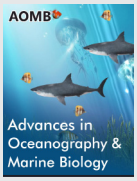

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Review Article

The Normative Logic and Structural Deficiencies of the Marine Genetic Resources Regime under the BBNJ Agreement

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Abstract

The regulation of activities related to the access and utilization of Marine Genetic Resources (MGRs) has long remained a legal vacuum in the international community. The adoption of the BBNJ Agreement fills this regulatory gap, carrying significant implications for reshaping the global distribution of marine interests and establishing a fair and equitable order for ocean governance. This study finds that the major controversies surrounding the legal regime of MGRs under the BBNJ framework primarily concern: the negotiation process of the MGRs regime; the legal status of MGRs; the regulation of Digital Sequence Information on Genetic Resources (DSI); the forms and modalities of benefit-sharing; and the arrangement of intellectual property rights. Following rounds of compromise and interest-balancing among stakeholders, the BBNJ Agreement ultimately does not directly address the legal status of MGRs. However, it innovatively extends regulatory coverage to the access and use of DSI, establishes a mandatory benefit-sharing mechanism encompassing both monetary and non-monetary benefits, and delegates the detailed implementation modalities of monetary benefit-sharing to future Conferences of the Parties. The issue of intellectual property rights remains unaddressed. It can be observed that the legal design of the MGRs regime, beyond merely achieving a balance of interests, is also guided by the pursuit of both fairness and efficiency as normative values underpinning the entire institutional framework.

Keywords: Marine genetic resources (MGRs); areas beyond national jurisdiction (ABNJ); BBNJ agreement; benefit-sharing; digital sequence information (DSI)

Introduction

Marine Genetic Resources (MGRs) in Areas Beyond National Jurisdiction (ABNJ), encompassing the high seas and "the Area," are critical components of global biodiversity, comprising hereditary material from marine animals, plants, and microorganisms with substantial scientific, economic, and ecological value. They underpin industries such as biotechnology, pharmaceuticals, and cosmetics, while also supporting the maintenance and restoration of marine ecosystems. Despite their importance, governance of MGRs in ABNJ has historically faced challenges stemming from regulatory gaps, technological disparities, and jurisdictional ambiguity, limiting equitable access and sustainable use. The Agreement on Biodiversity Beyond National Jurisdiction (BBNJ) represents a

historic effort to address these challenges; however, its legal regime remains complex and contested, reflecting divergent national interests and the North–South divide. Key controversies include determining applicable legal principles—freedom of the high seas versus the common heritage of humankind—regulating Digital Sequence Information (DSI), designing equitable benefit-sharing mechanisms, and addressing intellectual property rights (IPRs).

Structural and normative ambiguities within the BBNJ MGRs framework risk weakening its effectiveness: the coexistence of potentially conflicting legal principles complicates interpretation and enforcement, unresolved modalities of monetary benefit-sharing create critical implementation gaps, and deferral of IP issues to specialized bodies such as WIPO leaves derivatives and DSI inadequately protected. These challenges underscore the difficulty of balancing scientific advancement, state interests, and conservation objectives in ABNJ. This study critically examines the normative logic and structural deficiencies of the MGRs legal regime under the BBNJ Agreement, with four primary objectives: analyzing the legal and institutional frameworks governing MGRs, including principles, benefit-sharing mechanisms, and DSI regulations; identifying structural ambiguities and enforcement gaps; assessing how unresolved issues such as IP rights and monetary benefit-sharing affect equitable and sustainable use.

What Are the Marine Genetic Resources

According to A Guide to the Convention on Biological Diversity, genetic material refers to all hereditary material containing deoxyribonucleic acid (DNA), and in some cases ribonucleic acid (RNA) [1]. MGRs in ABNJ—which include both the high seas and "the Area" beyond national jurisdiction—are defined as genetic material from marine animals, plants, or microorganisms that contain functional units of heredity and have actual or potential economic, social, or scientific value, including their derivatives. With advances in science and technology and a deeper understanding of marine ecosystems, the value of MGRs from ABNJ has been increasingly recognized by the international community. These resources are of irreplaceable importance to industries such as biopharmaceuticals, cosmetics, and biotechnology, offering immense commercial potential. Moreover, as integral components of marine biodiversity with bio-remediation functions, MGRs play a crucial role in maintaining and restoring the ecological balance of the marine environment.

Background to the Establishment of the MGRs Legal Regime under the BBNJ Agreement

Given the immense value of MGRs, states have engaged in increasingly intense competition to access and exploit them in ABNJ. However, the collection and utilization of these resources depend heavily on significant financial investment and advanced technological capacity. Although, in principle, access to MGRs in ABNJ is open to all countries, the vast disparities between developed and developing nations in scientific and technological capabilities have transformed this nominal equality into substantive inequality [2]. Furthermore, in the absence of effective regulatory mechanisms, the repeated sampling of MGRs—combined with the cumulative impacts of other human activities on the marine ecosystem—poses a serious threat to the sustainability and integrity of these fragile genetic resources. From a legal perspective, the protection of MGRs in ABNJ should primarily be grounded in Part XII of the United Nations Convention on the Law of the Sea (UNCLOS). However, at the time of UNCLOS negotiations, scientific and technological limitations prevented humanity from discovering or appreciating the existence and value of MGRs in ABNJ [3].

As a result, UNCLOS does not contain explicit provisions addressing MGRs, which exposes clear normative gaps. For instance, it does not establish concrete mechanisms or procedures for designating marine protected areas, nor does it provide uniform standards or methodologies for conducting environmental impact assessments—both of which are essential for the effective conservation and sustainable use of MGRs. Although Article 192 of UNCLOS imposes a universal obligation on states to protect and preserve the marine environment—an obligation widely recognized as a rule of customary international law binding even upon non-parties—the overall framework of Part XII remains highly principled and lacks detailed, operational mechanisms. Consequently, it falls short of providing a coherent and effective legal framework for the protection of MGRs in ABNJ [4]. In light of these deficiencies, the adoption of a legally binding implementing agreement under the UNCLOS framework—namely, the Agreement on Biodiversity Beyond National Jurisdiction (BBNJ)—emerges as the most viable and necessary solution.

Controversies in the Legal Formation of the MGRs Regime

The legal regime governing MGRs has been one of the most complex and contentious issues in the negotiations of the BBNJ Agreement, representing the core of the North–South divide [5]. As the negotiations progressed, although considerable consensus was reached on many aspects of the Agreement, disagreements became increasingly concentrated on the MGRs issue. Indeed, the MGRs regime has consistently remained the most debated and politically sensitive topic, and its resolution was widely regarded as a decisive factor in determining whether the BBNJ Agreement could ultimately be adopted.

The main controversies surrounding the legal framework for MGRs under the BBNJ Agreement can be summarized into four key areas:

a) Disagreements over the applicable legal principles;

b) Whether Digital Sequence Information (DSI) should fall within the scope of regulation;

c) The forms and modalities of benefit-sharing; and

d) The treatment of intellectual property rights (IPRs).

Controversies over the Applicable Legal Principles

The first major controversy concerns which fundamental legal principle should apply to MGRs: the principle of the freedom of the

high seas or the principle of the common heritage of humankind. Determining the applicable principle is the logical and legal foundation for constructing the MGRs regime [6]. It not only shapes the design and direction of the regime itself but also reflects the overarching normative orientation of the entire BBNJ Agreement, thereby influencing institutional choices in other issue areas as well. Moreover, each party's preference for a particular legal principle is closely tied to its national interests. Even when specific regulatory provisions appear similar, the underlying principles guiding their design reflect fundamentally different interests and visions of ocean governance. Consequently, debates over which principle should govern MGRs have been deeply polarized, with states maintaining firm and opposing positions throughout the entire negotiation process of the BBNJ Agreement [7]. Ultimately, Article 7 of the adopted BBNJ Agreement places both the common heritage of humankind and the freedom of the high seas side by side [8]. This provision marks a significant innovation in the Agreement and carries two key implications. First, the coexistence of both principles reflects the reality that their underlying tensions remain fundamentally irreconcilable. Second, placing them side by side suggests a partial convergence among states on certain shared elements—such as the emphasis on open access embedded in the freedom of the high seas, and the notions of benefit-sharing and capacity-building derived from the common heritage of humankind.

Whether DSI Should Be Included in the Regulatory Framework

The large-scale generation of DSI has fundamentally transformed how genetic resources are utilized. While DSI has significantly improved the efficiency of genetic research and use, it also poses major challenges to existing benefit-sharing mechanisms [9]. Whether the acquisition of DSI should be regulated, whether the benefits derived from its use should be shared, and how such sharing should occur have become central issues not only in refining national benefit-sharing frameworks but also in shaping the legal regime of MGRs under the BBNJ Agreement. The core controversy stems from an inequitable reality: research institutions in developed countries have been using DSI derived from genetic resources originating in developing countries free of charge, without sharing any resulting benefits—a practice often described as "digital biopiracy" [10]. Consequently, the negotiations over the DSI issue were marked by sharp divisions. Developed countries such as Japan, South Korea, Switzerland, and Canada opposed including DSI within the benefit-sharing framework, arguing that doing so might restrict open data access, reduce information sharing, and ultimately hinder scientific progress [11].

In contrast, the Group of 77 and China, along with most developing countries, advocated for the fair and equitable sharing of benefits arising from the use of DSI, emphasizing both distributive justice and the need to enhance the scientific and technological capacities of developing states [12]. In the final text, the BBNJ Agreement maintains a conceptual distinction between MGRs and DSI but mentions them side by side, applying identical provisions and establishing a common benefit-sharing mechanism. This makes the BBNJ Agreement the first international treaty to introduce a benefit-sharing framework for DSI. The inclusion of DSI in this manner was largely the result of effective coordination among the Group of 77 and China before the resumed fifth session of negotiations, during which they jointly submitted a proposal on the MGRs regime that explicitly recognized DSI as an integral component of benefit-sharing—thereby shifting the course of the negotiations [13].

Controversies over the Forms and Modalities of Benefit-Sharing

The concept of benefit-sharing originates from the Convention on Biological Diversity (CBD). Grounded in the principle of state sovereignty, the CBD established a benefit-sharing mechanism based on commutative justice, requiring that countries accessing genetic resources negotiate with resource-providing countries to determine, through bilateral agreements, the specific terms of benefit-sharing. This approach seeks to balance the interests of both providers and users of genetic resources.

In terms of forms, benefit-sharing generally takes two types: non-monetary and monetary [14]. Non-monetary benefits refer to advantages not expressed in financial form, such as the sharing of biological samples, DSI, and research outcomes, as well as technology transfer, capacity-building, and collaborative research. Monetary benefits, by contrast, involve financial payments made by the parties that access or utilize the resources.

The main controversy concerns the modalities of benefit-sharing—whether it should be voluntary or mandatory. Under a voluntary model, parties determine benefit-sharing arrangements through negotiation and mutual consent, formalized by contract. A mandatory model, on the other hand, establishes legally binding minimum standards for rights and obligations through international legislation. Parties may still conclude contracts, but the agreed terms cannot fall below the baseline standards prescribed by international law.

According to Article 14(5) of the final BBNJ Agreement, monetary benefit-sharing was ultimately incorporated into the MGRs legal regime. However, the negotiations failed to reach consensus on the specific modalities of such monetary sharing, leaving the detailed arrangements to be decided by the future Conference of the Parties (COP). Notably, Article 14(6) of the Agreement introduces an innovative two-tiered mechanism for monetary benefit-sharing:

First phase – Upon the entry into force of the Agreement, developed States Parties are required to contribute an amount equivalent to 50% of their assessed contributions to a "special fund" established under the Agreement. This is the first time an international treaty has delinked monetary benefit-sharing from actual resource utilization, ensuring a stable and predictable source of funding for the mechanism.

Second phase – Under Article 14(7), States Parties will make further monetary contributions in accordance with the modalities to be determined by the COP.

The text of the BBNJ Agreement thus reflects a pragmatic compromise among States: while they diverged on the structure and implementation of monetary benefit-sharing, they ultimately agreed on the necessity of including it as a fundamental component of the MGRs regime.

Controversies over Intellectual Property

The core value of MGRs lies not in their exchange value as commodities, but in the genetic information they contain. Realizing the value of this information requires the application of biotechnology to extract, analyze, and synthesize genetic material. This process generates IP, particularly patents, protecting innovations such as biotechnological methods and products, which form the basis for the commercial utilization of MGRs. During the negotiations, developing countries advocated for restrictions on IP protections to ensure transparency, monitor the use of MGRs, and trace their origin, thereby guaranteeing the implementation of benefit-sharing. Developed countries, by contrast, proposed that IP issues be addressed through existing international mechanisms, such as the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO). Historically, the disclosure of the origin of genetic resources from ABNJ was largely excluded from WIPO processes, limiting developing countries' leverage [15]. In the final text of the BBNJ Agreement, aside from a reference to patents in notification obligations, no specific IP provisions were included. This reflects the deep divide among states regarding the relationship between benefit-sharing and intellectual property. To facilitate the adoption of the Agreement, explicit IP clauses were ultimately removed [16]. At the same time, there was consensus that specialized international organizations, such as WIPO, should continue to address the issue.

Conclusion and Analysis

As a product of compromises and the balancing of interests among states, the design of the MGRs regime inevitably contains ambiguities intended to bridge disagreements and facilitate the adoption of the BBNJ Agreement. However, some of these key ambiguities may give rise to conflicts in interpretation and implementation. Specifically, the Agreement avoids addressing the legal status of MGRs and instead places the freedom of the high seas and the common heritage of humankind principles side by side as general guiding norms. This coexistence of potentially contradictory principles creates interpretive and applicative tensions, weakening enforcement effectiveness. It also overlooks the sustainability obligations inherent in the common heritage principle, which undermines the conservation and sustainable use of MGRs [17]. The specific modalities for monetary benefit-sharing remain unresolved. Annual contributions from developed States Parties were introduced as a proxy to address benefit distribution and support marine biodiversity conservation. However, these contributions are relatively small and insufficient to fully carry out these functions [18].

Finally, intellectual property issues were deferred to specialized international bodies such as WIPO. Yet, under the WIPO platform, recent developments—such as the WIPO Treaty on Intellectual Property, Genetic Resources, and Associated Traditional Knowledge (GRATK)—impose low-threshold mandatory disclosure obligations with vague and weak enforcement measures. These provisions do not extend to derivatives or DSI, and therefore cannot fully meet the regulatory needs of the MGRs legal regime in ABNJ [19,20]. In sum, while the BBNJ Agreement represents a historic step in global marine governance, these structural ambiguities and unresolved issues highlight significant challenges for its effective interpretation, implementation, and enforcement.

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