).

[38] Ronán Long, Zhen Sun & Maraimalia Rodríguez-Chaves, *Gender Leadership and the United Nations Decade of Ocean Science: Pioneering Role of the International Seabed Authority*. The United Nations Convention on the Law of the Sea, Part XI Regime and the International Seabed Authority: A Twenty-five Year Journey 109–36 (Alfonso Ascencio-Herrera & Myron Nordquist eds., 2022).

[39] See discussion on these structures *infra*. *See also*, Ronán Long, *Beholding the Emerging Biodiversity Agreement through a Looking Glass: What Capacity-Building and Gender Equality Norms Should Be Found There?* Marine Biodiversity Beyond National Jurisdiction 241, 269–70 (Myron H. Nordquist & Ronán Long eds., 2021).

[40] Remote-sensing technologies have their limitations in so far as they can only be used in the photic zone, that is to say down to the 100-meter isobath. *See* Ved Chirayath & Alan Li, *Next-Generation Optical Sensing Technologies for Exploring Ocean Worlds: NASA*

biological and chemical samples in the deepest and remotest parts of the ocean including for commercial purposes.[41] The vessels are also capable of deploying coring systems to sample seabed substrata in water depths greater than the 6,000-meter isobath. Onboard, they are kitted out with specialist laboratories and instrumentation that facilitates in situ sampling and monitoring of biodiversity, along with equipment to commence the scientific processes of DNA and environmental DNA analyses of genetic material, biomolecule characterization and metabarcoding, as well as manipulating genomic information through the use of advanced genome-editing tools.[42] Many modern research vessels are fitted out with teleworking facilities, which allow scientists to work from land-based hubs or from home with direct access to video and data transmitted in real-time from submersibles as they explore the deep. A further phenomenon is that modern research vessels and autonomous platforms are increasingly owned and operated by private individuals and philanthropic foundations and thus not subject to the same oversight mechanisms of government-funded or international science programs.[43] These vessels can deploy in all ocean regions, along with undertaking a limited range of capacity development activities.[44]

The global disparities and the North–South divide in marine scientific research programs has not gone unnoticed and there is disquiet about scientists from higher-income countries conducting field studies, particular on inshore marine ecosystems, without undertaking capacity development activities or sharing their knowledge and resources with local scientists in low-income countries.[45] This in turn is influencing the

FluidCam, MiDAR, and NeMO-Net, 6 Frontiers in Marine Sci. (2019); Mayer & Roach, *supra* note 37, at 149–66.

[41] Rogers et al., *supra* note 4. Examples of vent bacteria that have been commercialized are cited by Blasiak et al., *supra* note 13, at 18.

[42] *Id.*

[43] For instance, the private company REV Ocean is currently building a research vessel in Norway. *See* The Vessel, www.revocean.org/vessel (last visited Mar. 9, 2021) (online). Also, ocean sampling programs have been undertaken by the J. Craig Venter Institute in the United States and the Tara Ocean Expedition in France. In relation to the latter, cheap technology enables the sequencing of entire genomes at sea without bringing samples ashore, see Rogers et al. *supra* note 4.

[44] *Id.*

[45] *See, e.g.*, Asha de Vos, *Opinion, The Problem of "Colonial Science,"* Sci. Am, July 1, 2020; Paris V. Stefanoudis et al., Turning the Tide of Parachute Science, 31 Current Biology Mag. R184–85 (2021). Aleke Stöfen-O'Brien et al., *Parachute Science through a Regional Lens: Marine Litter Research in the Caribbean Small Island Developing States and the Challenge of Extra-regional Research*, 174 Marine Pollution Bull. 113291 (2021).

positions adopted by delegations from developing countries at the intergovernmental conference on a new biodiversity treaty, especially with respect to the provisions on benefit sharing and capacity-building.[46] They are aware that the prohibitive costs associated with research on the ocean genome means that the opportunities to commercialize scientific findings rests almost exclusively in the hands of public and private laboratories in developed countries.[47] The global disparities in technology is also reflected in corporate holdings and ownership of gene patents associated with the deep-sea and hydrothermal vent systems, which are almost exclusively the preserve of corporate entities in the Global North.[48]

Indeed, a brief perusal of the number and nationality of vessels in the global fleet of research ships and vessels of opportunity that are capable of undertaking deep ocean science tells its own story,[49] with the majority of vessels flagged and operated by public and private entities in developed countries.[50] In addition, China has major ocean science capability and a large fleet of research vessels that deploy across the entire Indo-Pacific ocean region and as far afield as the Arctic Ocean.[51] Only a handful of developing countries, namely Brazil, Chile, Argentina, India, Iran, Turkey, Morocco and South Africa, have research vessels that can undertake prolonged research cruises on the high seas. The fifty-eight countries that constitute small island developing states have almost no research ship capacity beyond inshore vessels with limited range and equipment.[52] Apart from South Africa, African countries bordering the Western Indian Ocean have little capacity in molecular biotechnology and few opportunities to participate in transnational marine scientific research

[46] *See* discussion in sections 10 and 11, as well as notes 106 and 191, *infra*.
[47] *Id.*
[48] Robert Blasiak, Jean-Baptiste Jouffray, Colette C. Wabnitz, Emma Sundström and Henrik Österblom, *Corporate Control and Global Governance of Marine Genetic Resources*, 4 Sci. Advances (2018).
[49] UNESCO, Global Ocean Science Report 2020: Charting Capacity for Ocean Sustainability 110–12 (2020).
[50] *Id.* The United States leads the field in research ship resources with 441 vessels, followed by Japan (50), Sweden (42), Canada (40), the Republic of Korea (26), the UK (26) and Germany (25).
[51] Haili Wang, Marine Operations, Xiamen University, Address at the at the International Research Ship Operators' Meeting: Recent New Builds in China and the Operation of RV *Tan Kah Kee* (Oct. 8, 2019).
[52] UNESCO, *supra* note 49, at 112.

projects.[53] As a result, one expert report concluded that the "costs of research and technologies remains prohibitively high; scientific capacity is low; and there are significant gaps in taxonomic and ecological knowledge."[54] Efforts are made by public and private science bodies to provide participation and training opportunities to scientists from developing countries in scientific work programs at sea under bilateral science projects and other arrangements, as well as under the auspices of programs administered by international bodies such as the International Seabed Authority.[55] Overall, however, the North–South disparities in infrastructure and technical capabilities in marine scientific research are extensive and further compounded by significant shortcomings in the provisions on marine scientific research and technology transfer in UNCLOS, as will be seen next.

3.4 Unfinished Business and Inherent Biases

Although science and modern technologies are vital catalysts for the implementation and development of the law of the sea, the architects of UNCLOS left a range of significant issues open to interpretation and devoid of substance with respect to the scientific, educational and technical needs of developing countries.[56] In this regard, four general points can be made about UNCLOS that appear to tilt the regulatory balance in favor of the interests of the holders of infrastructure and technology in conducting research on marine genetic resources of areas beyond national jurisdiction.

First, UNCLOS provides a solid legal basis for all states and competent international organizations to conduct research as a high seas freedom subject to the rights and duties of other states.[57] Accordingly, the deployment of technologies for marine genetic research in international waters must comply with the general obligations on marine scientific research set down by UNCLOS.[58] Although clearly drafted in treaty language,

[53] Rachel Wynberg, *Marine Genetic Resources and Bioprospecting in the Western Indian Ocean*. Regional State of the Coast Report 407, 412 (José Paula ed., 2015).
[54] Id., at 414.
[55] Biliana Cicin-Sain et al., Policy Brief on Capacity Development as a Key Aspect of a New International Agreement on Marine Biodiversity Beyond National Jurisdiction 17–21 (2018).
[56] Bartenstein & Hamamoto, *supra* note 18, at 1605–761.
[57] UNCLOS, *supra* note 8, arts. 87(1)(f), 238.
[58] *Id.*, art. 258.

these provisions are largely declarative in ambit and place few constraints on the holders of technology, apart from the requirement that the deployment must be for peaceful purposes, undertaken with appropriate scientific methods, not unjustifiably interfere with other legitimate uses of the sea, and comply with other regulations such as the rules adopted for the protection and preservation of the marine environment.[59] The Convention provides scope for international organizations to regulate the use of technologies for environmental and other purposes but this in practice has left many matters unresolved about the conduct of science by the holders of new and emerging technologies. As a result, tensions arise when states and international organizations seek to regulate new research activities. For instance, UNCLOS provided little in detail regarding the practical matters and ethical considerations that need to be overcome in the international regulation of emerging technologies, as became evident in regulatory efforts by the International Maritime Organization (IMO) to legislate environmental technologies that manipulate ocean processes in order to mitigate human induced climate change.[60] Another example on the horizon with the advent of new molecular tools relates to the use of Clustered Regularly Interspaced Short Palindromic Repeats (Crispr) technology for marine genetic research, where the scientific risks are considerable but not directly addressed by UNCLOS or related law of the sea instruments.[61]

Second, a relatively longstanding conundrum in the law of the sea is that UNCLOS does not define the meaning of the term marine scientific research.[62] Nevertheless, UNCLOS provides for the deployment and use of "scientific research installation" and "equipment" for the conduct of scientific research in the marine environment,[63] as well as setting forth

[59] *Id.*, art. 248.

[60] Karen N. Scott, *Not an Intractable Challenge: Geoengineering MSR in ABNJ*. Marine Biodiversity Beyond National Jurisdiction 189–210 (Myron H. Nordquist & Ronán Long eds., 2011); *see also* Ronán Long, *A European Law Perspective: Science, Technology, and New Challenges to Ocean Law*. Science, Technology, and New Challenges to Ocean Law 63, 78 (Harry N. Scheiber, James Kraska & Moon-Sang Kwon eds., 2015).

[61] *See* discussion *infra* on the institutional arrangements and a clearing-house mechanism in the draft text.

[62] *See, e.g.*, Ronán Long, *Regulating Marine Scientific Research in the European Union: It Takes More Than Two to Tango*. The Law of The Sea Convention: U.S. Accession and Globalisation 428, 435, 440 (Myron H. Nordquist et al. eds., 2012); J. Ashley Roach & Robert W. Smith, Excessive Maritime Claims 414 (3d ed. 2012).

[63] UNCLOS, *supra* note 8, art. 258.

rules on their legal status, safety zones, noninterference with shipping routes, identification and warning signals.[64] In the context of legislating access and the sharing of benefits derived from marine genetic resources, UNCLOS offers little in the way of regulatory guidance on the use of installations and equipment in specialist fields of inquiry such as marine biotechnology or the deployment of scientific tools to undertake marine genetic research.[65] Indeed, other than the research vessel itself, the two terms "scientific research installation" and "equipment" as used in UNCLOS appear to cover all technologies and devices deployable in the ocean for genetic investigations in the marine environment.[66] This latitude is exacerbated by the absence of clarity in the rules that apply to the deployment of devices that operate autonomously without the support of a research vessel.[67] As alluded to previously, the regulatory gaps in the law of the sea became apparent with respect to the deployment of International Oceanographic Commission (IOC)–UN Educational, Scientific and Cultural Organization (UNESCO) Argo floats within and beyond national jurisdiction, which opened its own Pandora's box of challenges regarding the practical implementation of a transnational scientific program as part of the Global Ocean Observing System and the Global Climate Observing System.[68] Likewise, the law is unsettled regarding the liability rules that apply to environmental damage caused by the deployment of new technologies for genetic research in areas beyond national jurisdiction.[69] There is however considerable scope to resolve this issue at the biodiversity treaty negotiations, discussed later, should the plenipotentiaries choose to do so.[70]

Third, UNCLOS regulates the use and deployment of technologies for marine scientific research according to the jurisdictional framework that applies to maritime space. Again, there appears to be a strong bias in favor of technology holders in so far as all states are free to deploy technologies for marine scientific research purposes in areas beyond

[64] Id., arts. 259–62.
[65] Bartenstein & Hamamoto, *supra* note 18, at 1733–35.
[66] *Id.*, at 1734.
[67] Robert Veal, Michael Tsimplis & Andrew Serdy, *The Legal Status and Operation of Unmanned Maritime Vehicles*, 50 Ocean Dev. & Int'l L. 23–48 (2020).
[68] Mayer & Roach, *supra* note 37, at 149–66.
[69] Ronán Long, *Restoring Marine Environmental Damage: Can the* Costa Rica v Nicaragua *Compensation Case Influence the BBNJ Negotiations?,* 28 Rev. Eur. Compar. & Int'l Env't L. 244–57 (2019).
[70] *Id.*, at 254–56.

national jurisdiction, even though this freedom is qualified by UNCLOS. Thus, for example, in relation to the International Seabed Area, the technologies must be deployed exclusively for peaceful purposes and for the benefit of humankind as a whole, as well as in conformity with Part XI of UNCLOS, the 1994 Implementation Agreement and the seabed mining code as promulgated by the International Seabed Authority.[71] Particularly problematic from a law of the sea perspective is that UNCLOS does not provide a comprehensive regulatory framework to ensure the conservation and sustainable use of biodiversity beyond national jurisdiction including its genetic components, an oversight that provides the raison d'être underpinning the negotiation of a new international agreement to address this and other lacunae in the law of the sea.[72] As a consequence, the holders of technology are free to sample biodiversity for genetic properties on the high seas, as well as in the subjacent water column beyond the 200 nautical mile (M) exclusive economic zone (EEZ) limits and above the seafloor and subsoil of the continental margin of the coastal state without its consent.[73] As will be seen, the freedom to sample biodiversity has given rise to a vexed and central question in the biodiversity treaty-making process at the UN, which is how to share the benefits derived from research on marine genetic resources.[74] Some of the technologies discussed in this volume are essential to making an accurate determination of the precise geographical location of research activities on biodiversity and to ensuring that they are conducted without prejudice to the sovereign rights of the coastal state.[75] This determination is not always clear-cut and in practice

[71] UNCLOS, *supra* note 8, arts. 143, 147.

[72] Considerable efforts have nonetheless been made at the intergovernmental conference to ensure that the draft Marine Biodiversity of Areas beyond National Jurisdiction (BBNJ) Agreement is consistent with UNCLOS and does not to undermine relevant legal instruments and frameworks and relevant global, regional and sectoral bodies, *see* Roach, *supra* note 16, at 26–29.

[73] This is a contentious issue in relation to the agreement and is discussed further in the section on monitoring and benefit sharing, as well as in relation to the sedentary species of the continental shelf, *infra*. *See also* UNCLOS, *supra* note 8, art. 246(6).

[74] Marcel Jaspars & Abbe E. L. Brown, *Benefit Sharing: Combining Intellectual Property, Trade Secrets, Science and an Ecosystem-Focused Approach*. Marine Biodiversity Beyond National Jurisdiction 97–130 (Myron H. Nordquist & Ronán Long, eds., 2021).

[75] Clive Schofield & Joanna Mossop, *Biodiversity beyond National Jurisdiction and the Limits of the Commons: Spatial and Functional Complexities*. Marine Biodiversity Beyond National Jurisdiction 285, 285–305 (Myron H. Nordquist & Ronán Long, eds., 2021).

may often be very difficult to monitor in deep-water ecosystems such as cold-water corals that straddle the jurisdictional divide between the legal regimes that apply to the seabed and water column under UNCLOS as it pertains to continental margin.[76] The latter difficulty is especially true for small island developing states and least-developed countries that do not have access to the relevant technologies in most instances, thus curtailing their capacity to implement UNCLOS and to avail of their rights and discharge their duties in ocean development.

Fourth, UNCLOS falls well short on the delivery of one its primary objectives, which is to "contribute to the realization of a just and equitable international economic order which takes into account the interests and needs of mankind as a whole and, in particular, the special interests and needs of developing countries, whether coastal or landlocked."[77] The obligations to provide technical assistance to developing states parties to realize this objective are grouped in four sets of provisions in UNCLOS concerning: seabed mining;[78] the protection and preservation of the marine environment;[79] marine scientific research;[80] and the development and transfer of marine technology.[81] Apart from the obligations pertaining to seabed mining,[82] UNCLOS is silent on the resources to be applied to the tasks of capacity development and technical training and this shortcoming works to the detriment of developing states, particularly in the technology and infrastructure intensive fields of marine biodiscovery.[83] This weakness is compounded further by the absence of any legally binding obligation to transfer marine technology

[76] Ronan Joseph Long & Anthony J. Grehan, *Marine Habitat Protection in a Coastal Member State of the European Union: The Case of Deep-Water Coral Conservation in Ireland*, 17 Int'l J. Marine & Coastal L. 235, 243(2002).

[77] UNCLOS, *supra* note 8, preamble.

[78] *Id.*, arts. 144, 274.

[79] *Id.*, arts. 202, 203.

[80] *Id.*, art. 266.

[81] *Id.*, art. 266.

[82] *Id.*, art. 15, annex III; G. A. Res. 48/263, Seabed Mining Agreement, art. 5 (Aug. 17, 1994); U.N. Doc. ISBA/16/C/WP.2, International Seabed Authority Council, Draft Regulations on Prospecting and Exploration of Cobalt-Rich Ferromanganese Crusts in the Area, regulations 3.i(a), 29 (2012); Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion of Feb. 1, 2011, ITLOS Rep 10, ¶ 163.

[83] *See, e.g.*, Cicin-Sain et al., *supra* note 55; U.N. Doc. A/65/69, UN Secretary-General, Oceans and the Law of the Sea (Mar. 29, 2010), especially conclusions ¶ 323–25 at 88; *see also* discussion of new institutional setting and clearing-house mechanism *infra*.

to developing countries.[84] The hortatory nature of such obligations are particularly evident in Part XIV of UNCLOS, which sets out the ways and means for international cooperation and coordination in the voluntary transfer of technology on an equitable basis and the protection of the legitimate interests of technology holders, as well as on the establishment of national and regional marine scientific and technological research centers.[85] The Convention places emphasis on the voluntary transfer of technologies that can be used for deep seabed mining activities and the conservation of marine living resources,[86] along with the protection and preservation of the marine environment.[87] The inherent weakness of these provisions were well understood by the delegations representing developing countries attending the Third Law of the Sea Conference (1973–82) and their concerns were reflected in and informed the Resolution on Development of National Marine Science, Technology and Ocean Service Infrastructures, appended to the Final Act of the Conference.[88] The latter foresees a growing technological gap between developed and developing countries,[89] thereby undermining the effectiveness of UNCLOS.[90] For this reason, it urges industrialized countries to assist developing countries with respect to their scientific, technological and infrastructural needs.[91] Such assistance was further undermined by the 1994 Implementation Agreement, which effectively eliminated mandatory technology transfer in relation to seabed mining, as well as struck out the definition of technology in UNCLOS for this purpose.[92]

Despite these shortcomings, there have been a number of intergovernmental efforts since the coming into force of UNCLOS to operationalize

[84] The United States is a longstanding and well-versed opponent to the transfer of technology provisions in Parts XIII and XIV of the Law of the Seas Convention. *See* Jon M. van Dyke & David L. Teichmann, *Transfer of Seabed Mining Technology: A Stumbling Block to U.S. Ratification of the Law of the Sea Convention?*, 13 Ocean Dev. & Int'l L. 427–55 (2009).

[85] UNCLOS, *supra* note 8, arts. 266–77.

[86] *Id.*, arts. 62(4)(j), 144(1).

[87] *Id.*, art. 202.

[88] Annex VI of the Final Act of UNCLOS III was firmly based on the contribution that UNCLOS was to make to the realization of a just and equitable international economic order through the establishment of a new régime for the seas and oceans, and the study, protection and preservation of the marine environment.

[89] Annex VI, Final Act, UNCLOS III.

[90] *Id.*, ¶ 3.

[91] *Id.*

[92] Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of Dec. 10, 1982, Sec. 5(2), July 28, 1994, 1836 U.N.T.S. 41.

the technology transfer provisions therein, especially in response to the requirement to develop "guidelines, criteria and standards for the transfer of marine technology on a bilateral basis or within the framework of international organizations and other fora."[93] Most notably, IOC–UNESCO adopted the Criteria and Guidelines for the Transfer of Marine Technology in 2003, which applies to "instruments, equipment, vessels, processes and methodologies required to produce and use knowledge to improve the study and understanding of the nature and resources of the ocean and coastal areas."[94] The Guidelines are predicated on the transfer of technology free of charge or at a reduced rate with a view to stimulating social and economic growth of developing states.[95] They also provide for the establishment of a clearing-house mechanism to coordinate the transfer of technology.[96] In practice, however, little has happened in the intervening period of twenty years since the adoption of the Guidelines and few requests have been received from developing countries in the absence of such a mechanism, a matter to which we will return.[97]

In summary, there are considerable shortcomings in UNCLOS and related instruments that lead directly and indirectly to the preferential treatment of the holders of ocean science infrastructure and related technologies in the practical aspects of implementing law of the sea obligations in relation to marine scientific research and technology transfer. More generally, the cumulative effect of these shortcomings is that they do little of substance to assist developing countries in implementing their law of the sea obligations or indeed in establishing a just

[93] UNCLOS, *supra* note 8, art. 271.

[94] International Oceanographic Commission Res. XXII-12, § A, ¶ 2 (July 2, 2003) (hereinafter IOC Guidelines); *see also* Ariel W. González, *Cutting a Gordian Knot? Towards a Practical and Realistic Scheme for the Transfer of Marine Technology*. Law, Science and Ocean Management 345–80 (Myron Nordquist et al. eds., 2007); U.N. Doc. A/66/70/Add.2, UN Secretary-General, Oceans and the Law of the Sea (Aug. 29, 2011); UNESCO & Intergovernmental Oceanographic Commission, Transfer of Marine Technology: Knowledge Sharing and Capacity Development for Sustainable Ocean and Coastal Management, U.N. Doc. IOC/BRO/2014/3 (2015); Intergovernmental Oceanographic Commission, Non-Paper on Existing and Potential Contributions of IOC-UNESCO to the BBNJ Process 9–17 (2020).

[95] IOC Guidelines, *supra* note 94, § A, ¶ 2.

[96] *Id.*, § C, ¶ 1.

[97] See discussion of new institutional setting and clearing-house mechanism *infra*; *see also* Stephen Minas, *Marine Technology Transfer under a BBNJ Treaty: A Case for Transnational Network Cooperation*, 112 Am. J. Int'l L. Unbound 144–49 (2018).

and equitable international economic order in relation to the ocean.[98] As noted in one economic assessment, UNCLOS "responds in a confusing and occasionally unwise fashion to poor nations' legitimate interests in equitable treatment. In some respects, it completely ignores issues of fairness."[99] The absence of fairness appears to be most acute in relation to developing countries deriving benefits under UNCLOS from biological discoveries, technological innovation, deep ocean exploration and advances in biotechnology research on marine genetic resources of areas beyond national jurisdiction.[100] However, as will be seen next, there has been considerable efforts to resolve these shortcomings through protracted intergovernmental law of the sea negotiation processes that have been underway under the auspices of the UN for two decades and more.

3.5 Slow Road to Damascus via the UN

The rapid pace of technology developments in ocean science can be contrasted with the slow pedantic nature of international law-making to protect the marine environment. In this respect, international efforts to plug the regulatory gaps relating to marine biodiversity have been undertaken under various processes, which can be traced back to the deliberations of the UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea in 2003 and 2004.[101] The subsequent UN General Assembly decision to establish an 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, which convened on nine occasions between 2006 and 2015,

[98] See *supra* note 88.

[99] Eric Posner & Alan Sykes, *Economic Foundation of the Law of the Sea*, 104 Am. J. Int'l L. 569, 569 (2010).

[100] *See, e.g.*, Lyle Glowka, *The Deepest of Ironies: Genetic Resources, Marine Scientific Research, and the Area*, 12 Ocean Y.B. 154–78 (1996); Craig Allen, *Protecting the Oceanic Gardens of Eden: International Law Issues in Deep-Sea Vent Resource Conservation and Management*, 13 Geo. Int'l Env't L. Rev. 563, 563 (2001); Doris König, *Genetic Resources of the Deep Sea: How Can They Be Preserved?* International Law Today: New Challenges and the Need for Reform? 141, 148 (Doris König et al., eds., 2008).

[101] Kristina Gjerde, *Perspectives on a Developing Regime for Marine Biodiversity Conservation and Sustainable Use beyond National Jurisdiction*. Ocean Law Debates: The 50-Year Legacy and Emerging Issues for the Years Ahead 354–80 (Harry N. Schreiber, Nilufer Oral & Moon-Sang Kwon eds., 2018).

moved the subject forward in the contorted labyrinth of treaty-making processes at the UN. A major milestone was achieved in the latter process when the Ad hoc Working Group agreed in 2011 to focus the negotiations on a package of measures concerning: marine genetic resources, including questions on the sharing of benefits; measures such as area-based management tools, including marine protected areas; environmental impact assessments; and capacity-building and the transfer of marine technology.[102] Again at the behest of the UN General Assembly, a preparatory committee to prepare the treaty-making process met on four occasions between 2016 and 2018 and made recommendations on the elements for inclusion in a new treaty under UNCLOS, specifically focused on the conservation and sustainable use of biodiversity beyond national jurisdiction.[103] Thereafter, the recommendations of the preparatory committee were carried forward to an intergovernmental conference with the task of developing a legally binding instrument on the basis of the package of measures previously agreed in 2011.[104]

Throughout these processes, the discussion on the legal status afforded to marine genetic resources rekindled to a degree the great ideological debates and diplomatic tensions that permeated the Third UN Conference between the proponents of the freedom of the high seas and the common heritage of mankind, including the relationship between the latter and the benefit sharing arrangements that will apply under the new agreement.[105] Moreover, it was evident from the early days of the negotiations that disparities in infrastructure and technical capability influenced the positions adopted by developing countries on many of the main issues tabled for negotiation.[106] At the same time, new

[102] G. A. Res. 72/249, *supra* note 17, para. 2.

[103] Ronán Long & Mariamalia Rodriguez-Chaves, *Anatomy of a New International Instrument for Biodiversity Beyond National Jurisdiction: First Impressions of the Preparatory Process*, 6 Env't Liab. 213–29 (2015).

[104] G. A. Res. 72/249, *supra* note 17.

[105] *See, e.g.*, Dire Tladi, *The Common Heritage of Mankind in the Proposed Implementing Agreement*. Legal Order in the World's Ocean: UN Convention on the Law of the Sea 72–90 (Myron H. Nordquist, John Norton Moore & Ronán Long eds., 2018).

[106] *See, e.g.*, Rena Lee, President, Intergovernmental Conference on an International Legally Binding Instrument under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction, Address at the Closing of the Third Session (Sept. 13, 2019); International Institute for Sustainable Development (IISD), *Summary of the Third Session of the Intergovernmental Conference (IGC) on the Conservation and Sustainable Use of Marine Biodiversity of Areas beyond National Jurisdiction: 19–30*

technologies may be part of the solution to resolve some of the most contentious matters that need to be resolved, including: the sharing of benefits from marine genetic resources; the building of scientific and technical capacity of developing countries; and the development and transfer of marine technology.[107] Much of the detail on how this is to be achieved remains unsettled prior to the fourth and possibly a further session of the intergovernmental conference.[108] Nonetheless, at the time of writing, the lion's share of the deliberations at the UN appear to be complete and the broad contours of what is possible in terms of options is already sketched out in considerable detail in the draft text for the purpose of taking the negotiations forward to a successful conclusion. Accordingly, at the time of writing, it is easy to surmise that the outcome of the negotiations may well mark a new era in the regulation of marine technologies and a turning point in providing technical assistance to developing states. A number of facets of the draft text of the agreement therefore calls for further comment.[109]

3.6 Questions of Terms and Objectives

The Convention and law of the sea instruments in general are in the main part silent on the meaning of marine science– and technology-related terms.[110] In contrast, several scientific and technical terms are the subject of negotiation at the intergovernmental conference.[111] Most notably, one of the options canvassed by the draft text of the agreement relates to the meaning of "marine technology," which reads as follows:

August 2019, 25 Earth Negotiations Bull. (Sept. 2, 2019) (hereinafter IISD); *see also* Roach, *supra* note 16, at 25–89.

[107] *Id.*

[108] The fourth session is scheduled for March 7–18, 2022. The United Nations General Assembly may decide to convene an additional session thereafter if this is required to bring the process to a conclusion.

[109] The text referred to is the Revised Draft Text, *supra* note 19.

[110] For a definition of technology that no longer applies, see art. 5(8), Annex III, UNCLOS. In the law of the sea, undefined terms more generally remain particularly problematic *see, e.g.*, George Walker, Definitions for the Law of the Sea: Terms Not Defined by the 1982 Convention *passim* (2012); *see also* J. Ashley Roach & Robert W. Smith, Excessive Maritime Claims 486–500 (4th ed. 2020).

[111] *See* Revised Draft Text, *supra* note 19, art. 1; *see also* Siva Thambisetty, *Biodiversity beyond National Jurisdiction: (Intellectual) Property Heuristics*. Marine Biodiversity Beyond National Jurisdiction 131, 132–35 (Myron H. Nordquist & Ronán Long, eds., 2021).

> information and data, provided in a user-friendly format, on marine sciences and related marine operations and services; manuals, guidelines, criteria, standards, reference materials; sampling and methodology equipment; observation facilities and equipment (e.g., remote sensing equipment, buoys, tide gauges, shipboard and other means of ocean observation); equipment for in situ and laboratory observations, analysis and experimentation; computer and computer software, including models and modelling techniques; and expertise, knowledge, skills, technical, scientific and legal know-how and analytical methods related to marine scientific research and observation.[112]

There is also a proposal to define the transfer of marine technology to mean "the transfer of the instruments, equipment, vessels, processes and methodologies required to produce and use knowledge to improve the study and understanding of the nature and resources of the ocean."[113]

These two relatively open-ended definitions are informed by the scheme for the transfer of technology set out in the 2003 IOC–UNESCO Criteria and Guidelines on the Transfer of Marine Technology, discussed previously.[114] If adopted, these broad definitions have the potential to tip the scales toward serving the needs of developing states in so far as they will bring both physical and intangible assets within the scope of the capacity-building and technology transfer provisions of the agreement including information and computer software, as well as expertise and skills in technology, science and law. The definitions also appear wide enough to bring many if not all emerging technologies and nonmarine-related technologies within the scope of the substantive provisions on capacity-building and technology transfer set out in the agreement. Unsurprisingly perhaps, the wide scope and need for expansive definitions were questioned at the third session of the intergovernmental conference by developed countries including those represented by the European Union (EU) and its member states, Japan, the United States, the Republic of Korea, Canada, Australia and Switzerland.[115] In marked contrast and perhaps in recognition of the well-founded belief

[112] Revised Draft Text, *supra* note 19, art. 1(11). This is a more expansive definition than that found in art. 5(8), Annex III, UNCLOS, which states that technology "means the specialized equipment and technical know-how, including manuals, designs, operating instructions, training and technical advice and assistance, necessary to assemble, maintain and operate a viable system and the legal right to use these items for that purpose on a non-exclusive basis."

[113] Revised Draft Text, *supra* note 19, art. 1(14).

[114] *See* IOC Guidelines, *supra* note 94.

[115] *See* IISD, *supra* note 106, at 3–4.

that emerging technologies are primary drivers of sustainable economic growth, developing states including most especially Pacific Small Island Developing States supported strongly their inclusion in the draft text.[116]

In relation to the meaning of other terms that are closely related to the provisions on technology transfer, the draft text is notably reticent in several respects. For instance, it does not define the meaning of the term "capacity-building."[117] Instructively and perhaps indicative of the difficulties that need to be overcome, three options were canvassed at the first three sessions of the intergovernmental conference on how best to address this aspect of the agreement, namely: the inclusion of an indicative list of capacity-building activities in the agreement, or in an annex thereto; or mandating a future Conference of the Parties or a Scientific and Technical Body to develop such a list in due course.[118]

Another remarkable aspect of the deliberations is that there has been a dearth of discussion about the meaning of core terms such as "conservation" and "sustainable use,"[119] or to link such terms with the attainment of specific conservation or sustainable use targets on marine biodiversity.[120] This omission is surprising as the meanings of the aforementioned terms go to the very heart of the objectives of the new instrument and will have a major bearing on the material scope, as well as the rights and responsibilities of states parties. In the longer-term, there is a danger that the absence of clarity on the precise meaning of these terms will lead to a relatively shallow instrument in terms of

[116] Id., at 4.

[117] During the intersessional period after the third session of the intergovernmental conference, the core Latin American states proposed defining the term as "any activity intended to enable or improve academic, professional and technical training; the exchange of knowledge and skills; access to physical infrastructure; institutional strengthening; communication between relevant actors; the exchange of scientific information, technological development and innovation; and raising awareness through public information and basic knowledge about marine biodiversity in areas outside of national jurisdiction." This proposed definition draws from the concepts included in the IOC's capacity development strategy. *See* UNESCO & Intergovernmental Oceanographic Commission, IOC Capacity Development Strategy: 2015–2021 15–18 (2016).

[118] Revised Draft Text, *supra* note 19, art. 46; *see also* Lee, *supra* note 106, at 17–21.

[119] Roach, *supra* note 16, *passim*. On the many unresolved issues on how conservation and sustainable use objectives are to be realized going into the fourth session of the IGC, *see also* Fran Humphries & Harriet Harden-Davies, *Practical Policy Solutions for the Final Stage of BBNJ Treaty Negotiations*, 22 Marine Pol'y 103, 910, 1–7 (2020).

[120] *See, e.g.*, Paris Agreement to the United Nations Framework Convention on Climate Change, art. 2(a), Dec. 12, 2015, 27 U.N.T.S. 7 (hereinafter Paris Agreement); *see also* discussion on technology mechanism, *infra*.

substance.[121] In order to rectify this shortcoming, it is still open to the plenipotentiaries at the final session of the conference to flesh-out the meaning of these terms by embedding specific conservation targets in the preamble or operative parts of the agreement. With this in mind, they could for instance set down a minimum threshold of spatial coverage of the ocean in relation to the designation of marine protected areas and the application of area-based management tools, such as a 30 percent target of marine protected areas by 2030.[122] Apart from adding substance to the meaning of the term conservation under the agreement, an added advantage of doing so is that the attainment and implementation of spatial coverage targets are easily monitored using remote-sensing technologies such as the systems described elsewhere in this book.

Perhaps wisely, there appeared to be little appetite throughout the negotiations to define technical terms pertaining to genetic research such as "biotechnology," "derivative" or "digital sequence information."[123] Likewise, it is doubtful that the agreement when adopted will provide a definition of marine genetic research or indeed marine scientific research.[124] The latter lacuna is unlikely to compromise the effectiveness

[121] This is a relatively common weakness in international treaties. *See* Andrew T. Guzman, *The Design of International Agreements*, 16 Eur. J. Int'l L. 579, 602 (2005).

[122] There have been a number of political initiatives including the démarche taken by the UK and forty-one other countries to designate 30 percent of the ocean as marine protected areas by 2030, as one of the goals for the post 2020 biodiversity framework under the Convention on Biological Diversity. *See* U.N. Doc. CBD/WG2020/2/4, Open-Ended Working Group on the Post-2020 Global Biodiversity Framework, Report of the Open-Ended Working Group on the Post-2020 Global Biodiversity Framework on Its Second Meeting, at 11–13 (2020); U.N. Doc. CBD/WG2020/REC/2/1, Open-Ended Working Group on the Post-2020 Global Biodiversity Framework, Recommendation Adopted by the Open-Ended Working Group on the Post-2020 Global Biodiversity Framework, at 10–12 (2020).

[123] There is little international consensus on what many of the technical terms mean *see e.g.*, U.N. Doc. CBD/DSI/AHTEG/2020/1/3, Ad hoc Technical Expert Group on Digital Sequence Information on Genetic Resources, Digital Sequence Information on Genetic Resources: Concept, Scope and Current Use, at 2 (2020); *see also* Charles Lawson & Michelle Rourke, *Digital Sequence Information as a Marine Genetic Resource Under the Proposed UNCLOS Legally Binding Instrument*, 120 Marine Pol'y 103878 (2020). On the importance of digital sequence information and new technologies and the implications of the agreement, see Rogers et al., *supra* note 4.

[124] There has been some discussion of the meaning of marine scientific research in the context of access or activities in relation to marine genetic resources, see statement of the president at the closing of the third session and the oral reports of the facilitators of the informal working groups to the plenary on August 30, 2019. *See* Lee, *supra* note 106, at 6, 23; *see also* Roach, *supra* note 16, at 33.

of the agreement, particularly when one considers that the International Court of Justice did not find it necessary to define scientific research in order to render its judgement in the Antarctic Whaling case.[125]

Overall, the approach of the negotiators and their reluctance to insert definitions of technical terms into the text appears prudent. Similar to other law of the sea treaties, the agreement cannot be expected to define technical standards or to prescribe in detail the regulatory requirements that will apply to new technologies. Indeed, such a task would be almost impossible, and, in all likelihood, such terms run the risk of becoming outdated rather quickly. Nonetheless, the agreement needs to be responsive to the dynamic nature of technological innovation in marine science as well as to the adoption of complementary instruments of binding character by other international organizations such as the IMO. Instructively in this regard, the parent Convention to the agreement uses a variety of terms and expressions to incorporate generally accepted international rules, standards, regulations or procedures into its provisions and states parties are obliged to implement and conform to such requirements, whether or not they are party to the legal instrument establishing them.[126] In some instances, UNCLOS uses peremptory language to indicate the standard of national laws to enforce international minimum requirements in so far as they must have "at least the same effect as," "no less effective than" or "taking into account rules and standards" established by competent international organizations.[127]

[125] Whaling in the Antarctic (Austl. v. Japan), Judgement, 2014 I.C.J. 226, ¶ 86 (Mar. 31).

[126] UNCLOS, supra note 8, art. 211(2). There are several different formulations of these requirements in the provisions in the Convention on the international rules and national legislation to prevent, reduce and control pollution of the marine environment, *see*, arts. 207(1), 209(2), 210(6), 212(1), 213, 214, 216(1) and 222; on the duties of flag states on the high seas, arts. 94(3)(4) and (5); on the conservation and management of the living resources of the high seas, art. 119(1)(a). Also, art. 10(c), Fish Stocks Agreement. The instruments corresponding to "generally accepted international rules and standards" are set out in IMO Circ. Ltr. No. 2456, Implication of UNCLOS for the Organization, Annex II (17 February 2003). For commentary on rules of reference, see, *inter alia*: United Nations, Obligations of States Parties under the United Nations Convention on the Law of the Sea and Complementary Instruments (2004);

James Harrison, Saving the Oceans Through Law 176–77, 214–17, 282 (2017). On the role of other instruments in developing the law of the sea, *see*

Catherine Redgwell, *Mind the Gap in the GAIRS: The Role of Other Instruments*. Convention Regime Implementation in the Offshore Energy Sector 600, 617 (Nigel Banks & Seline Trevisanut eds., 2015).

[127] In relation to the need to "take into account" rules and standards established by competent international organizations on the markings of scientific and research

One can therefore argue that there is a compelling case for the inclusion of a clause in the draft text that requires states parties to comply with "generally accepted rules and standards established or adopted by a competent international organization or diplomatic conference," in relation to future technologies that may be applied to attain the objectives of the agreement.[128] This legal drafting technique, commonly referred to as rules of reference is used by UNCLOS and international environmental treaties to maintain uniformity in the international regulation of offshore activities.[129] Such a reference will update obligations arising under the agreement with legislative developments in other sectors in response to technological, environmental and legal considerations that change over time. States parties will thus be required to conform to generally accepted international rules and standards as they apply to new and emerging technologies, thereby establishing a coordination and compliance mechanism linked to international minimum standards without having to amend the agreement. The inclusion of a clause on rules of reference will also facilitate an evolutionary approach to treaty interpretation by international dispute settlement bodies should the need arise in the future.[130] Crucially, the proposed approach will ensure that the agreement will be read and interpreted by international courts and tribunals in light of other international treaty regimes.

3.7 Future-Proofing the Agreement through a Process of Normative Accretion

The draft text sets out a number of normative principles and approaches to guide states parties in attaining conservation and sustainable use objectives of the agreement.[131] To a greater or lesser degree, all of the principles and approaches may well entail the application of scientific

installations to ensure safety at sea and air navigation, for example, see UNCLOS, supra note 8, art. 262.

[128] *See* Redgwell, *supra note* 126, at 40–61.

[129] *See, e.g.,* UNCLOS, *supra* note 8, arts. 210(6), 211(2); U.N. Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks Res. 164/37, art. 10(c) (Sept. 8, 1995); *see also* Harrison, *supra* note 126, at 176–77, 214–17, 282.

[130] A violation of the Convention on the International Regulations for Preventing Collisions at Sea, as "generally accepted international regulations" concerning measures necessary to ensure maritime safety, was deemed to constitute a violation of UNCLOS itself in the South China Sea Arbitration (Philippines v. China) (Award) (July 12, 2016) (PCA Case No 2013-19) ICGJ 495, para. 1803.

[131] Revised Draft Text, *supra* note 19, art. 5.

technologies, including: the principle of nonregression; the polluter-pays principle; the precautionary principle/approach; the ecosystem approach; an approach that builds ecosystem resilience to the adverse effects of climate change and ocean acidification and restores ecosystem integrity; and the use of best available science, as well as the traditional knowledge of indigenous peoples and local communities.[132] If adopted, these principles and approaches, as direct obligations under international law, will be particularly important in the context of interpreting, applying and developing the rights and responsibilities of future states parties. At an organizational level, they will also inform the work and decision-making of the proposed new institutions including the proposed Scientific and Technical Body, discussed further later on.[133]

In light of the dynamic and rapid pace of technological developments in ocean science, one can again make a strong argument in favor of setting down additional normative requirements that obliges states parties to use "best available techniques (technologies)" and "best environmental practices" in the attainment of the objectives of the agreement.[134] These normative constructs, as evaluative standards, feature in several global and regional treaties pertaining to the marine environment and are especially useful in instances where there is a need to adopt precautionary measures to mitigate environmental risk or in response to climate change.[135] As such, they establish one of the most formidable benchmarks governing the use of new and emerging technologies in the protection of the marine environment.[136] If included in the agreement, these normative requirements will create direct obligations that are dynamic and that will evolve over time in line with technology developments and scientific knowledge. Furthermore, their precise normative content and weight can be determined by

[132] *Id.*

[133] Revised Draft Text, *supra* note 19, art. 49.

[134] *See* Advisory Opinion of Feb. 1, 2011, *supra* note 20, ¶¶ 136–37; *see also* Harrison, *supra* note 126, at 78–80, 224–25.

[135] Convention for the Protection of the Marine Environment of the North-East Atlantic app. ¶¶ 2, 6, Sept. 22, 1992, 2354 U.N.T.S. 67; Convention on the Protection of the Marine Environment of the Baltic Sea Area, art. 6(21), Mar. 22, 1974, 1507 U.N.T.S. 166; *see also* Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ¶ 8, 1046 U.N.T.S. 120 (as amended).

[136] André Nollkaemper, *Legal Implications of the Obligation to Apply the Best Available Technology*, 26 Marine Pollution Bull. 236–38 (1993).

international courts and tribunals by means of their contentious and advisory jurisprudence.[137]

There are several broad formulations of obligations that states parties must ensure under the draft text including taking the necessary measures to ensure implementation and compliance with its provisions.[138] The agreement will thus create obligations of conduct and due diligence for states parties in taking reasonable measures to ensure that public and private operators under their jurisdiction or control adhere to the general obligation to conserve and sustainably use biodiversity. Instructively, international courts and tribunals have held that due diligence to protect and preserve the marine environment can be measured against the technical and scientific standards commonly accepted by states.[139] Moreover, in instances of dispute settlement concerning environmental harm, due diligence is a flexible and evolving standard of responsibility.[140] Due diligence also requires vigilance on the part of states parties in the enforcement and the exercise of administrative control over public and private operators,[141] including one must assume on the use of new technologies to undertake research on marine genetic resources of areas beyond national jurisdiction. The due diligence obligations that will flow from the agreement are a vital long-term consideration that will go to the effectiveness of the instrument in many ocean regions, where there are few means to ensure compliance with international obligations.

A noteworthy and related question concerns the level of developing country capability to deploy new technologies and if this is a factor that ought to be taken into consideration in determining the standard of due diligence that applies in the conservation and sustainable use of biodiversity. There is jurisprudential guidance to be derived on this issue from the International Tribunal for the Law of the Sea (ITLOS) Seabed Mining Opinion, which held that UNCLOS did not accord preferential treatment

[137] *See e.g.*, Pulp Mills on the River Uruguay (Arg. v. Uru.), Judgment, 2010 I.C.J. 14; Advisory Opinion of Feb. 1, 2011, supra note 20, ¶ 117; Request for Advisory Opinion submitted by the Sub-regional Fisheries Commission, Advisory Opinion of Apr. 2, 2015, ITLOS Rep. 4 (hereinafter Advisory Opinion of Apr. 2, 2015); South China Sea Arbitration (Philippines v. China), 33 R.I.A.A. 153, ¶¶ 743, 754, 944, 956, 959, 964, 971, 974 (Perm Ct. Arb. 2016).

[138] Revised Draft Text, *supra* note 19, art. 53(1).

[139] *Id.*; *see also* Duncan French & Tim Stephens, ILA Study Group on Due Diligence in International Law, First Report 29–30 (2014).

[140] Advisory Opinion of Feb. 1, 2011, *supra* note 20, ¶ 117.

[141] Advisory Opinion of Apr. 2, 2015, *supra* note 137, ¶ 131, *quoting* Pulp Mills on the River Uruguay, *supra* note 137, ¶ 197.

to sponsoring states that are developing states in the context of seabed mining activities.[142] With a view to establishing a level playing field in relation to international obligations, the ITLOS Seabed Disputes Chamber advised that the responsibilities and liability of the sponsoring state apply equally to all sponsoring states, whether developing or developed.[143] Accordingly, one can expect that disparities in accessing and deploying technologies will not detract disproportionately from the due diligence obligations that arise under the agreement. Furthermore, the due diligence obligations imposed on developing states parties are all the more reason to have adequate and meaningful capacity-building and technology transfer provisions embedded in the agreement.

3.8 Role of Technology in Monitoring and Benefit Sharing

Maritime boundary and ocean observation technologies are germane to monitoring and ensuring compliance with the geographical and material scope of the agreement.[144] In this context, the agreement will apply to areas beyond national jurisdiction, defined as the high seas and the area.[145] As seen elsewhere in this volume, the precise geographical limits of these maritime jurisdictional spaces can be determined using the seabed survey tools to survey the outer limits of the continental margin in accordance with UNCLOS,[146] as well as to measure and chart EEZ and territorial sea limits in other geographical regions such as the Mediterranean Sea, which remains predominantly high seas with some exceptions.[147] Similarly, video and positional data can be used to identify the precise geographical locus of genetic research activities in the supra-jacent waters of the continental margin beyond 200 M, as well as to ensure compliance with the sovereign rights and responsibilities of the coastal state over continental shelf resources, including with respect to living organisms belonging to sedentary species on the outer continental margin.[148]

Since the treaty-making negotiations commenced at the UN, it is evident that modern tracking technologies have the potential to play a

[142] Advisory Opinion of Feb. 1, 2011, *supra* note 20, ¶ 158.
[143] *Id.*
[144] Revised Draft Text, *supra* note 19, art. 4(2).
[145] *Id.*, art. 1(4).
[146] UNCLOS, *supra* note 8, art. 76.
[147] Revised Draft Text, *supra* note 19, art. 15(4).
[148] UNCLOS, *supra* note 8, art. 77(4); *see* Schofield & Mossop, *supra* note 75, at 297–99.

vital role in resolving many of the intractable issues associated with access and the use of marine genetic resources, especially with respect to the sharing of benefits under the agreement.[149] This aspect of the draft text has been the source of an intense debate, particularly about the realization of a just and equitable international economic order in relations to the law of the sea.[150] As mentioned previously, a principal challenge relates to balancing the principle of the common heritage of humankind and the freedom to undertake marine scientific research on the high seas.[151] Significantly, at the third session of the intergovernmental conference, the plenipotentiaries expressed divergent views about the establishment of a track-and-trace mechanism under the agreement for the purpose of benefit sharing, or establishing a role for a clearing-house mechanism (reviewed later), or indeed assigning a role to the Scientific and Technical Body to this end.[152] One of the most sensitive issues concerns the establishment of an obligatory notification system under the agreement in relation to the sampling and use of marine genetic resources.[153]

In line with their longstanding positions on such issues, the United States and the Russian Federation in particular have opposed the setting down of prescriptive requirements in relation to marine genetic resources, especially measures that will impede the freedom to conduct marine scientific research or indeed inhibit the generation of scientific data and information.[154] Moreover, diverging views were expressed by the plenipotentiaries on the types of activities subject to monitoring or whether it should be a voluntary or mandatory benefit sharing scheme that is established by the agreement.[155] Nonetheless, it is clearly apparent that modern technologies can be applied to ensure the orderly functioning of a fair and effective scheme. For instance, should the plenipotentiaries agree, information and communication technologies can be applied to facilitate the notification, permitting or licensing arrangements for access to marine genetic samples in situ, along with

[149] UNCLOS, *supra* note 8, arts. 7–13.
[150] *See* Jaspars & Brown, *supra* note 74, at 98–130; Thambisetty, *supra* note 111, at 134.
[151] This has been a fundamental challenge since the commencement of the negotiation processes and most particularly at the intergovernmental conference, see Tladi, *supra* note 105, at 72–90.
[152] Lee, *supra* note 106, at 5-22-7-22; IISD, *supra* note 106, at 6–8.
[153] *Id.*
[154] IISD, *supra* note 106, at 6–8.
[155] *See* Lee, *supra* note 106, at 5-22-7-22.

any requirements concerning the bioinformatic recording of marine genetic resource data, marker identity and gene sequence data.[156] Information technologies can also be used to protect the intellectual property entitlements of those involved in research and development of genetic resources.[157] There is also considerable scope to use blockchain and distributed ledgers to facilitate the sharing of information and the tracing of samples for benefit sharing purposes including in silico information and digital sequence data.[158]

All of these issues remain on the table going into the final session(s) of the conference but remain highly contentious. Most notably, throughout the treaty-making processes at the UN, doubts have been expressed about the merit the establishment of an expensive track-and-trace system, or the alternative of a more workable traceability system, primarily because of the relatively remote possibility of generating scientific discoveries with commercial potential.[159] Moreover, diverging views have been expressed about the substantial costs, the administrative burden and the informatic requirements, as well as feasibility and desirability of a proposed identification and notification system.[160] Technology solutions nonetheless appear to provide the key to balancing the respective interests and needs of states parties in sample collection and data access,[161] as well as in the establishment of transparent and effective modalities for the sharing and monitoring of benefits derived from marine genetic resources.[162] Although not yet agreed, this may include monitoring compliance with the rules and standards adopted under the auspices of the World Intellectual Property Organization and the World Trade Organization.[163] Irrespective of the outcome of the negotiations on these matters, one study points out that "developments in technologies for discovering, collecting, using, storing and sharing genetic resources and associated information will continue to push the boundaries" of

[156] *See* Jaspars & Brown, *supra* note 74, at 98–130; *see also* Fran Humphries, Muriel Rabone & Marcel Jaspars, Traceability Approaches for Marine Genetic Resources Under the Proposed Ocean (BBNJ) Treaty, 8 Frontiers in Marine Sci. (2021). Also see the discussion on unique identifier postcollection that ties the sample to a specific sampling event by Rogers et al., *supra* note 4.
[157] Revised Draft Text, *supra* note 19, art. 12.
[158] Jaspars & Brown, *supra* note 74, at 124.
[159] *See* Long & Rodriguez-Chaves, *supra* note 99, at 221–23.
[160] *See* Lee, *supra* note 106, at 7; IISD, *supra* note 106, at 8.
[161] Revised Draft Text, *supra* note 19, art. 10.
[162] *Id.*, arts. 11, 13.
[163] *Id.*, art. 12.

regulatory systems.[164] In anticipation of these developments, a fundamental and closely related aspect of the agreement concerns the structure and mandate of the institutions that sit at the heart of the proposed governance arrangements for biodiversity beyond national jurisdiction.

3.9 New Institutional Architecture

The draft text proposes the establishment of three institutions, namely: a Conference of the Parties, supported by a Scientific and Technical Body; and a Secretariat.[165]

The precise form and functions of the proposed institutions are contingent upon the outcome of the negotiations on the substantive parts of the agreement. By the end of the third session of the intergovernmental conference, the outline of the institutional architecture was nonetheless evident from the draft text and includes the establishment and role of a Conference of the Parties as the decision-making body responsible for the implementation of the agreement.[166] The work of the latter will be supported by a subsidiary Scientific and Technical Body with consultative, advisory, monitoring and reporting functions.[167] The name of this body alone is a good reason for optimism and its powers may extend to providing advice on a wide range of technical and other matters concerning the four substantive strands of the agreement.[168] Much of the detail has yet to be agreed but it may include: the identification of state-of-the-art technology and expertise related to the conservation and sustainable use of marine biological diversity;[169] the establishment of working relationships with bodies with similar mandates under other regulatory frameworks;[170] and with respect to the use of the knowledge of indigenous peoples and local communities.[171]

Notably, at the third session of the intergovernmental conference, there was a divergence of views expressed by the plenipotentiaries on the precise role of the Scientific and Technical Body. The Pacific Small Island Developing States have advocated that the body should be called

[164] *See* Humphries & Harden-Davies, *supra* note 119, at 13.
[165] Revised Draft Text, *supra* note 19, arts. 48–50.
[166] *Id.*, art. 48(4).
[167] *Id.*, art. 49(4).
[168] *Id.*
[169] *Id.*, art. 49(4)(g).
[170] *Id.*, art. 49(3).
[171] *See* Humphries & Harden-Davies, *supra* note 119, at 12.

the Scientific, Technology and Technical Body. In this regard, delegations from the Global South and small island developing states have called for the body to be granted an express technological mandate,[172] a proposal that attracted support from a range of developing countries including the EU, Switzerland and Japan.[173] The Russian Federation opposed this proposal, China and Iceland erred on the side of caution, and the United States advocating a role for nonparty states in the work of such a body.[174] There was no discussion of how, or if, the advisory body will have a mandate to make recommendations on ethical matters pertaining to the use of molecular engineering technologies in marine genetic research, such as the one mentioned previously concerning the use of Crispr-Cas for gene editing.[175] The delegation representing the Holy See was the only one to propose that research on marine genetic resources must not be undertaken "to the detriment of the human race for unethical or unapproved purposes as recognized by national or international law."[176] Remarkably, the whole issue of biosafety was not discussed in any detail at the first three sessions of the intergovernmental conference.[177] Overall, however, it is foreseeable that the new institutions will end up with significant powers and responsibilities to respond to technical innovation and new scientific discoveries, which may extend to the use of artificial intelligence to enable quicker and more advanced drug discovery.[178] They will thus be well placed to drive future regulatory developments with respect to new technologies. That may even include a role concerning the development and application of blue/green technologies to further understand and mitigate the impacts of environmental and climate change pressures on biodiversity,[179] a topic that we will return to later.[180]

[172] *See* Lee, *supra* note 106, at 22; IISD, *supra* note 106, at 17–18.
[173] IISD, *supra* note 106, at 17.
[174] *Id.*
[175] *See* BASIAK ET AL., *supra* note 13, at 43.
[176] IISD, *supra* note 106, at 7.
[177] *See* Humphries & Harden-Davies, *supra* note 119, at 12.
[178] *See* Ewen Callaway, "*It Will Change Everything*": DeepMind's AI Makes Gigantic Leap in Solving Protein Structures, NATURE, Nov. 30, 2020.
[179] For example, the project underway at Woods Hole Oceanographic Institute and Harvard University on fuelling ocean robots. *See* Evan Lubofsky, *Opinion: Microbial Methane: New Fuel for Ocean Robots?* OCEANUS, Mar. 8, 2021.
[180] *See* discussion in Section 3.10 on how the agreement can strike a more equitable balance in the law of the sea in relation to benefit sharing.

3.10 Empowering a One-Stop Information Sharing Platform

Part and parcel of the new institutional setting is the proposal to establish a clearing-house mechanism to facilitate the implementation of the agreement.[181] This proposal draws from similar mechanisms operating under other environmental and climate change treaties.[182] If it comes to fruition, the clearing-house mechanism will be a very welcome and long overdue development in the law of the sea that will draw together the scientific and technical dimensions, along with the engagement of public and private actors, to ensure the conservation and sustainable use of biodiversity.[183] At an operational level, the clearing-house mechanism will operate as a centralized web-based platform that facilitates the collective implementation of the agreement in a transparent and effective manner. As such, it will have to serve the interests and needs of states parties and the new institutions, as well as delivering on the many practical aspects of operationalizing the provisions on marine genetic resources, environmental impact assessment, area-based management tools, and capacity-building and the transfer of marine technology.[184] As seen previously, this may extend to the benefit sharing arrangements with respect to marine genetic resources, as well as information on access and the use of samples and data, intellectual property rights and patents, and scientific reports, along with opportunities for transnational collaboration in research and the development of new technologies.[185]

[181] Revised Draft Text, *supra* note 19, art. 51; *see also* Humphries & Harden-Davies, *supra* note 119, at 13.

[182] *See* Convention on Biological Diversity, June 5, 1992, 1760 U.N.T.S. 79; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Mar 22, 1989, 1673 U.N.T.S. 57 (as amended); Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Sept. 10, 1998, 2244 U.N.T.S. 337; Stockholm Convention on Persistent Organic Pollutants, May 22, 2001, 2256 U.N.T.S. 119; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES Capacity-Building Rolling Plan (2017); *see also* Harriet Harden-Davies, *Towards a Capacity-Building Toolkit for Marine Biodiversity beyond National Jurisdiction*. Marine Biodiversity Beyond National Jurisdiction 231–40 (Myron H. Nordquist & Ronán Long, eds., 2021); Minas, *supra* note 97, at 144–49; Marjo Vierros & Harriet Harden-Davies, *Capacity Building and Technology Transfer for Improving Governance of Marine Areas Both Beyond and Within National Jurisdiction*, 122 Marine Pol'y 104158 (2020).

[183] United Nations, The First Global Integrated Marine Assessment 923–33 (2016).

[184] Revised Draft Text, *supra* note 19, arts. 51(2)–(7).

[185] *Id.*, arts. 51(3)–(4).

One possibility is that the clearing-house mechanism will be operated by IOC–UNESCO, acting in concert with the International Seabed Authority, the IMO and other relevant organizations.[186] Again, the draft text draws from the 2003 IOC–UNESCO Criteria and Guidelines on the Transfer of Marine Technology, which, as mentioned earlier, provides for such a mechanism.[187] One of the core and essential functions of the latter is to provide scientists in developing countries with technical expertise and practical experience in technology transfer.[188] As such, the IOC–UNESCO clearing-house mechanism for the Latin America and Caribbean region, within the framework of the Caribbean Atlas project, may prove to be a useful prototype in so far as it shares information at a regional level on education and training opportunities, laboratories, institutions and research vessels, along with geospatial data and the findings of marine environmental research.[189] Furthermore, the IOC is developing a clearing-house mechanism in the form of the "Ocean InfoHub" aimed at integrating data, information and knowledge resources services, which can also be adapted to service the agreement.[190]

At the third session of the intergovernmental conference, delegations representing both developed and developing states stressed the importance of the proposed clearing-house mechanism as a "vital information exchange platform."[191] Moreover, the EU, CARICOM (Caribbean Community), Australia, the United States, the Russian Federation, China and Switzerland envisage that its future development could entail a role for the planned Conference of the Parties.[192] Another novel proposal is that the clearing-house mechanism will be used to share information on the legislative, administrative and policy measures to ensure compliance with the agreement.[193] Clearly, the precise modalities on how such a mechanism will operate in practice and facilitate the collecting of scientific information, as well as matching the capacity-building needs of developing states, will be closely linked to the mandate and work of the proposed Scientific and Technical Body, as well as the

[186] *Id.*, art. 51(6).
[187] *See* IOC Guidelines, *supra* note 94, at 11–12.
[188] *Id.*
[189] *See* UNESCO, *supra* note 49, at 116–17.
[190] *See* IOC Guidelines, *supra* note 94, at 15–16; *see also* Ocean InfoHub Project, https://oceaninfohub.org/ (last visited Mar. 24, 2021) (online).
[191] *See* Lee, *supra* note 106, at 19; IISD, *supra* note 106, at 22.
[192] IISD, *supra* note 106, at 18.
[193] *Id.*

financial resources underpinning the agreement. If resourced properly, the web-based platform has the potential to be a vital operational mechanism linked to the day-to-day implementation of the four substantive parts of the agreement, including the provisions on marine genetic resources.[194] Again, concerns have been raised at the third conference session about some quintessential technical matters, with Israel pointing out for instance that the mechanism should not undermine intellectual property rights, or compromise any information that would normally be subject to protection under the national law of states parties, a view supported by the United States and the Russian Federation.[195]

3.11 Match-making and Establishing a Technology Mechanism

In view of the dynamic nature of ocean science and related technologies, it is difficult to see how the prospective regulatory arrangements for the conservation and sustainable use of biodiversity will deliver on its goals unless it provides access to science, technology, expertise and other resources to states parties based on their specific needs. Therefore, one of the important options set out in the draft text relates to the match-making functions of the clearing mechanism with a view to aligning capacity-building needs with donor support from governmental, nongovernmental or private entities.[196]

The IOC–UNESCO anticipates that the Ocean InfoHub clearing-house mechanism under development can discharge important match-making functions under the agreement.[197] Fortuitously in this regard, there are several examples of successful technology mechanisms in other areas of international environmental law that lessons can be drawn from and applied under the agreement.[198] In view of their proven success, perhaps there is still scope at the final session of the intergovernmental

[194] *Id.*
[195] *Id.*
[196] Revised Draft Text, *supra* note 19, art. 51(4). On the importance of capacity-building and technology transfer under the agreement, see Harriet Harden-Davies & Paul Snelgrove, *Science Collaboration for Capacity Building: Advancing Technology Transfer through a Treaty for Biodiversity beyond National Jurisdiction*, 7 Frontiers in Marine Sci. (2020).
[197] *See* IOC Guidelines, *supra* note 94, at 15–16.
[198] They include the technology facilitation mechanism, the technology bank for least developed countries, and the technology transfer work of the IMO. *See* Minas, *supra* note 97, at 144–49.

conference to expand the mandates of the Scientific and Technical Body and the role of the clearing-house mechanism to align them more clearly with the establishment and development of a technology mechanism for the conservation and sustainable use of biodiversity.[199]

Should the negotiators seize the opportunity to do so, important lessons can be drawn from the technology mechanism established under the UN Framework Convention on Climate Change (UNFCCC), which supports the implementation of the Paris Agreement on technology-related matters, including the implementation of nationally determined contributions (NDCs).[200] This has proved to one of the great strengths of the climate change legal regime. Instructively, almost 50 percent of all developing countries specifically referred in their initial NDCs under the Paris Agreement to the importance of technological innovation or research and development for achieving their climate objectives.[201] The mechanism is guided by a technology framework adopted by parties to the Paris Agreement and consists of two bodies: the Technology Executive Committee and the Climate Technology Centre and Network, who are answerable to the Conference of the Parties.[202] The principles of inclusiveness, results-oriented approach, transformational

[199] U.N. Doc. FCCC/CP/2010/7/Add.1, U.N. Ad hoc Working Group on Long-Term Cooperative Action under the Convention on Climate Change Dec. 1/CP.16, Cancun Agreements, ¶¶ 113–29 (Mar. 15, 2001); *see also* Minas, *supra* note 97, at 144–49; Jaspars & Brown, *supra* note 74, at 128–29.

[200] Paris Agreement, *supra* note 120, art. 10; *see also* Stephen Minas, Matt Kenned & Karsten Krause, *Navigating a Just Transition through the Climate Emergency: What Role for Finance and Technology*, 31 Irish Stud. Int'l Affairs 131–52 (2020); Stephen Minas, *The Paris Agreement's Technology Framework and the Need for "Transformational Change,"* 4 Carbon & Climate L. Rev. 213, 241–54 (2020).

[201] Tech. Exec. Comm., U.N. Framework Convention on Climate Change, Technological Innovation for the Paris Agreement: Implementing Nationally Determined Contributions, National Adaptation Plans and Mid-century Strategies passim (2017). The UNFCCC Secretariat synthesis report on forty-eight new NDCs found that 88 percent contained information on technology. U.N. Doc. FCCC/PA/CMA/2021/2, The Nationally Determined Contributions under the Paris Agreement (Feb. 26, 2021), at 31.

[202] Article 10, paragraph 4, of the Paris Agreement provides a legal basis for the technology framework and the precise modalities were negotiated over the course of 2016–2018 and finalized at the 2018 Katowice Conference of the Parties. *See* Paris Agreement, *supra* note 120, art. 10, ¶ 4; U.N. Ad hoc Working Group on Long-Term Cooperative Action under the Convention on Climate Change Dec. 4/CP.7, annex, ¶ 14 (Nov. 10, 2001); U.N. Ad hoc Working Group on Long-Term Cooperative Action under the Convention on Climate Change Dec. 15/CMA.1, annex, ¶ 4 (Dec. 15, 2018) (hereinafter Ad hoc Working Group Dec. 15/CMA.1).

approach and transparency underpin the framework, which is focused on advancing the thematic areas of innovation, implementation, enabling environment and capacity-building, and collaboration and stakeholder engagement, as well as support.[203] The Technology Executive Committee engages in "iterative regulatory dialogue" on technology matters with the Conference of the Parties, who are empowered to further develop the climate change regulatory regime in light of this advice.[204] The Climate Technology Centre and Network are well-versed in providing practical technical assistance to developing countries and ensuring greater access to information and knowledge on new technologies through networks of stakeholders and external experts, including partner institutions.[205] The mandate of the Climate Technology Centre and Network is broad and extends to the identification of climate-friendly technologies for mitigation and adaptation, the preparation of project proposals, research and development, the enhancement of capacity to manage the technology cycle and the facilitation of financial support.[206]

Undoubtedly, considerable guidance on successful regulatory design can be derived from the functioning of the technology mechanism to support the implementation of the UN climate change regime. Again, many of the latter regulatory approaches are salutary and could inform the marine biodiversity negotiations at the final session of the intergovernmental conference with a view to strengthening the agreement so that states can benefit from new technologies. Most notably, since its inception, the sophisticated approach to collaboration and partnerships under the climate change regime has allowed the Climate Technology Centre and Network to marshal the support of more than 600 participants in 160 countries and to draw upon the expertise of public and private research and technology bodies, and finance and civil society organizations, along with nationally designated entities.[207] Despite the modest nature of the legal obligations, the scale of practical outcomes is nothing

[203] *Id.* U.N. Ad hoc Working Group Dec. 15/CMA.1, annex.
[204] *See* Minas, *supra* note 200, at 242.
[205] U.N. Doc. FCCC/SB/2020/4, Subsidiary Body for Sci. & Tech. Advice & Subsidiary Body for Implementation, U.N. Framework Convention on Climate Change, United Nations, Joint Annual Report of the Technology Executive Committee and the Climate Technology Centre and Network for 2020 5–27 (2021) (hereinafter JOINT ANNUAL REPORT).
[206] U.N. Doc. FCCC/CP/2011/9/Add.1, U.N. Conference of the Parties to the Framework Convention on Climate Change Dec. 2/CP.17, ¶ 135 (Dec. 11, 2011).
[207] *See* JOINT ANNUAL REPORT, *supra* note 205, at 22–23.

short of impressive over the first seven years of operation, with the mechanism facilitating technology development and transfer assistance to 102 countries and received 216 requests for technical assistance, including 15 multicountry requests.[208] Crucially, the mechanism operates very successfully without any mandatory transfer of intellectual property rights to developing countries.[209] Indeed, it ought to be noted that a technical assistance project may lead to a subsequent technology transfer agreement in which the technology transfer is entirely voluntary. Another formidable strength of the climate change technology framework is that it derives assistance from a broad suite of donors and financial sources including the Climate Change Financial Mechanism and private philanthropy, as well as in-kind contributions from participants.[210] Furthermore, apart from impacting upon the future development of the regulatory framework for climate change, it influences states, intergovernmental organizations, international financial institutions, the private sector and the research community. Somewhat ironically, the success of the climate change technology mechanism can be contrasted with the inertia of the approach adopted under the law of the sea previously, including the absence of resources and international commitment to operationalize the 2003 IOC–UNESCO Criteria and Guidelines on the Transfer of Marine Technology.[211]

Hence it is easy to conclude that the establishment of a similar technology mechanism for biodiversity beyond national jurisdiction will greatly facilitate the implementation of the agreement. As such, it can be used to regularly update the agreement and influence the work of the institutional bodies and states parties on the practical aspects of technology support, development and transfer in practice during all aspects of the technology cycle. In this context, it will mark a shift away from the binary choices between developed and developing countries and top-down approaches to technology transfer that are a feature of the law of the sea. Accordingly, a case can be made for the inclusion of a treaty basis for such a mechanism in the agreement and to embed it in the provisions

[208] *Id.*, at 15–16.

[209] Minas, *supra* note 97, at 144–49.

[210] In the period 2013–2020, it received donor support of US$74 million from various public and private sources, as well as financial and in-kind and pro bono contributions from partners and participants. The principal donor countries were the EU, Japan, Norway, Denmark, the United States, Canada, Switzerland, Germany, Korea, Italy, Sweden, Finland, Ireland and Spain. *See* Join Annual Report, *supra* note 205, at 24.

[211] *See* IOC Guidelines, *supra* note 94.

on the institutional bodies, clearing-house mechanism and financial resources.[212]

In the latter respect, the establishment of a sustainable funding stream for the agreement, including its capacity-building and technology transfer components, cannot be overemphasized and will ultimately have a major bearing on the success of the regulatory arrangements governing marine biodiversity of areas beyond national jurisdiction. In this regard, developing countries have argued that there is a requirement for ring-fence funding to support the work of the institutions and the clearing-house mechanism, as well as financial support for capacity-building and technology transfer. At the end of the third session of the intergovernmental conference, the draft text provides for both voluntary and mandatory funding options from a range of public and private sources to support the work of the institutions and also to assist developing states in the implementation of the agreement.[213] There was however strong divergence of views evident on this crucial element of the agreement, with developing countries calling for mandatory sources, which were opposed by developed countries, including the EU.[214] In designing and agreeing the financial resource provisions, it is again open to the plenipotentiaries to draw from successful approaches adopted under the Global Environment Facility, the Minamata Convention and the Convention on Biological Diversity, as well as the scheme that operates for seabed mining.[215] Ultimately, it is easy to anticipate that the financial architecture will define the success of the agreement and its ability to forge more equitable regulatory arrangements on this crucial aspect of the law of the sea. Interestingly, most of the decisions concerning the development of the technology transfer mechanism for climate change was achieved through decisions of the parties, rather than by a highly prescriptive treaty obligations, which as mentioned previously only provides overarching guidance on the matter.[216]

[212] Revised Draft Text, *supra* note 19, arts. 48–49, 51–52.

[213] See discussion UNCLOS, *supra* note 8, art. 52(2).

[214] *See* Lee, *supra* note 106, at 22–23; IISD, *supra* note 106, at 22.

[215] Minamata Convention on Mercury, Oct. 10, 2013, T.I.A.S. No. 17-816, 2256 U.N.T.S. 119; *see also* Ronán Long, *Beholding the Emerging Biodiversity Agreement through a Looking Glass: What Capacity-Building and Gender Equality Norms Should Be Found There?* Marine Biodiversity Beyond National Jurisdiction 241, 269–70 (Myron H. Nordquist & Ronán Long, eds., 2021).

[216] Daniel Bodansky, Jutta Brunné□, & Lavanya Rajamani, International Climate Change Law 140–41 (2017).

3.12 Can the Agreement Strike a More Equitable Balance in the Law of the Sea?

Advances in science, automation and technologies are continuously influencing ocean affairs. Yet the provisions in UNCLOS that promote transnational cooperation in marine scientific research and technology transfer were agreed forty years ago. They provide a strong conceptual basis for capacity development and technology transfer but do little else to support the implementation of UNCLOS.[217] With the benefit of hindsight, it is easy to see that the international community has promised much but has undertaken little beyond lightweight efforts to ensure greater access to infrastructure and technologies in order to meet the interests and needs of developing countries with respect to deep ocean biodiversity, or to strengthen engagement with public and private technology stakeholders and other networks.[218] In view of these shortcomings, the discussion in this chapter was premised upon two arguments. First, the special interests and needs of developed and developing countries are distinguishable on the basis that the latter do not have the infrastructure and technology to undertake scientific research on marine genetic resources in international waters. Following on from this, second, the final session(s) of the biodiversity negotiations represent a unique opportunity to redress the scientific and technological inequalities between developed and developing countries with a view to facilitating a more equitable balance of interests in the law of the sea.

The ultimate success of the treaty-making process at the UN will therefore be judged on how fine a balance it strikes in resolving the many issues that are still subject to negotiation. As seen, developing countries have been very active on the strands of the negotiations addressing marine genetic resources and benefit sharing, as well as the provisions on capacity-building and technology transfer. Furthermore, they have forged alliances with the EU, Monaco and other developed countries such as New Zealand with a view to advancing their common interests on

[217] Ronán Long, *Marine Science Capacity Building and Technology Transfer: Rights and Duties Go Hand in Hand Under the 1982 UNCLOS*. Law, Science and Ocean Management 297, 308 (Myron Nordquist et al. eds., 2007).

[218] See Cicin-Sain et al., *supra* note 55, *passim*. Also see the conclusion that regional networks are underdeveloped apart from Europe, Petro Tolochko & Alice Vadrot, *The Usual Suspects? Distribution of Collaboration Capital in Marine Biodiversity Research*, 124 Marine Pol'y 10431 (2021).

these issues.[219] Somewhat surprisingly, the anticipated ideological battle between developing and developed countries concerning the freedom of the high seas and the common heritage of mankind as they apply to marine genetic resources has not impeded the search for innovative treaty-based solutions at the intergovernmental conference. If anything, the deliberations have demonstrated that new technologies continue to inform the progressive development of international rules on the conservation and sustainable use of biological diversity. Furthermore, the examples cited in this chapter show how considerable diplomatic efforts are being made by all delegations to ensure that technological considerations underpin several aspects of the agreement, including the institutional arrangements. Technologies thus offer a route to the middle ground between the principles of freedom of the high seas and the common heritage of humankind, as well as a means to avoid encroaching on the sovereign rights and jurisdictional interests of coastal states in maritime spaces adjacent to areas beyond national jurisdiction.

Despite this progress, many questions remain open and at play as the multilateral treaty-making process draws to a close. Most notably, questions arise about how profound a role technology can play in providing an equitable framework for the exploitation of genetic resources under the new regulatory arrangements, or indeed can technology be applied to mitigate the existential risks associated with the loss of biodiversity in the absence of adopting binding conservation targets.[220] What is more, although many delegations have noted the importance of technology to the implementation of the agreement, it is not clear that they share a common vision on what technology measures should be set down therein or what matters ought to be left to future meetings of the Conference of the Parties to act upon. In reflecting on the answers to these questions, one should bear in mind that new technologies for marine genetic research and ocean observation will inevitably develop over time, especially in combination with advances in artificial intelligence, drones, submersibles, robotics for mapping, imaging and sampling, as well as for data acquisition and use. In parallel, the challenges encountered in

[219] Ronán Long & John Brincat, *Negotiating a New Marine Biodiversity Instrument: Reflections on the Preparatory Phase from the Perspective of the European Union*. Cooperation and Engagement in the Asia-Pacific Region 443–68 (Myron H. Nordquist, John Norton Moore & Ronán Long eds., 2019).

[220] *See* discussion *supra* on a question of terms.

managing activities in the marine environment will also change over time.

In order to meet these challenges and with a weather eye to future-proofing the agreement, the chapter argues that the plenipotentiaries attending the final session of the intergovernmental conference have the opportunity to make fundamental and very positive changes to the regulatory environment by amending the draft text in three respects. First, by inserting "rules of reference" provisions into the agreement in order to ensure that the technical standards applying to technologies used in the conservation and sustainable use of biodiversity shall be no less effective than "generally accepted international rules and standards."[221] Second, by setting down express requirements in the normative principles and approaches provisions regarding states parties use of "best available technologies or techniques" and "best environmental practices" to attain the objectives of the agreement.[222] Third, by codifying obligations of conduct and due diligence for states parties under the agreement, especially in relation to the adoption national rules and standards to ensure that public and private operators under their jurisdiction or control adhere to conservation and sustainable use objectives. As pointed out previously, these amendments will build into the agreement a process of normative accretion that is inherently evolutionary in ambit and capable of responding to environmental, technological and regulatory developments in the fullness of time.[223] The crucial point is that the agreement should not stand still in devising functional and reasonable solutions to meet the needs of both developing and developed countries in light of scientific and technological advancements.[224]

Looking to the future, it appears that the international community is at the cusp of a golden era for scientific investigation of the ocean with the advent of the UN Decade of Ocean Science for Sustainable Development (2021–30), which will see the rapid development of an ocean data-sharing mechanism through a global online open-access data-sharing platform and data clearing-house mechanism; the collection of new baseline data on living resources, as well as on the pressures and risks

[221] UNCLOS, *supra* note 8, art. 211(2).
[222] Revised Draft Text, *supra* note 21, art. 5.
[223] For similar arguments in relation to the process as it applies to the offshore energy sector, see Redgwell, *supra* note 126, at 40–61.
[224] Louis B. Sohn, *The Impact of Technological Changes on International Law*, 30 Wash. & Lee L. Rev. 18 (1973).

to the marine environment; and the enhanced transnational coordination of ocean observation efforts.[225] In parallel, there is a global ocean mapping campaign under the auspices of a private nonprofit organization based in Japan, the Nippon Foundation, which will provide a high-resolution map of the seabed.[226] When fully implemented, these non-regulatory approaches to ocean science will bring about transformational change in human knowledge of the ocean. They may also shift the focus of capacity development and technology transfer to the creation of viable business opportunities in partnership with developing countries to tackle the sustainability challenges such countries face. Indeed, one should not overstate the importance of law in promoting capacity development and technology transfer in so far as the OECD has pointed out in the context of fostering sustainable blue economic growth worldwide: "what is increasingly required, however, is also a better understanding of how knowledge markets and networks can facilitate access to the globalizing knowledge market, supporting knowledge flows and transfers of intellectual property through such institutions as technology transfer offices, business incubators and multi-sector service provision centers."[227] In light of the latter finding, the fourth point made in the previous discussion is that consideration should also be given by the plenipotentiaries attending the final session of the intergovernmental conference to expanding the mandates of the Scientific and Technical Body and the role of the clearing-house mechanism to align them more clearly with development of a technology mechanism, similar to the approach adopted under the climate change regime. Indeed, it is easy to conclude this chapter by pointing out that the future success of the agreement is largely contingent on the establishment of a sophisticated clearing-house mechanism and the financial resources that are committed to support its effective functioning in due course.

Taken all together, the proposed amendment to the draft agreement set out in this chapter presents a unique opportunity to reform an outdated, ineffective and unfair system of capacity-building in relation to marine scientific research and technology transfer under UNCLOS. Finally, it needs to be borne in mind that the global health emergency associated with the COVID-19 pandemic has demonstrated the extraordinary power of modern communication and information technologies.

[225] G. A. Res. 72/73, ¶ paras. 292–95 (Jan. 4, 2018).
[226] *See* Mayer & Roach, *supra* note 37, at 156–61.
[227] *See* OECD, *supra* note 5, at 38.

The pandemic has also highlighted the vulnerability of people living in developing countries. Strikingly, the relatively rapid development of vaccines to combat COVID-19 shows the astounding potential of the pharmaceutical industry to produce and license new pharma products through the use of new screening and other biotechnology tools. There is good cause to believe that great scientific discoveries that benefit humankind will also come about through the application of similar nanotechnologies and innovative tools in ocean science in the fullness of time. A note of caution has however to be sounded regarding the inequalities encountered in delivering a global vaccination program, which provides salutary evidence that we continue to live in a bifurcated world in relation to access to the life-saving benefits derived from new science including new drugs in particular. Thus, it is entirely understandable why developing countries are seeking a more equitable balance in relation to regulatory arrangements under the draft agreement pertaining to the conservation and sustainable use of biodiversity, which truly considers the interests and needs of humankind as a whole. To that end, the outcome of the BBNJ negotiations will attest to the dynamic nature of treaty-making at the UN, as well as the importance of the rule of law in maintaining peace and public order as it applies to the ocean.