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BBNJ Agreement: Considerations for Scientists and Commercial End Users of MGR at Research, Development and Commercialization Stages

Muriel Rabone, Tammy Horton, Fran Humphries, Christopher H. C. Lyal, Hiroko Muraki Gottlieb, Amber H. Scholz, Thomas Vanagt, and Marcel Jaspars

Abstract

The research, development and commercialization pipeline for accessing, using and sharing marine genetic resources (MGR) of areas beyond national jurisdiction (ABNJ) is highly varied and complex. Equally complex is the governance framework under the 2023 agreement on the conservation and sustainable use of marine biological diversity of ABNJ, for which many practical details, including procedures, are yet to be decided by treaty Parties. This chapter draws from real world examples to analyse ways in which current scientific practice is supported or challenged by framework elements, including notification, monitoring and benefit sharing systems and associated infrastructure such as the BBNJ Standardized Batch Identifier and data management plans. It compares how the elements and infrastructure may work in practice using six R&D scenarios ranging from an idealized linear pathway to more complex pathways involving automation, sequence information and traditional knowledge associated with MGR in different geographical and temporal scales. For an efficient and 'future proofed' framework that supports innovation and fulfils treaty objectives, it is proposed that treaty bodies and policy makers need to look beyond the idealized R&D pathways envisaged in the treaty and engage directly with scientists and commercial end users when designing the practical details of implementation.

Muriel Rabone and Fran Humphries: These authors contributed equally to this chapter.

M. Rabone · C. H. C. Lyal
Department of Life Sciences, The Natural History Museum, London, UK

T. Horton
Ocean BioGeosciences, National Oceanography Centre, Southampton, UK

F. Humphries
Griffith Law School, Griffith University, Nathan, QLD, Australia

H. Muraki Gottlieb
Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA

A. H. Scholz
Department of Science Policy and Internationalization, Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany

T. Vanagt
3BIO, Brussels, Belgium

M. Jaspars (✉)
Marine Biodiscovery Centre, Department of Chemistry, University of Aberdeen, Aberdeen, UK
e-mail: m.jaspars@abdn.ac.uk

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Keywords

Marine genetic resources (MGR) · Digital sequence information (DSI) · Access · Utilization · Benefit sharing · FAIR · BBNJ Standardized Batch Identifier · Reporting requirements · BBNJ agreement

Abbreviations

ABSC	Access and benefit sharing committee
AI	Artificial intelligence
AUV	Autonomous underwater vehicle
API	Application programming interface
BS	Benefit sharing
BBNJ identifier	BBNJ standardized batch identifier
CHM	Clearing house mechanism
COP	Conference of the parties
DES	Digital extended specimen
DMP	Data management plan
DSI	Digital sequence information
FPIC	Free and prior informed consent
IPLC	Indigenous peoples and local communities
ITPGRFA	International treaty on plant genetic resources for food and agriculture
MAT	Mutually agreed terms
MGR	Marine genetic resource
STB	Scientific and technical body

14.1 Introduction

Following almost two decades of negotiations, the adoption by consensus of the *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* (BBNJ Agreement (UNGA, 2023)) marks a new phase in marine biodiversity governance in roughly two-thirds of the world's oceans known as areas beyond national jurisdiction (ABNJ). No States have sovereignty or sovereign rights to ABNJ, which encompass the water column of the high seas and the deep seabed below (UNCLOS[1] Parts VII and XI). In response to alarming marine biodiversity decline (Díaz, 2019), the BBNJ Agreement is a treaty[2] that was designed to fill a gap in biodiversity governance and address questions of equity in the exploration of marine genetic resources (MGR) of ABNJ. This chapter provides insights into how Part II of the BBNJ Agreement, MGR governance, may be applied in practice. Questions from an operational perspective remain as modalities and clarification of the MGR framework will be decided in future by the Conference of the Parties to the BBNJ Agreement (CoP), supported by treaty (subsidiary) bodies and infrastructure. These include the Access and Benefit Sharing Committee (ABSC), the Scientific and Technical Body (STB) and the Clearing House Mechanism (CHM). Building on the textual treaty interpretation of Chaps. 2–8 of this edited collection,[3] this chapter analyses key practical considerations for implementation of treaty obligations for scientists and commercial end users, and more broadly for the entities (public and private) that collect, hold and utilize MGRs of ABNJ and associated digital sequence information (DSI) and traditional knowledge (TK) at the pre/post-collection, research and development (R&D) and commercialization stages.

The BBNJ Agreement creates a framework for Parties to cooperate on marine biodiversity governance in accordance with treaty objectives. The overall objective is 'to ensure the conservation and sustainable use of marine BBNJ, for

[1] *United Nations Convention on the Law of the Sea*, opened for signature 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994).

[2] Which will come into force 120 days after 60 states become Parties to the treaty.

[3] Broggiato et al. (2025), Humphries (2025), Humphries et al., (2025a, b), Langlet et al. (2025), Muraki Gottlieb et al., (2025a, b), Pena-Neira and Coelho (2025).

the present and in the long term, through effective implementation of the relevant provisions of the Convention[4] and further international cooperation and coordination (art 2). The BBNJ Agreement has four elements—Part II (MGR, including the fair and equitable sharing of benefits), Part III (Area-Based Management Tools, including Marine-Protected Areas), Part IV (Environmental Impact Assessment) and Part V (Capacity Building and the Transfer of Marine Technology) plus other provisions such as Part VI (institutional arrangements). The objectives for Part II are

(a) The 'fair and equitable sharing of benefits arising from activities with respect to' MGR and DSI on MGR of ABNJ 'for the conservation and sustainable use of marine biological diversity of ABNJ';
(b) The 'building and development of the capacity of Parties', 'particularly developing States Parties' and other categories listed, to carry out these activities;
(c) 'the generation of knowledge, scientific understanding and technological innovation, including through the development and conduct of marine scientific research, as fundamental contributions to the implementation of this Agreement'; and
(d) 'the development and transfer of marine technology in accordance with this Agreement' (art 9).

Part II provides a framework for MGR governance. Under the treaty, MGR means 'any material of marine plant, animal, microbial or other origin containing functional units of heredity of actual or potential value' (art 1(8)). DSI is undefined but is a placeholder term that is increasingly used in international fora to denote information associated with genetic resources such as DNA, RNA, proteins and possibly metabolites (CBD/COP/DEC/15/9, CBD/DSI/AHTEG/2020/1/3). 'Traditional Knowledge' is also undefined, but its scope is likely to be determined under national laws by governments or Indigenous Peoples and local communities (IPLCs) (Humphries, 2025; Pena-Neira & Coelho, 2025). Key elements of the framework are:

(a) A notification system for users of MGR and DSI encompassing:
    a. pre- and post-collection notifications;
    b. 'utilization' notification; and
    c. reporting on 'access' to MGR and DSI in repositories and databases;
(b) A system for the fair and equitable sharing of benefits from the use of MGR that contributes to the conservation and sustainable use of marine biological diversity in ABNJ;
(c) A monitoring and transparency system, including a BBNJ Standardized Batch Identifier (BBNJ Identifier); and
(d) Provisions on access and use of TK of IPLCs associated with MGR in ABNJ.

Regarding (c), the CHM will automatically generate a BBNJ Identifier upon receipt of a pre-collection notification (see Sect. 2.1). This is a unique identifier that tags the whole collection (the 'batch') to provide a stable link between information about the collection event (including the location of collection) and any MGR or DSI that is subsequently held or deposited in a repository or database. The idea is that the original collection will be linked to any subsequent unique identifiers for the MGR and DSI to help ascertain provenance (i.e. original location where they were collected) of the MGR and DSI that will be the subject of R&D and aggregate reports to the CHM (see Sect. 2.4). It is equivalent to an identifier for a deep-sea research cruise (as in current usage) but would meet certain characteristics of being 'persistent' or stable over time and globally unique, resolvable and authoritative (Guralnick et al., 2015; Page, 2023). Usage of persistent identifiers is key to database interoperability and to making data FAIR, or Findable, Accessible, Interoperable and Reusable (Islam et al., 2023; Juty et al., 2020; Rabone et al., 2023a, 2023b;

[4] *United Nations Convention on the Law of the Sea*, opened for signature 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994).

Wilkinson et al., 2016). The importance of FAIR and persistent identifiers for MGR traceability and the treaty has been discussed previously in the literature (Humphries et al., 2021; Rabone et al., 2019). FAIRness of MGR data is now a requirement of the BBNJ Agreement (art 14). Utilization of MGR from ABNJ (e.g. publication of papers or patents, or development of products) necessitates notification to the CHM when this information is available, to (1) allow transparency and (2) determine the level of benefit sharing; key objectives of Part II. The BBNJ Identifier is intended to be integrated into existing databases and embedded in the outputs of scientific research (including publications and patents), facilitating automated retrieval (Oldham & Thambisetty, 2023). However, many questions remain on how this could be implemented in practice.

Similarly, many of the practical details such as procedures and guidance on interpretation and scope are yet to be determined by treaty bodies and Parties. Scientists, repositories, commercial end users and other stakeholders however can already start thinking about how the treaty framework will affect them when implemented under national law. These stakeholders may already have aligned their practices and procedures with access and benefit sharing (ABS) procedures under national laws that implement the *Convention on Biological Diversity* (CBD) and the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their utilization to the Convention on Biological Diversity* (Nagoya Protocol) and other international ABS frameworks (Kachelriess et al., 2025). The task is now to consider how to also to align their practices with the new BBNJ Agreement framework as it unfolds.

It must be noted that if MGR is collected from areas within national jurisdiction (AWNJ), it may be subject to national ABS laws that implement the international frameworks of the CBD (Kachelriess et al., 2025). Analysis of other legal frameworks governing MGR in AWNJ is beyond the scope of this chapter, but this highlights how the R&D pipeline for MGR may be subject to different governance regimes for the same research project, depending on where the MGR was originally collected.

The aim of this chapter is to analyse how the BBNJ Agreement infrastructure, procedures and processes might apply under a series of scenarios of R&D and commercialization pathways, to better understand the effects of treaty implementation. Section 14.2 outlines the key requirements of Part II of the BBNJ Agreement—notifications (pre- and post-collection and utilization), 'accessing' MGR and DSI from repositories and databases, reporting requirements and benefit sharing. It outlines ways in which current scientific practice is both supported and challenged by key elements of the MGR governance framework, with examples. Section 14.3 outlines six scenarios of R&D and commercialization ranging from an idealized linear approach to more complex scenarios including those involving the use of DSI and TK under different temporal and spatial scales. These scenarios highlight areas of ambiguity in the treaty obligations, which can vary significantly depending on the R&D pathway. It argues that this variety highlights the need for the CoP and other treaty bodies to think beyond the idealized linear R&D pathway when developing policies and guidance to Parties on implementation of Part II. Engaging directly with scientists, commercial end users, repositories and other stakeholders during implementation can 'help future proof' the treaty and ensure its objectives are met, including the generation of knowledge, scientific understanding and technological innovation.

14.2 Implications of the MGR Framework for Stakeholders

The other chapters in this edited collection provide a detailed analysis and interpretation of Part II provisions (see Humphries et al., 2025a for an overview of chapters). The purpose of this section is to highlight elements of the MGR governance framework that are relevant for demonstrating the extent to which current R&D

practices are supported or challenged by these elements. This analysis includes

- an overview of notification, benefit sharing and transparency requirements and consistency with current practice;
- real world examples to illustrate complexities of research processes including examining the UK as a case study;
- perspectives on practicalities for implementation and how current practice can be best adapted for requirements of the BBNJ Agreement; and
- identification of areas for input by the treaty bodies.

The focus of this section concerns the points in time where the R&D pipeline interacts with the requirements for notification (art 12), transparency (art 16) and benefit sharing (art 14). A key focus of the analysis is how the BBNJ Identifier connects these elements. The BBNJ Identifier is a key innovation in the framework, which is an administrative tag or identifier automatically issued by the CHM upon pre-collection notification that can link the CHM with other scientific or administrative identifiers and databases to assist with information gathering for treaty obligations as above (see also Lawson et al., 2025). Scenario 6 in Sect. 14.3 also relates to how R&D might interact with article 13 on TK associated with MGR in ABNJ, which has been analysed in other chapters of this collection, including Pena-Neira and Coelho (2025). To assist with understanding the elements in this section and Sect. 14.3, Fig. 14.1 outlines a graphical representation of the notification requirements in article 12, showing timelines for pre- and post-collection and utilization notifications and links between the BBNJ Identifier and downstream MGR and DSI unique identifiers. The numbers refer to relevant articles in the BBNJ Agreement.

14.2.1 Pre-collection Notification

The first step in the notification process is the pre-collection notification to the CHM, which Parties are required to ensure is completed six months or as early as possible prior to the collection or sampling of MGR from ABNJ (art 12(2)). The practicalities for the infrastructure and procedures are yet to be determined by the CoP at the time of writing. This obligation is on Parties but in practice, under national law,

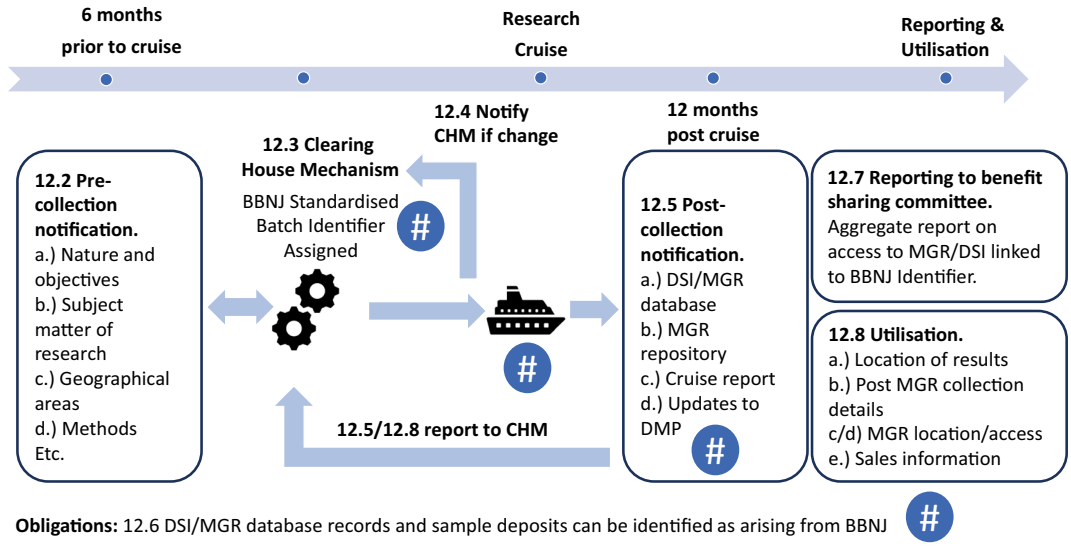

Fig. 14.1 Article 12 notification requirements under the BBNJ agreement

Parties may require their governments to act as a conduit for all notifications or may require their nationals to notify the CHM directly.

Table 14.1 shows a comparison of pre-collection notification in practice and the BBNJ Agreement's requirements in article 12(2). This shows that most of the notification requirements are already met under existing scientific good practice. However, providing opportunities for researchers from developing States to take part in the proposed research (which is also referenced in Part V of the BBNJ Agreement on Capacity Building and the Transfer of Marine Technology) could be an area that the CoP may benefit from input of the treaty bodies.

Within the UK marine scientific research community, these pre-collection notification requirements are already standard practice, managed by the National Marine Facilities at the National Oceanography Centre, through the Marine Facilities Planning portal (MFP). For example, the JC263 cruise to the Porcupine Abyssal Plain in 2024 is listed with the dates, sampling equipment, and planned data and samples to be collected.[5] In the UK, this planning procedure is currently in usage only for national research vessels owned or administered by the Natural Environment Research Council (NERC). The European institutes, the Royal Netherlands Institute for Sea Research (NIOZ) and Institute of Marine Research (IMR, Norway) also use the same system. Sampling may take place outside the traditional 'cruise' pattern, ie from autonomous vessels (see scenario 4 in Sect. 3.4), or private/philanthropic-owned vessels, which could also potentially use this system or, if not, equivalent compliance with BBNJ Agreement requirements will need to be ensured. This portal could also inform a global model for scientific vessels given the need for a more harmonized approach.

The MGR that fall within scope of the BBNJ Agreement is broad, but the term "sample" is undefined, which may need further clarification from the treaty bodies (Humphries, 2025). A collection can encompass a wide range of sample types, from: environmental samples of water, ice or sediment that (may) contain whole or partial organisms; through to whole organisms, e.g. single identified specimens, or mixed samples of specimens; to samples derived from any of these, such as extracted DNA or tissue preparations (Rabone et al., 2019). Samples may also be collected for other purposes, but later utilized for MGR research. Collection of any physical sample that may contain MGR (water, sediment, fauna) could be included under the BBNJ Agreement, regardless of the intent of use (commercial or non-commercial). This is because the trigger for the treaty is a collection event in ABNJ and appears not be limited to collections for the purpose of investigating the genetic attributes of the organisms, unlike the CBD framework (Humphries et al., 2024b). When developing the modalities of the BBNJ Agreement, it will be important for treaty bodies and Parties to consider exclusions for samples which are collected but not intended to be used for MGR research and not stored (such as water samples collected for physical oceanography data).

The importance of data management plans (DMPs) and data archiving are well recognized by science funders. In the UK, oceanographic data are archived (British Oceanographic Data Centre; BODC) as is marine biodiversity data (Marine Environmental Data and Information Network, MEDIN, Data Archive Centre/DASSH, The Archive for Marine Species and Habitats Data). A DMP is provided for each cruise as standard practice in the UK, but further clarification of the sampling may be needed, covering what is current compliance and what is needed for implementation. If there are several independent scientists and research programmes on board, this may necessitate adapted DMPs. Here a set of protocols could be developed with input from the STB and the cruise lead could hold overall responsibility. For example, DMPs could be made available on the treaty's CHM. There are also opportunities within the DMP requirements to apply FAIR data formats and to provide suggestions as to the databases

[5] https://nerc.marinefacilitiesplanning.com/programme.

Table 14.1 Information to be notified to the CHM 6 months or as early as possible prior to the collection in situ of MGRs of ABNJ

Article 12.2	Current good practice and opportunities for improvement
(a) The nature and objectives under which the collection is carried out, including, as appropriate, any programme(s) of which it forms part	Provided as part of a cruise plan
(b) The subject matter of the research or, if known, the marine genetic resources to be targeted or collected and the purposes for which such resources will be collected	Provided as part of a cruise plan
(c) The geographical areas in which the collection is to be undertaken	Provided as part of a cruise plan. Additional detail is frequently provided as route of vessel defined before cruise departure. Some countries, such as the United States, have security concerns that may not make it possible to provide precise information prior to departure
(d) A summary of the method and means to be used for collection, including the name, tonnage, type and class of vessels, scientific equipment and/or study methods employed	Vessel information is available via the operator (e.g. national oceanographic agency, private operator or charitable organization). Scientific equipment equipment/methods are defined in the cruise plan but subject to change
(e) Information concerning any other contributions to proposed major programmes	Whether there will be contributions will depend on the funder and research programme
(f) The expected date of first appearance and final departure of the research vessels, or deployment of the equipment and its removal, as appropriate	The relevant dates are provided as part of the cruise plan
(g) The name(s) of the sponsoring institution(s) and the person in charge of the project	The information is provided as part of the cruise plan. The sponsoring institution could be a research funder, national oceanographic institution, or charitable organization. Person in charge is usually the cruise leader or the principal investigator on the cruise application
(h) Opportunities for scientists of all States, in particular scientists from developing States, to be involved in or associated with the project	Opportunities to be part of the cruise may be available. However, information on opportunities is not kept in one platform
(i) The extent to which it is considered that States that may need and request technical assistance, in particular developing States, should be able to participate or to be represented in the project	Participation of States with needs for technical assistance that request it may be able to participate or be represented in a project. However, information is not kept in one platform
(j) A data management plan prepared according to open and responsible data governance, taking into account current international practice	A data management plan is provided as part of a cruise plan. However, there may be opportunities to harmonize data formats and reporting. Further, best practices for where certain types of data should be deposited could be considered

that could be used for particular types of data (Lawson et al., 2025).

While pre-collection notification requirements in Table 14.1 are consistent with current research practice as covered in scenario 1 (see Sect. 3.1), there are several challenges for understanding how all scenarios will be governed by the treaty and the national laws supporting its implementation. The BBNJ Agreement is silent on the responsible entity that would submit the required information to the CHM, but it may be the home institution of the cruise principal investigator. Clarification on who is responsible for notification could be provided by the treaty bodies. Further, the CHM is to be notified of any "material change" to the cruise planning. Many variables can affect cruise planning and operations. It is unclear where the threshold lies for reporting these changes to the CHM, but pragmatism is

Table 14.2 Information to be notified along with the BBNJ identifier to the CHM as soon as it becomes available, but no later than 1 year from the collection in situ of marine genetic resources of areas beyond national jurisdiction

Article 12(5)	Current good practice and opportunities for improvement
(a) The repository or database where digital sequence information on marine genetic resources is or will be deposited	This information is provided as part of the data management plan, which forms part of the cruise plan. Similar to the data management plan outlined in Table 14.1, there may be an opportunity to harmonize the consistency and requirements on reporting the relevant information
(b) Where all marine genetic resources collected in situ are or will be deposited or held	The information about where the physical materials collected in ABNJ is recorded as part of the cruise database, which forms part of the cruise report
(c) A report detailing the geographical area from which marine genetic resources were collected, including information on the latitude, longitude and depth of collection, and, to the extent available, the findings from the activity undertaken	The geographical sampling location is recorded as part of the cruise database, which forms part of the cruise report. For operational reasons, some data may be missing from the database. The result of the collection activities may take some time depending on a few factors: the number of samples collected, the number of personnel available, and financial and other resources
(d) Any necessary updates to the data management plan provided under paragraph (2) (j) above	This is a new requirement for the DMP. Depending on the extent of updates, the new requirement may be relatively easy for the researchers to fulfil

needed to avoid overloading both researchers and operations of the CHM itself with unnecessary reporting and data (see Scenario 1). Reporting guidelines would facilitate compliance with the notification requirement. Here the treaty bodies such as the STB can play a significant role in providing recommendations to the CoP.

14.2.2 Post-Collection Notification

After a vessel returns to shore with MGR of ABNJ, post-collection notification requirements to the CHM are expected no later than a year following the MGR collection (art 12(5) (a–d)). This includes information on the repository where the MGR samples are held, the databases where the DSI are, or will be, deposited, and a report detailing what was collected and where and a general summary of findings. Most of the notification requirements can be fulfilled by providing the cruise report and the relevant cruise database/s (Table 14.2). For UK marine scientific research, this information is usually captured in a Cruise Summary Report and/or the later Cruise Report.[6] The capture of the post-expedition requirements could be incorporated into this existing process in the UK, which can be revised to ensure compliance with the BBNJ Agreement.

Table 14.2 shows a comparison of post-collection notification in practice and the BBNJ Agreement's requirements in article 12(5). As with the pre-collection notification requirements in Table 14.1, most of the requirements align with existing scientific practices, but there may be opportunities for further harmonization, such as reporting the repository or database where DSI on MGRs is or will be deposited. Guidance by treaty bodies on practicalities is important given the complexities throughout the R&D pathways described in this chapter.

The research process initiated on the cruise may take many months to years to complete (Engel et al., 2021; Humphries et al., 2021). Subsequent research may result in MGR sample deposits in repositories similar to those

[6] https://www.ukri.org/councils/nerc/facilities-and-resources/find-A-nerc-facility-or-resource/marine-facilities-policy-and-guidance/.

listed here, associated records in taxonomic biodiversity and DSI databases, and research publications, which would, in theory, be linked to a BBNJ Identifier. The requirement in BBNJ Agreement's article 12(5)(c) to detail "findings from the activity undertaken" within one year from collection could be viewed as challenging in some cases due to the number of samples obtained and lack of personnel available to carry out the work during the term of the research funding (i.e. "findings" are yet to be ascertained). Follow-on research often involves additional researchers not involved in the original cruise and associated research project. Cruise funding is often time limited and restricted to vessel time itself, mobilizing/demobilizing research project teams, consumables needed for research and sample shipment. Even if downstream research is funded, it may be time limited and often ceases within a few years of the cruise. This means that there is little support for follow-on research and additional reporting unless additional funding is obtained. In any case, research timescales may be lengthy especially when large collections have been obtained that require curation and analysis. This highlights inherent issues in science funding, primarily the disconnect between short term timescales of grants and long timescales for research and maintenance of collections and databases (Rabone et al., 2019). The BBNJ Agreement does qualify such requirement by stating, "in accordance with current international practice and *to the extent practicable*" (emphasis added) to ensure that the requirements can be implemented.

The requirement under article 12(5)(d) to update the DMP in article 12(2)(j) is not a current scientific practice, but with adequate resources (e.g. financial, personnel, etc.), such work may be possible. Considering article 12(8)(d) on modalities envisaged for access to MGR and DSI being utilized and "*"a data management plan for the same",* it is not clear what the role of a DMP is here or why it is required if the earlier parts of article 12 are complied with, and good scientific practice is followed. The treaty bodies could also consider the question of how a researcher may handle results from the original samples with the BBNJ Identifier that is identified and has value for research years or even decades after the DMP was submitted. That said, the determination of practicability could be better determined at the Party level to ensure that the requirement can be implemented.

14.2.3 Utilization Notification and the "BBNJ" Standardized Batch Identifier

The utilization notification focuses on reporting the outcomes of R&D (commercial or non-commercial) on MGR and associated DSI. Article 12(8) requires that where MGR of ABNJ and where practicable the DSI "on such resources are subject to utilization, including commercialization, by natural or juridical persons under their jurisdiction, Parties shall ensure that the following information, including the 'BBNJ' standardized batch identifier, if available, be notified to the Clearing-House Mechanism as soon as such information becomes available:

(a) Where the results of the utilization, such as publications, patents granted, if available and to the extent possible, and products developed, can be found;
(b) Where available, details of the post-collection notification to the Clearing-House Mechanism related to the marine genetic resources that were the subject of utilization;
(c) Where the original sample that is the subject of utilization is held;
(d) The modalities envisaged for access to [MGR and DSI on MGR] being utilized, and a DMP for the same;
(e) Once marketed, information, if available, on sales of relevant products and any further development".

The term "utilization" is defined as "to conduct research and development on the genetic and/or biochemical composition of MGRs, including through the application of biotechnology"

(art 1(14)). This means that there need only be an investigation into the genetic or biochemical composition of the MGR or associated DSI for the activity to fall within scope of utilization—it does not require some form of genetic manipulation or human intervention. "Biotechnology" may be one form of utilization, but "utilization" can encompass a much broader range of activities including taxonomic and conservation research, subject to confirmation from the CoP. The CoP may need to review the operation of the utilization notification and any future benefit sharing arrangements associated with utilization to ensure the broad "utilization" trigger supports conservation objectives of the treaty (Humphries, 2025). The MGR definition does not explicitly include derivatives, which are instead brought into the treaty through the definition of biotechnology. "Biotechnology" means "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (art 1(3)). Arguably this means that the utilization notification may apply to derivatives only if they are used to make or modify products or processes for specific use, rather than simply investigating them for their genetic or biochemical composition (Humphries, 2025).

Article 12(8) on reporting utilization of MGR and associated DSI could be interpreted to mean that any DNA sequencing conducted as part of research activities constitutes utilization of MGR, i.e. not limited to commercialization routes. Under the CBD and Nagoya Protocol approach to ABS, countries have the discretion to define the scope of activities that trigger obligations. In the ABNJ context, the framework will only be effective if there is a common understanding of key definitions and the geographical, temporal and subject matter scope of the obligations (Humphries, 2025). Guidance on the types of activities that fall within the scope of the "utilization" trigger will be important for the BBNJ Agreement given the implications for basic research if the reporting requirements are impractical. For example, in the EU implementation of the Nagoya Protocol, usage of DNA sequencing data (i.e. DSI) for species identification is excluded from "utilisation" (Regulation (EU) No 511/2014)).

One of the requirements is to report where the original sample that is the subject of utilization is held. Since the BBNJ Identifier potentially covers many different MGR (specimens, sample types and species) from the pre-collection notification, and these may be held in many different repositories, this requirement may have challenges for implementation. MGR samples are likely to be transferred from the original repository (e.g. that reported in 12(5)(b)) to another as work continues; therefore, due diligence is needed to ensure the BBNJ Identifier accompanies samples and data. A new data standard Latimer Core[7] for biological collections captures information at the level of the collection, rather than of the individual specimen or sample like Darwin Core and could facilitate this (e.g. by recording the BBNJ Identifier). Given how R&D and commercialization can progress in a non-linear way (e.g. scenarios 2–6), due diligence will be necessary between actors throughout the process to ensure that the BBNJ Identifier is maintained with the MGR and DSI on MGR and downstream materials/products/data so that these can be recorded as required in article 12(8)(a).

Implementing the requirements for global databases, such as those holding biodiversity records and DSI may be achievable, but there may also be unforeseen challenges. For biodiversity databases like Ocean Biodiversity Information System (OBIS) and Global Biodiversity Information Facility (GBIF), MGR records, e.g. relating to specimens/samples held in collections, the BBNJ Identifier could be captured by existing data fields in global data standards such as Darwin Core, and the BBNJ Identifier incorporated into the occurrence record in the database. More development may be required for DSI records in INSDC, for example, addition of a field on a DSI page for the BBNJ Identifier. These global databases will

[7] https://tdwg.github.io/ltc/index.html.

likely need to engage with the treaty bodies to provide technical details about the functions and limitations (e.g. funding and technology) to ensure future compliance with article 12(8)(c) and article 12(6) outlined in Sect. 2.4 below (see also Muraki Gottlieb et al., 2025a).

There are significant potential informatics requirements for the CHM itself to meet the obligation to generate and resolve BBNJ Identifiers and handle all the notifications. It may need to interface with external databases and meet confidentiality and security requirements. In designing, implementing and maintaining the architecture of the CHM, a non-trivial operation, integration with existing data systems and awareness of emerging practices is essential. It is important that the BBNJ process, via bodies like the STB, are agile to latest developments in data science. Whatever the configuration of the CHM, the BBNJ Identifier will need to be robust to changes in technology and transcend the architecture, as data and web infrastructures may change considerably over time.

As explored in the scenarios in Sect. 14.3, collections without a BBNJ Identifier utilized in R&D may need to be identified or tagged, either as part of the BBNJ Identifier system or in some other way. This would capture scenarios such as legacy MGR collected prior to the BBNJ Agreement entering into force (scenario 2) or automation that may not trigger a pre-collection notification (scenario 4) or MGR utilized in a product but originally collected from harvest fisheries that are outside the scope of Part II (scenario 5). How this could work in practice requires input from repositories and other stakeholders and could be informed by existing and developing approaches. For example, Latimer Core as above, and GGBN has developed data standards for directly linking specimen records with Nagoya Protocol permit requirements (Droege et al., 2016; Schiller et al., 2024). The emerging digital specimen identifier concept, or Digital Extended Specimen (DES), which is based on a key principle that each object has a globally unique, persistent, authoritative and actionable identifier is also relevant to the BBNJ Identifier system in general (Hardisty et al., 2022; Islam et al., 2023; Page, 2023). Overall, the system should be light touch, embedded in community practice through broad consultation and not require "null" reporting where no utilization has occurred.

(1) *Publications*

The BBNJ Agreement requires Parties to ensure that the location of the results of utilization (publications, patents granted, and products developed) are reported to the CHM (art 12(8)(a)). Regarding publications, if supported by journals, the BBNJ Identifier could be recorded, for example as part of the methods, so that publications can be automatically retrieved using text mining e.g. via an application programming interface or API (Oldham & Thambisetty, 2023). Scientific journals sometimes support compliance with international agreements such as the Nagoya Protocol and scientific good practice, such as the requirement to provide accession numbers for DSI sequenced in the research reported (Humphries et al., 2021). Asking journals to add the BBNJ Identifier to the list of required information may be feasible. Implementation of the BBNJ Identifier would therefore benefit from cooperation between journals, databases (e.g., INSDC) funding organizations and the treaty bodies.

Challenges may arise during text mining such as the need for access to the full text of a publication which is possible for open access publications but may be problematic for publications behind a paywall. Further, text mining currently often requires scrutiny by a human operator. For example, results may give false positives and these need to be removed manually, potentially a very labour-intensive process. Given that a Party is responsible for the reporting obligation, text mining would have to be modified to include only the Party in question. One interpretation of article 12(8) is that the Party where the utilization occurs is responsible for the "utilization" notification (art 12(8)), but this poses practical challenges when the results of research are in countries outside of where the utilization occurs (Humphries et al., 2025b).

Also, many publications have authors from multiple countries, and this may lead to double counting of outputs as the publication will be reported in the aggregate report for each country, unless there is agreement that, for example, the Party where the principal investigator (often the last author) resides has responsibility, in a way possible under the EU regulations implementing the Nagoya protocol (Regulation (EU) No 511/2024). Further, States that are not Parties to the BBNJ Agreement do not have notification, monitoring or benefit sharing obligations under the treaty, which is likely to create gaps and loopholes in the BBNJ Identifier reporting system for data about DSI "access" and "utilization". The reporting requirements in article 12(8) are qualified by stating that the required information including the BBNJ identifier should be notified to the CHM "if available". Another reason for this qualification is to address utilization of MGR (or its DSI) that was collected from ABNJ prior to the treaty or relevant law entering into force if a Party does not elect to override the retroactivity provision under article 10(1) (see Sect. 3.2). As with other provisions, the inclusion of practicability is important to maintain flexibility so that the requirements can be effectively implemented by Parties.

(2) *Patents and Products*

The requirement to report on the location of patents granted and if available products developed may now be achievable following recent international developments. The 2024 World Intellectual Property Organization *WIPO Treaty on Intellectual Property, Genetic Resources and Associated Traditional Knowledge* (WIPO, 2024) requires the disclosure of origin or source of genetic resources and traditional knowledge in patent applications where a product or process is based on the resources or knowledge (Brown, 2025). For commercial products there is no centralized registry for origin of genetic resources included in patents. It may be possible for certain regulated patented products (e.g. pharmaceuticals, food/feed) to obtain disclosure of origin information. However, for others (e.g. industrial enzymes) obtaining information about the origin of genetic resources may be more challenging. It may still be possible to find out, if good scientific practice has been followed and due diligence applied i.e. that the BBNJ Identifier is associated with a product. It should also be noted that some industries do not patent, which may impact compliance with article 12(8) notification for "utilization". The challenge will be for a Party to obtain information on products containing MGR linked with a BBNJ Identifier where the R&D was carried out by a multinational corporation and different elements of R&D carried out in different countries, including under the jurisdiction of non-Parties. Also, a product may have been developed using multiple MGR with different BBNJ Identifiers, which may necessitate complex record keeping with unintended non-compliance (see also scenario 3 in Sect. 3.3 below).

Requirements for information on any products developed and sales of such products (art 12(8)(e)) may be the most challenging requirement to meet. Potentially use of the BBNJ Identifier throughout the R&D process and due diligence if research outputs are published will allow the reporting of data on products, but accessibility of these data are very rare once MGR enters the commercialization phase (Humphries et al., 2021). This may require reliance on self-reporting by industry, potentially as part of corporate social responsibility or a system similar to that applied for ethical biotrade. Companies could benefit from legal certainty in products developed, and even utilize the BBNJ Identifier in marketing of products (Oldham & Thambisetty, 2023). Parties could potentially regulate for this within national jurisdictions. The second challenge will be to determine which Party reports on the activities of a multinational corporation and its products. A further, unaddressed, question is what the implications are for a product that uses DSI sourced from multiple origins with different international frameworks including CBD and the BBNJ Agreement and/or DSI outside the scope of these two frameworks. In these cases of "mixed

DSI use" which legal requirements will prevail in the event of inconsistency, or will all apply equally? What if the ABNJ portion's contribution to a product is a small minority or not part of the claim but "only" part of the reference material of the patent application? Will BBNJ agreement reporting requirements still apply? These practical questions will require further consideration (see also scenario 3).

The BBNJ Agreement has an initial monetary benefit sharing scheme that is decoupled from the MGR R&D processes discussed here. That said, once the BBNJ Agreement enters into force, the CoP will decide on the modalities for a monetary benefit sharing scheme arising from the utilization of MGR and DSI, requiring an understanding of current practices of scientists and commercial end users. In that regard, there is a lack of baseline data on products from BBNJ. Private sector entities could provide records of products developed/costs/profits directly to the CHM since such information may be requested by a Party that has jurisdiction over the entity. This would support the work of the ABS Committee to make guidelines or a code of conduct for activities with respect to MGR and DSI (art 15(3)(a)). While details associated with the future monetary benefit sharing tied to samples from BBNJ may not be decided for a year or more, the private sector could explore potential implications of the requirements and prepare avenues for data sharing on commercial uses.

14.2.4 Access to MGR and DSI in Repositories and Databases

Both the notification and benefit sharing systems contain obligations about access to MGR and DSI in repositories and databases. Parties must take measures to ensure that MGR and DSI on MGR of ABNJ (together with their BBNJ Identifier) that are subject to "utilization" are "deposited in publicly accessible repositories and databases, maintained either nationally or internationally, no later than three years from the start of such utilization, or as soon as they become available, taking into account current international practice" (art 14(3)). Access to MGR and DSI may be subject to the reasonable conditions of:

(a) The need to preserve the physical integrity of MGR;
(b) "Reasonable costs associated with maintaining the relevant gene bank, biorepository or database in which the sample, data or information is held";
(c) Reasonable costs associated with providing access; and
(d) Other reasonable conditions in line with the objectives of the BBNJ Agreement.

The treaty goes on to say that opportunities "for access on fair and most favourable terms, including on concessional and preferential terms, may be provided to researchers and research institutions from developing States" (art 14(4)).

As soon as information becomes available, Parties must notify to the CHM the modalities envisaged for access to MGR and DSI that are subject to "utilization" (art 12(8)(d)). These "access" provisions are distinct from the concept of "utilization", although the term "access" is undefined in the treaty (Humphries, 2025).

Several UK institutes collect, house and conduct work on MGR from ABNJ including publicly funded research institutes, universities, museums, and private consultancies. Relevant organizations include the Marine Biological Association (MBA), the National Oceanography Centre (NOC), the British Antarctic Survey (BAS), the Natural History Museum (NHM), Plymouth Marine Laboratory (PML), and a numerous universities and consultancies. These include both "official" national repositories of the NHM for example, which fall under existing legislation (the British Museum Act) and more general scientific repositories, housed in university, government, or commercial research institutes and laboratories (e.g. biotechnology companies, private consultancy). These entities and sectors will have different degrees of formalization for collections management. Depending on interpretation of the

BBNJ Agreement, some may comprise entities responsible for reporting. These organizations currently house MGR, which would fall under the BBNJ Agreement only if the retroactive application of provisions under article 10(1) are accepted by the UK when ratifying. But whether retroactivity is applied or not, all MGR collected and housed in these repositories *following* ratification would be in scope. Retroactivity also has implications for handling and storage of MGR and DSI. If applied, then ensuring that MGR are identified as originating from ABNJ could be required for existing collections (art 12(6)) which may necessitate significant additional curation and databasing (with cost implications, as outlined below).

Article 14(4) as above covers what the negotiators considered were reasonable conditions for facilitating access. Scientific sample repositories in the UK (including but not restricted to museum collections) are available for research as standard practice globally, any limitations on access are likely to arise for the reasons stated in the text, "preserving the physical integrity of samples". This recognizes that samples as physical entities are finite by nature and undergo attrition, i.e. can be "used up" in the research process. Other reasonable conditions could include existing research agreements, for example samples may be embargoed during the research project phase until the project is completed. "Reasonable costs" will arise through provision of access to samples (e.g. sample processing, staff time) to account for the time-intensive process of curation of biological collections and associated data. These potential fees could be waived or reduced for developing States, as is current practice for some museums and collections. Potentially the benefit sharing fund (see Sect. 2.5 below) could subsidize the costs of collection material for users from developing States. Input on "reasonable conditions" and "reasonable costs" could also be provided by the STB. It is important to recognize also that while most collections of MGR are currently housed in developed States (Collins et al., 2021), whatever the challenges for these institutes to meet the treaty requirements, those based in developing States will be far greater.

The requirement for repositories and databases to ensure MGR/DSI can be identified as originating from ABNJ in article 12(6) could be challenging as outlined in 2.3 above. The onus is on the Party that hosts these entities to ensure and monitor compliance which may be possible for national repositories with adequate resources. The BBNJ Identifier will need to be captured by in-house databases of marine research institutes/repositories, which as for global databases in Sect. 2.3 above would require development or field modification for the relevant database and associated documentation. Automating reporting will be important for larger organizations to minimize administrative burden.

Article 12(7) requires Parties to ensure that repositories, to the extent practicable, and databases under their jurisdiction prepare a biennial aggregate report on "access" to MGR and DSI linked to their BBNJ Identifier and make the report available to the ABS Committee. The language "to the extent practicable" recognizes that it may not be possible to require all repositories to compile the report, but at least the major repositories holding MGR may have the capacity to compile such a report. One key issue for understanding what to report is that the term "access" is undefined. For example, a scientist may borrow an MGR from a collection simply to compare it physically with another MGR. Such action would not be considered utilization, but potentially considered "access" by default. Practicalities of such an interpretation would need to be carefully considered given common practice of exchange of material across institutions, and scientists visiting institutions to study their collections. Monitoring "access" at such granularity would be of little value to the benefit sharing system but could have massive cost implications. Similarly, what defines "access" for DSI will need to be carefully considered (see scenario 3 in Sect. 3.3). It is important that disproportionate and burdensome reporting requirements are avoided, such as equating a BLAST

search with access. Monitoring access to DSI in any case will not be feasible as stated in the 2022 Kunming-Montreal Global Biodiversity Framework (GBF) decision on DSI that "Recognizes that tracking and tracing of all digital sequence information on genetic resources is not practical" (CBD/COP/DEC/15/9; see also Rohden et al., 2020; Scholz et al., 2022). Further, while the aggregate report in theory would be light touch, there would be a need to collate information in totality to be able to report in aggregate. Ideally reporting processes would be automated as far as possible (see Sect. 2.3). National legislation implementing the treaty obligations will need to address what "access" means, and guidance from the CoP will be important to ensure consistency across Parties.

14.2.5 Benefit Sharing

Article 14 provides a framework for the fair and equitable sharing of monetary and non-monetary benefits from activities with respect to MGR and DSI on MGR of ABNJ (Broggiato et al., 2025; Lavelle & Wynberg, 2025). The treaty text provides an inclusive list of non-monetary benefits, including

- Access to samples, sample collections and DSI;
- Open access to FAIR (findable, accessible, interoperable, reusable) scientific data;
- Information contained in the notifications and BBNJ Identifier in publicly searchable and accessible forms;
- Transfer of marine technology and capacity building;
- Increased technical and scientific cooperation, in particular with those in developing States; and
- Other forms of benefits as determined by the CoP (art 14(2)).

It establishes a special fund that will be funded through annual Party contributions, additional contributions from Parties and private entities and payments in accordance with article 14(7) monetary benefit system (art 52(4)). Under this system, the CoP will decide on the modalities for the sharing of monetary benefits from the utilization of MGR and DSI, taking into account the recommendations of the ABS Committee. Modalities may include milestone payments, payments related to the commercialization of products, a tiered fee based on aggregate level of activities by a Party or other forms the CoP decides.

Article 14(3) provides that one form of non-monetary benefit sharing is open access to FAIR data in national databases "in accordance with current international practice and open and responsible data governance". Existing principles of FAIR data management are well established in the scientific community (Page, 2023) and open access to DSI, required for peer-reviewed publication, is consistent with these principles. Standard practice for UK-funded research are data policies to ensure data are openly accessible within a two-year window, with some UK institutes mandating publication solely in open access journals, contributing to non-monetary benefit sharing (art 14(2)(a–h)).

Article 14(9) indicates that benefit sharing modalities under the BBNJ Agreement "should be mutually supportive of and adaptable to other access and benefit-sharing instruments". Article 15(5) sets out how the ABS Committee "may consult and facilitate the exchange of information with relevant legal instruments and frameworks … including benefit-sharing, the use of DSI on MGR, best practices, tools and methodologies, data governance and lessons learned". Current discussions under the CBD and the GBF regarding how benefits from the use of DSI should be shared recognize the complexity of the situation and are developing a framework for the instruments that deal with DSI to work together towards a common solution. Guiding principles are listed in the "DSI Decision" under the GBF and are based on sound scientific and pragmatic principles (CBD/COP/DEC/15/9). If such an overarching global benefit sharing mechanism could be agreed for all DSI falling under different UN instruments, then a multilateral DSI fund could disburse funds for

conservation and sustainable use of biodiversity both within and beyond national jurisdiction.

This section demonstrates that many of the requirements under the MGR framework are already part of scientific practice, but there is a long way to go in incorporating practices by commercial end users into the framework. It is important for implementing the objectives of both Part II and Part V of the BBNJ Agreement to go beyond these contributions, including the instances of contributions to capacity building and transfer of marine technology (CB/TT) listed in Article 14(2)(e–h) (Harden-Davies et al., 2022). Funding for capacity building could be scaled up through existing practices, where opportunities are promoted and encouraged through science programme funding calls. Alignment with capacity building initiatives under the Nagoya Protocol is also important. Mandatory funding for CB/TT could be considered by research funding bodies, with careful input on ensuring sustainability. There are opportunities for greater harmonization in CB/TT efforts. Policies should be checked at national levels and revised to ensure compliance with BBNJ Agreement requirements and ensure that reporting can be collated centrally from a range of sources including repositories, databases, ABS clearing house mechanisms and Party implementation infrastructure, to share with the ABS Committee and the CoP for ongoing decision-making on notifications and benefit sharing.

14.3 Scenarios About How the BBNJ Agreement May Apply to R&D and Commercialization

This section explores scenarios based on existing scientific practices associated with MGR research, which follow the pathway of a collected sample from ABNJ through the R&D pipeline (including potential commercialization): in effect, a "day in the life" of an MGR. Scenario 1 is a simple linear example followed by more complex, non-linear scenarios concerning MGR, DSI and TK. Scenarios cover the following areas/activities:

1. MGR collected from a research cruise using a national research vessel (Sect. 3.1);
2. the use of MGR collected prior to the BBNJ Agreement/national laws coming into force (Sect. 3.2);
3. the use of ABNJ-sourced DSI (Sect. 3.3);
4. automation in collection and R&D (Sect. 3.4),
5. MGR for R&D sourced from fish harvest-related activities (Sect. 3.5), and
6. the use of TK associated with MGR in ABNJ (Sect. 3.6).

14.3.1 Scenario 1—Simple Linear Scenario—Collecting MGR from ABNJ with a Research Vessel (Cruise)

This scenario describes a linear example where MGR is collected on a research cruise using a national research vessel carrying out biological/biodiscovery research in ABNJ (see, e.g. Alcock, 2014; Clark et al., 2016; Rabone et al., 2019). Research cruises to ABNJ are commonly funded by national research funding bodies through a grant application (which would typically also include a cruise proposal and cruise application). Such a grant application may include plans for sample and data collection and utilization, and a DMP, which are requested by many funders at this stage. To enable efficient use of valuable cruise time, many research cruises involve multiple teams, often from different countries, carrying out distinct research projects. This requires careful cruise planning, including use of equipment and on-board facilities and may involve compromises among the teams. A plan for training early career researchers including from developing States may be included, but is not necessarily required, which is a potential area for improvement in the treaty process. Once a grant for a deep-sea expedition is awarded, the next stage may involve confirming

technical feasibility of the proposed work and availability of sampling and on-board facilities. The cruise path may cross regions under special designation such as marine protected areas and associated permits or environmental impact assessments would need to be in place. During the research cruise, the sampling sites and deployments, and even intended cruise path may change due to weather conditions. The functionality of sampling gear and discoveries made while on the cruise may also alter the research aims and objectives (Clark et al., 2016). Once collected, samples may be preserved on board or analysed immediately, and data generated. As described in Sect. 14.2, any physical samples collected in ABNJ could be in scope as (a) may contain MGR, and (b) the collection event in ABNJ rather than the intent of use triggers requirements (Humphries 2025).

The BBNJ Agreement requires a pre-collection notification to be submitted to the CHM six months or as early as possible prior to the collection or sampling of MGR from ABNJ (art 12). Once submitted, the CHM will automatically issue a BBNJ identifier to be linked to the pre-collection notification. The issued BBNJ Identifier would link the sample/organism and associated DSI that are subsequently identified from the collection if it is included in the metadata or other records associated with the samples or DSI. In other words, the user of the MGR or DSI may be able to trace the organism or data back to the original collection if the BBNJ Identifier maintains its link within repositories or databases. This requirement can only be fulfilled once the CHM and its BBNJ Identifier function are operational, the timeframe of which is currently unknown. After the BBNJ Identifier is issued, there is a requirement that "updated information shall be notified to the CHM within a reasonable period of time and no later than the start of collection in situ, when practicable" if there is a "material change to the information provided to the CHM". It is not clear what constitutes a "material change" and what entity would determine whether the changes exceed the threshold (see Sect. 2.1 above).

During operations, a database will be populated with information about cruise operations, potentially including deployments and sample collections. This information forms part of the subsequent cruise report that presents the results obtained within a set time from demobilization, often within a year. Once the cruise returns to port, samples may be shipped to the institutions of respective project teams. This means that the same MGR, and different MGR with the same BBNJ Identifier, may end up in multiple repositories in various countries, with implications for reporting (see Sects. 2.2 and 2.3 above). The final cruise report may contain a narrative including a summary, study sites and scientific sampling. Several national oceanographic institutions have online portals for depositing the cruise plan and cruise reports and have sophisticated mechanisms to interrogate the sampling data generated, but this capacity is limited to developed States with resources (see Sect. 2.1 above).

After the research activities are complete and the vessel returns to shore, there is the requirement in the BBNJ Agreement's article 12(5) to notify the CHM with required post-collection information "as soon as it becomes available, but no later than one year from the collection in situ of marine genetic resources of areas beyond national jurisdiction". Most of the notification requirements can be fulfilled by providing the cruise report and the relevant cruise database (see Sect. 2.2 above). Article 12(7) requires that Parties to prepare an aggregate report on MGR and DSI linked to the BBNJ Identifier for the ABS Committee every two years "to the extent practicable". In principle, each sample record in the cruise database would be associated with the same BBNJ Identifier, which will stay linked to MGR/DSI from the original collection. If a research programme has multiple project leads, there is likely to be one database per project. There is an opportunity for treaty bodies to encourage the consistent application of data and metadata standards to ensure that all data complies with FAIR principles (see Sect. 14.2). Much of the detail around how the process will work remains to be determined by the CoP,

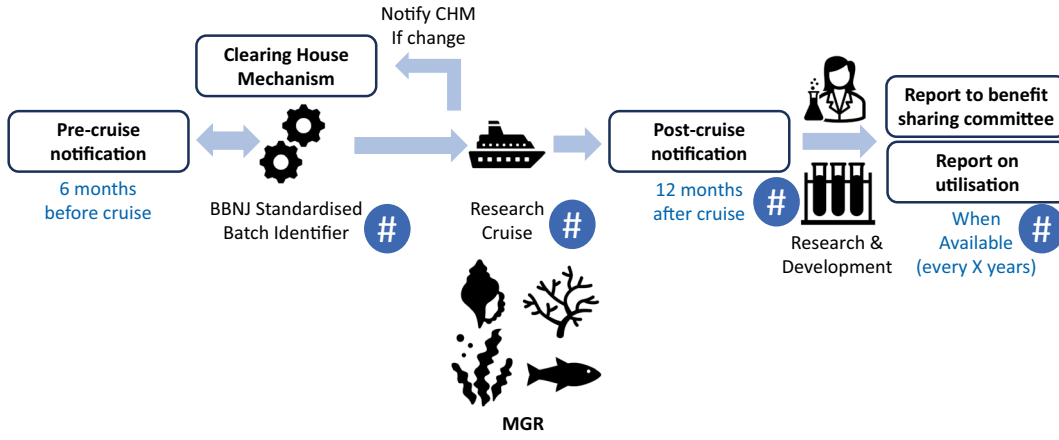

Fig. 14.2 Requirements of article 12 applied to a simple linear scenario involving a planned cruise by a national research vessel

with the support of its subsidiary bodies, but the intent appears to be to keep the system as simple as possible using the BBNJ Identifier (art 12(7), 14(7)).

In summary, cruise plans and reports in current practice already fulfil many of the BBNJ requirements (see also Tables 14.1 and 14.2) but even a linear scenario can have many variables. Further, while this scenario describes a cruise in ABNJ, cruises may collect both within and beyond national jurisdictions (Rabone et al., 2019) (Fig. 14.2).

14.3.2 Scenario 2—The Use of MGR and DSI Collected or Generated Prior to the BBNJ Agreement Coming into Force

Article 10(1) provides that the BBNJ Agreement applies to activities with respect to MGR and DSI on MGR of ABNJ collected and generated after the entry into force of the treaty for the respective Party. In other words, a State that has ratified the treaty by implementing their obligations under national laws (i.e. become a Party to the treaty), will state the date from which their laws will apply to the collection and generation of MGR and DSI for their nationals who undertake these activities. This follows the ordinary rules of international law that treaties and laws are not normally retrospective (see Humphries, 2025). However, the article goes on to say that the treaty obligations apply to "utilization" of MGR and DSI on MGR of ABNJ that were collected or generated *before* entry into force, unless a Party makes and exception when ratifying. In other words, while the provisions for collection, including pre- and post-collection notifications and the provisions for "access" to MGR and DSI in repositories are not retrospective, depending on the way each Party deals with temporal scope under their national laws, the provisions for "utilization" may be retrospective and cover MGR from ABNJ collected before the legislation came into force.

If a Party does not opt out of the retrospective effect for utilization, MGR collected prior to the law coming into force that is the subject of "utilization" (e.g. legacy MGR) will not have a BBNJ Identifier as there will have been no pre-collection notification (Fig. 14.3). This MGR may still need to be included in any report to ABS Committee and subsequent reports on utilization, however. The BBNJ Agreement does not specify how relevant information about MGR without a BBNJ Identifier should be supplied to the CHM. In the first instance, it may not even be possible to determine what is in scope given legacy collections may not have locality data to ascertain whether they were collected

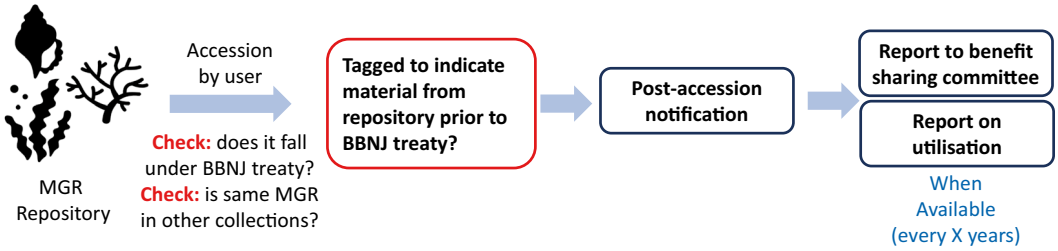

Fig. 14.3 Potential workflow for MGR collected prior to a treaty housed in an MGR repository, accounting for potential retroactivity of article 10

from ABNJ. Retroactivity for MGR under the BBNJ Agreement raises other complexities. The same MGR from the same pre-BBNJ cruise may be housed by institutes in different States, some that are Parties have opted out of retroactivity and some that have not and some States that have not become Parties and are not under BBNJ Agreement obligations, which would complicate reporting for ongoing R&D and commercialization of MGR and associated DSI. It may also promote jurisdiction shopping where "utilization" is conducted in States with the least regulatory and reporting burden.

Legacy MGR potentially could be "tagged" in some way to indicate it was obtained from ABNJ before the BBNJ Agreement and relevant Party's law entered into force (Fig. 14.3). Such a tag could both differentiate the pre-BBNJ MGR and also act as a flag that not all data will be available and therefore may not meet the notification requirements for utilization (e.g. location where the original sample is held, details of the post-collection notification and the modalities of access by third parties (art 12(8)). The data outlined in the pre-collection and post-collection notifications may not have been collected originally, or there may be significant costs for the repository in finding the information (see Sect. 14.2), although the only reporting requirements in this retroactive scenario concern those relating to "utilization". However, the technical feasibility of implementing such a tag, or how it may align with the BBNJ Identifier, is unclear, and whether it would clarify, or further complicate matters requires consultation with repositories, databases and other stakeholders (Sect. 14.2).

14.3.3 Scenario 3—Use of ABNJ-Sourced DSI

For DSI on MGR of ABNJ that has been deposited in a database after the BBNJ Agreement enters into force, with the source MGR having been notified under a pre-collection notification (Fig. 14.4), a BBNJ Identifier will be associated with the MGR and connected to the resulting DSI (art 12(5)(a), 12(6)) to enable downstream reporting on "access" and "utilization" (arts 12(7), 12(8)). These requirements raise the question of what comprises "access" and "utilization" for DSI. For example, does using DSI in a comparative search (e.g. BLAST) or in a phylogenetic tree constitute access? Or would such activities need to be more substantial than simply comparative? And, if so, can and will this distinction be made? It is important interpretations of these terms by treaty bodies are grounded in practicalities and researchers are cognizant of what activities may apply (see Sect. 14.2).

The requirement for post-collection notification to the CHM on the original MGR and the repository where the sample is kept (arts 12(8)(b–c)) could be met using the BBNJ Identifier associated with the DSI on MGR, allowing it to be traced to the relevant notification (although not necessarily to the relevant repository—see Sect. 14.2). If research yields a patentable discovery and a patent is applied for and granted (i.e. if claims are being made on the DSI on MGR or if the DSI is needed "in order to enable a practitioner skilled in the art to reproduce

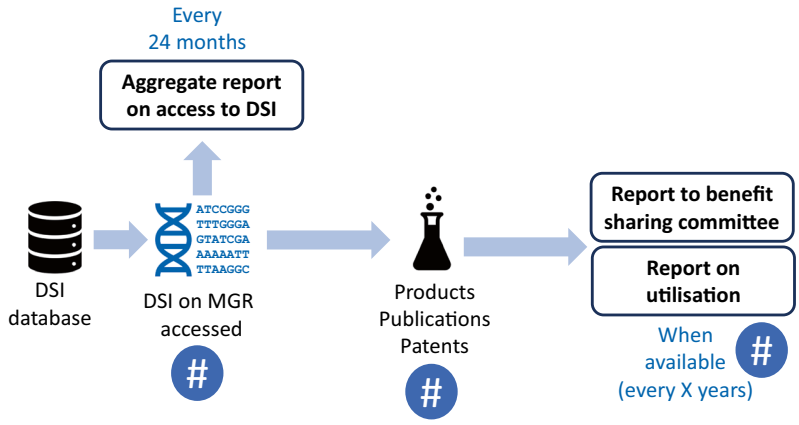

Fig. 14.4 A "simple linear" example of the use of DSI on MGR of ABNJ where the DSI on MGR is used directly from a database with no modification to generate a product

the invention"; TRIPS agreement,[8] article 27), then article 12(8) also requires notification to the CHM of where this patent can be found. The WIPO recently revised policies and now requires disclosure of origin so this should allow compliance (WIPO, 2024, see Sect. 2.3 above). Similarly, INSDC now requires spatiotemporal information for all DSI published on the database, with some exceptions. Issues may also arise if the sequence queried is not unique but shared, for example in members of a single species that has been collected both in ABNJ and in AWNJ.

In reality, the use of DSI is far more complex than the above simple linear scenario suggests. DSI used in a product may be derived from multiple MGR from both ABNJ and AWNJ, potentially also collected before the BBNJ Agreement entered into force (Fig. 14.5). At the start of this process, DSI on MGR is queried against a DSI database containing millions of sequences returning potentially 10–1000 s of sequences from different organisms, including e.g. terrestrial microorganisms (under CBD), plants [under the *International Treaty on Plant Genetic Resources for Food and Agriculture*[9]] and deep-sea fish (MGR collected prior to the BBNJ Agreement). Sequences from these three sources may be combined with the original DSI on MGR used in the query leading to a "hybrid" consensus sequence (a synthetic sequence based on many sequences). This new hybrid may be subject to even further modification based on additional sequences or via targeted mutations or directed evolution. After a research process taking months to years, a final sequence is arrived at which could be used in a final product that may be patented and commercialized. It will be challenging to determine the individual contribution of each original sequence was to the final product. Further modifications may take the product DSI far from the original sequence so that it is likely impossible to trace it back to the original DSI on the source MGR. Also, only the DSI derived from MGR collected after the BBNJ Agreement for the respective Party came into force will have a BBNJ Identifier. It will be very challenging therefore to calculate which benefits should be

[8] *Marrakesh Agreement Establishing the World Trade Organization*, Annex 1C (*Agreement on Trade-Related Aspects of Intellectual Property Rights*), opened for signature 15 April 1994, 1869 UNTS 299 (entered into force 1 January 1995) (TRIPS Agreement).

[9] *International Treaty on Plant Genetic Resources for Food and Agriculture,* opened for signature 3 November 2001, 2400 UNTS 303 (entered into force 29 June 2004).

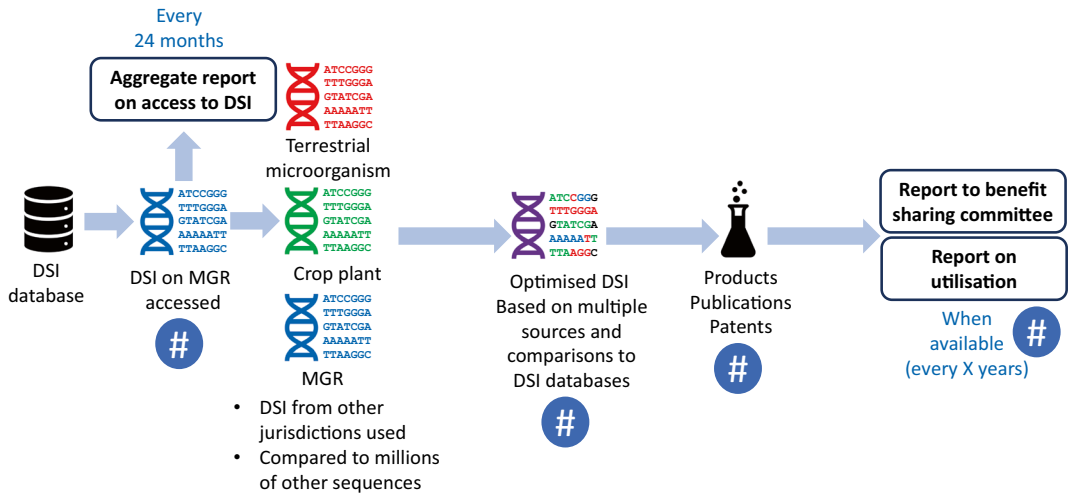

Fig. 14.5 A more complex and realistic example of how DSI on MGR might be used to create a product. DSI on MGR is compared to other sequences in the database, and the eventual sequence contains elements of DSI from other types of organisms that fall under different regulations/regimes. Additional optimization may be carried out to derive the eventual DSI that is used to create a product

shared with which UN ABS fora for each of the DSI utilized. In any case, there are currently no mechanisms in place to deal with benefit sharing from DSI under any UN instrument dealing with DSI (UNEP, 2022).

If a DSI on MGR that is used was deposited prior to the BBNJ Agreement entered into force (legacy DSI), then article 10(1) allows a Party to opt out of retroactivity (scenario 2). Some data held in databases prior to the BBNJ Agreement will not have spatiotemporal information that makes it easy to identify as originating from ABNJ, and therefore in scope. Even if the DSI can be identified as coming from MGR of ABNJ, it will not have a BBNJ Identifier, or even the required associated data, so it may not be feasible to comply with article 12. The application of retroactivity on DSI may require the "tagging" or identification of pre-BBNJ DSI records in databases. How this tag could (or even should) be implemented requires further input by treaty bodies and Parties. Further, given the main DSI databases (INSDC) are multinational collaborations, the question who will implement and report on this data remains.

14.3.4 Scenario 4—Automation in Collection, Research and Development

"Collection in situ" includes the activities of collection and sampling (art 1(4)). Autonomous underwater vehicles (AUVs), also called Uncrewed Marine Vessels, that collect data and samples from ABNJ can have different levels of autonomy, ranging from remotely operated vehicles (ROV) with some human operation to fully autonomous vessels with machine learning and artificial intelligence (AI) capabilities (IMO, 2021). AUVs can take samples of water and sediment that contain MGR or samples of live biological specimens. They can collect, integrate and transmit information related to the physics, chemistry and biology of the ocean (Chai et al., 2020). Techniques for automated collection and analysis are rapidly evolving. For example, sequencing can now be carried out in situ (in the field), using portable sequencing technologies, and combined with environmental DNA (eDNA) sampling, which allows sequencing of DNA filtered directly from water or sediment samples to

analyse genetic material in the cells and identify species present (Harrison et al., 2019).

Parties have an obligation to ensure information is notified to the CHM when MGR and, where practicable, DSI are subject to utilization, including commercialization "by natural or juridical persons under their jurisdiction" (art 12(8)). The legal status of AI and whether it can be a "juridical person" varies between States (see Humphries, 2025). Whereas ROVs for example have some human involvement, it is likely that the wording of the "utilization" notification for MGR and DSI will have a loophole for fully autonomous entities without legal personhood. In contrast, the pre- and post-collection notifications and obligations relating to "access" to MGR and DSI in repositories and databases have no such limitations and can be triggered by activities carried out by remotely operated and fully autonomous entities. However, the pre- and post-collection notifications are confined to collection in situ of MGR of ABNJ, which means the physical samples and not the information components such as DSI, which is subject to obligations as distinct subject matter (see Humphries, 2025). It is only collection of the physical MGR that is the trigger for the pre-collection notification and the automatic assignment of the BBNJ Identifier, meaning that those activities that collect data directly from ABNJ as described above may not be captured.

Further, the nature of autonomous collections and sampling do not necessarily fit within the expected timeframes of the pre- and post-collection notifications. Without humans on board, the patterns and timing of collection can vary significantly from the cruise envisaged in scenario 1. Autonomous collections and sampling may be from permanent moorings, AUVs or floats that can conduct uninterrupted missions for months if not years (Chai et al., 2020). The information may be transmitted to a research facility within national jurisdiction in real time or AUVs may carry out in situ analysis in ABNJ (Chai et al., 2020). The research projects might change during the uninterrupted (possibly indefinite in future) deployment but notification of material changes to the pre-collection must be done before the vessel leaves shore for the first time (art 12(4)). It may be impractical for the post-collection notification to be carried out no later than one year from collection in situ if the collection is ongoing.

Whereas the "utilization" obligation was envisaged by the negotiators as being an activity that comes after the collection activity in ABNJ under the linear scenario 1 with advances in technology, "utilization" of MGR and DSI may occur within ABNJ at the time of collection as above (Chai et al., 2020). There are rapid advances in employing machine learning/AI techniques for the utilization of DSI, but if these are considered to be fully autonomous, they may fall outside scope of the utilization notification and information sharing obligations. In practice, it may be impossible for a Party to distinguish between those utilization activities carried out within their jurisdictions by natural and juridical persons and those that are not.

Currently it is unclear what activities fall under obligations concerning "access" to MGR and DSI in repositories and databases (see Sect. 2.4 above). If access extends to a BLAST search or similar, then it would not matter whether the activity was generated through AI or not because the "access" provisions are not similarly constrained as the "utilization" provisions to those undertaken by natural or juridical persons. Figure 14.6 outlines a common-sense approach to notification of activities with respect to MGR and DSI on MGR of ABNJ following the linear scenario for manned cruises. One option is post-deployment notification after 12 months as shown (Fig. 14.6) but an AUV may collect data for a full year or beyond, therefore another option could be 12 months after final data upload/mission completion.

By including different subject matter triggers for "collection" and "utilization" activities, the BBNJ Agreement creates possible loopholes for AI-related research that is increasingly being used in each of these activities. MGR and DSI as physical and digital entities are distinct but intrinsically linked (Rabone et al., 2019). The artificial separation of collection for physical

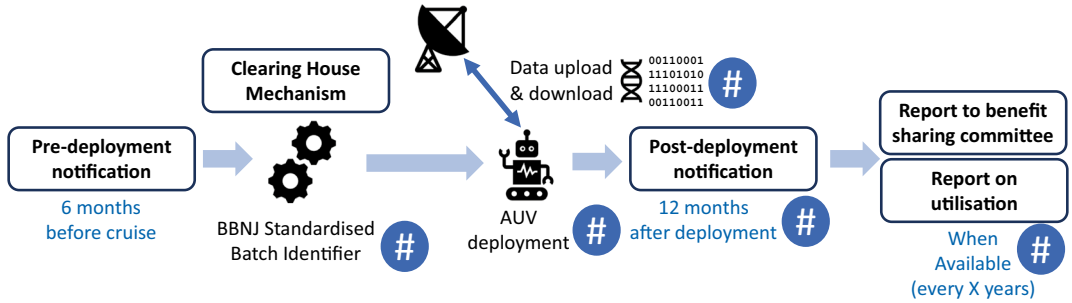

Fig. 14.6 Potential pathway for MGR collected by unmanned underwater vessels, using artificial intelligence in the process

samples and for the information components creates loopholes and complexities in the notification system. Until the BBNJ Agreement bodies clarify the situation for AUVs, applying a common-sense approach, Parties should ensure that the pre-notification is carried out prior to the first deployment of the AUV to ABNJ if the original project intends to collect samples and data. The notification mechanism is largely tailored to the linear ideal of collection, sampling and utilization of MGR from ABNJ via manned cruises rather than automation in these activities. In reality, BBNJ Agreement bodies will need to provide specific guidance for accommodating the distinguishing features of fully autonomous activities, such as the length of deployment and the geographical location of subject matter including activities that do not fit neatly within the linear scenario.

14.3.5 Scenario 5—Fish and Fishing-Related Activities

Article 10(2) of the BBNJ Agreement provides two related exemptions to the scope of application for Part II MGR. These are (1) fishing regulated under relevant international law and fishing-related activities (art 10(2)(a); and (2) fish or other living marine resources known to have been taken in fishing and fishing-related activities from ABNJ, except where such fish or other living marine resources are regulated as utilization under part II on MGR (art 10(2)(b)). Together, these provide a broad exclusion of both fisheries harvest activities and living marine resources, including fish, caught as a commodity in ABNJ. The exclusion not only covers the activity of fishing but also the resources that are the result of such activities. Like the Nagoya Protocol, the determining factor is the presence/absence of utilization. In terms of fishing activities, the exclusion means that such activities will not have to comply with any of the collection-related requirements of Part II MGR, such as a pre-cruise notification, which might pose some practical challenges.

Regarding living marine resources, many different scenarios could be described in which these are collected with other purposes than utilization as an MGR, yet later the resource, parts of it, or associated organisms are utilized as MGR. Examples include specimens acquired from recreational fishing, or from commercial fishing vessels (including bycatch) via observers, or acquired later, e.g. from fish markets, and/or subsamples thereof, including ecto- or endo-parasites (Koepper et al., 2022), gut microbiomes, or tissue samples. In these cases, the MGR will enter the BBNJ MGR pathway at a later stage (Fig. 14.7). All the post utilization steps, such as notification on use and reports to the ABS Committee, will be similar to standard MGR collections.

A simple case can illustrate how the exemption in article 10(2)(b) may apply. An unusual fish is harvested as part of a catch from a

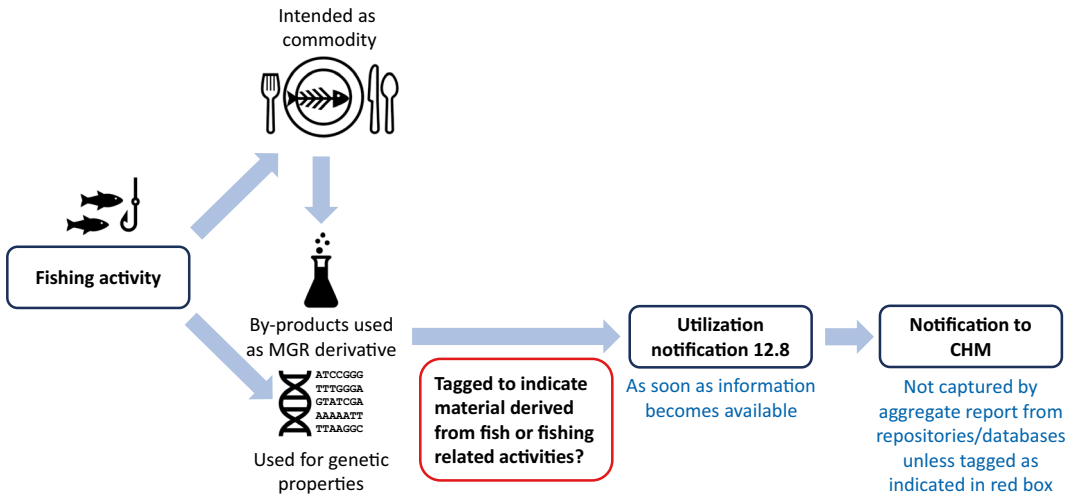

Fig. 14.7 Using MGR arising from fishing or fishing-related activities under the BBNJ agreement

commercial fishery from the high seas. It is sold at a fish market to a researcher who is interested in investigating its apparent unusual properties. There has been no pre-or post- collection notification because it was extracted from ABNJ under the fisheries exemption. Consequently, the harvest (collection) does not have an associated BBNJ Identifier (because there was no pre-collection notification) and the fish enters the R&D pipeline at the stage of "utilization". "Utilization" obligations are triggered if there is R&D 'on the genetic and/or biochemical composition' of MGR (art 1(14)). Genetic manipulation of the fish would clearly trigger the utilization notification, as would other investigations into its genetic or biochemical composition (see Sect. 2.3 above). This utilization notification to the CHM would apply in the same way as MGR that have been collected on a research cruise for example. The utilization notification is not dependent on having a BBNJ Identifier (it is only required "if available"). The aggregate report to the ABS Committee would not include access to MGR or DSI, which is dependent on the relevant MGR or DSI being linked to a BBNJ Identifier (art 12(7), see Sect. 2.4 above). This means that the only means of including the information about MGR in aggregate reports would be if the CoP designed another mechanism to "tag" this material as originating from ABNJ under fish or fishing-related activities, similar to potential tagging of "legacy" or pre-BBNJ MGR and DSI (scenarios 2 and 3) to link repository data to the CHM. The outcomes of research from its use, however, may be notified under the utilization notification to the CHM.

A less straightforward example would be harvesting marine living resources known to have been collected by fishing-related activities from ABNJ to increase biomass for pharmaceutical leads. For example, deep-sea sponges might be harvested from ABNJ or as bycatch in another ABNJ fishery such as halibut or cod fisheries (Munoz et al., 2020). To bring a commercial product to market may require large quantities of the original sponge (if it is not cost effective to synthesize the product) over a long period of time for different stages of R&D and commercialization. This might either be achieved from repeated collections from ABNJ or through aquaculture, which is a key activity for building biomass and has been used for producing sponges and metabolites for pharmaceutical purposes in AWNJ (Duckworth, 2009). Would obtaining the sponges under harvest fisheries be exempt so that the collection is not subject to pre-collection notification when the intent of the harvest is ultimately for R&D purposes? If sponges are originally collected from ABNJ and then farmed in AWNJ as a bulk commodity

(increasing biomass) would it be exempt under article 10(2)? The operation of the article 10 exemption seems to require an element of intent, whereas the collection notification does not require "intent" of collection for R&D purposes (unlike the "utilization" notification) because the trigger for the pre-collection notification is simply collection or sampling of MGR of ABNJ (art 1(4)) (Humphries et al., 2025b). Although the sponges would be collected for fishing-related purposes (harvest or aquaculture), the ultimate use is for "utilization" and it is likely that it would not fall within the exemption and be subject to both pre-collection and "utilization" notifications.

The CoP may need to clarify whether intent is a relevant for the fishing-related exemption to apply and when intent must be ascertained. An example illustrating the possible need to ascertain the ultimate use of the harvested fish or marine living resources at the time of collection concerns harvesting fish to produce fish oil as a product for nutraceutical or medical applications. If the fish are collected (harvested) for their oil (as a bulk commodity), then article 10(2) exemption would apply (scenario A). If the oil was subsequently refined though industrial means to increase its strength (scenario B), would the exemption status change? Arguably, the fishing activity is still harvesting a fish to produce a (more refined) bulk commodity within the meaning of article 10. If the fish that were harvested or the derivatives from the fish (i.e. the oil) are subsequently subject to R&D on the genetic or chemical composition (e.g. ascertaining genes associated with higher oil content) to create an oil with new properties (scenario C), would the activity then fall within the "utilization" notification which applies to MGR or their derivatives (art 1(3) definition of biotechnology)? It is likely this would be viewed by scientists as R&D and not simple processing. However, when it comes to "utilization" of a derivative (as opposed to the MGR), it arguably falls within the notification trigger if it meets the higher threshold of "making or modifying products or processes", rather than simply investigating the genetic or chemical composition (see Sect. 2.3, Humphries, 2025). This indicates that in scenario C, if the fish are harvested for their oil (derivative), which is simply investigated for genes associated with higher oil content, it might not meet the "utilization" threshold but if they are harvested for their oil to create an oil with new properties (e.g. manipulate molecules to increase potency or work with other chemicals to increase storage life or minimize side effects), it might. In reality, whether a fish or fishing activity is in scope of the exemption will depend on the way a Party implements its treaty obligations under national law, but guidance from the CoP would be crucial for a consistent approach.

While the treaty is silent about "intent" for the exemption or utilization notification triggers to apply in a specific case,[10] in practice the above examples demonstrate that "intent" may indicate whether the harvest is for the purposes of bulk commodities (exemption is likely to apply) or R&D (exemption is unlikely to apply). The activities under the exemption are undefined and negotiators removed the qualifying term "commodity" which would have made it clearer that the activities under the exemption are not for the purpose of investigating genetic or biochemical composition. As the above examples demonstrate, the reality is that determining whether a fish or living marine resource or fishing/fishing-related activity is exempt or not may depend on the R&D activity being undertaken and whether the research relates to the MGR (investigating genetic/biochemical composition) or its derivatives (making or modifying products or processes). Figure 14.7 outlines the simple case above for determining whether the exemption applies and if not, how the information about its use would reach the CHM. It demonstrates that only the utilization notification to the CHM would be triggered but unless a new tag or identifier is created for material derived from fish/fishing-related activities (red box), the aggregate report to the ABS Committee for access to MGR or DSI from repositories and

[10] Intent is not relevant.

databases (art 12(7)) would not be able to pick up this data.

14.3.6 Scenario 6—Traditional Knowledge Associated with MGR in ABNJ

The BBNJ Agreement takes a similar approach to the CBD and Nagoya Protocol in regulating access to TK associated with MGR in ABNJ (see Pena-Neira & Coelho, 2025). Instead of TK being managed under the BBNJ Agreement's multilateral notification, monitoring and benefit sharing mechanisms, it will be governed by each Party "where relevant and as appropriate" under a bilateral approach of authorizations and contracts (Mutually Agreed Terms—MAT) with the knowledge holder. Parties have wide discretion about whether they take legislative, administrative or policy measures "with the aim of ensuring that" TK associated with MGRs in ABNJ held by IPLCs is only accessed with Free, Prior and Informed Consent (FPIC) or approval and involvement of the IPLC that holds the knowledge; "Access to and use of such TK shall be on mutually agreed terms" (art 13). This obligation means that each Party that decides to regulate TK may have different procedures and requirements for determining what TK is covered by the obligation (the scope), identifying the correct knowledge holders, obtaining FPIC and establishing MAT.

While the BBNJ Agreement does not directly regulate benefit sharing relating to access and use of TK, access to such knowledge "may be facilitated" by the CHM (art 13). However, the CHM is primarily a centralized open access platform (art 51), and aside from implications for potential confidentiality requirements of some TK, it is unlikely to be responsible for the accuracy of the information. Rather, it will be the responsibility for Parties to ensure correct and current information is on the CHM platform. The extent of the CHM role for facilitating access to TK will not be clear until the CoP has met. It is likely to include linking the public to relevant websites with information on procedures for identifying and approaching relevant knowledge holders or at least, how to approach governments and/or communities to find their information and procedures. Both access to and use of the TK must be on MAT, but the CHM does not have an explicit function to facilitate the "use of" the knowledge, indicating that regulating use and benefits from the use will be in accordance with national law. MAT may be affected under authorization systems or contract law or under other mechanisms such as registration systems already established to implement Nagoya Protocol obligations for TK. The extent to which the CHM will have a direct role in the exchange of information about benefit sharing is unclear, but it may have a passive role for linking databases where this information may be located (art 51(3)(c)).

In many cases, procedures for complying with article 13 are likely to be the same or similar to accessing TK associated with MGR in AWNJ. This is because TK systems and cosmologies are not bounded by legal fictions of boundaries and jurisdiction under international law (Menime & Bowrey, 2022; Mulalap et al., 2020). These common elements under national law may include the meaning of TK, IPLCs, FPIC and MAT. Definitions of TK and IPLCs are likely to be determined under national laws or by the IPLCs involved, sometimes on a case-by-case basis (see Humphries, 2025). There is a large body of work on the meaning of FPIC in the context of the CBD and Nagoya Protocol but again, there may be specific meanings under national laws (CBD, 2016). Mutually agreed terms usually means contractual mechanisms where both parties (the knowledge holder and the proposed knowledge recipient) agree on the terms and conditions of access to and use of the knowledge. This may or may not include monetary or non-monetary benefit sharing as there is nothing in the BBNJ Agreement that requires fair and equitable benefit sharing for TK, unlike article 5 of the Nagoya Protocol for TK associated with genetic resources from AWNJ. It would be up to each Party to decide how to deal with benefit sharing, either through contract law or multilateral benefit sharing funds.

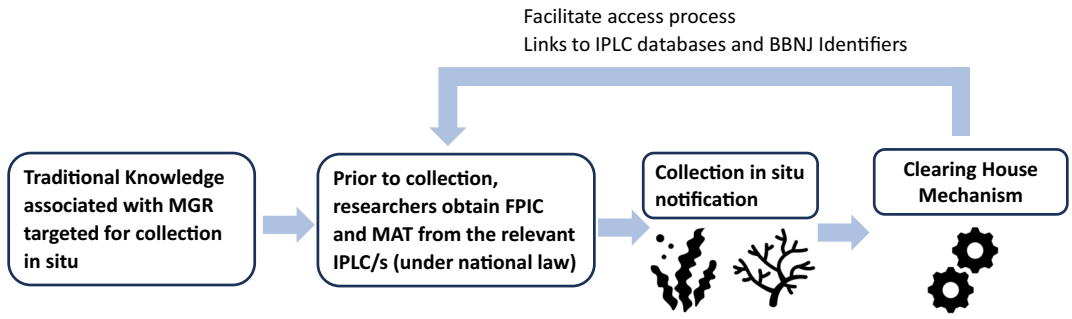

Fig. 14.8 Narrow interpretation—obligation is triggered when the traditional knowledge is used or proposed to be used to target MGR in ABNJ for their genetic material properties (prior to collection)

Although the TK obligation will be interpreted by Parties according to their interests and circumstances, there are interpretations that are unique to ABNJ that may require clarification by BBNJ Agreement bodies to avoid loopholes. These include clarifying the geographical, temporal and subject matter scope (nature of the knowledge) of the obligation. There is uncertainty about the types of TK that might fall within scope—whether it will be narrowly interpreted as only knowledge about the genetic attributes of MGR or more broadly includes knowledge about activities and observations associated with MGR (Mulalap et al., 2020). The obligation refers only to MGR *in* ABNJ, unlike other BBNJ provisions relating to MGR *of* ABNJ, suggesting that the geographical scope may be confined to specific MGR actually collected in situ in accordance with the BBNJ Agreement, rather than the known distribution of the MGR being ABNJ (Humphries, 2025). The activity of "access" to the TK is undefined and the term "use" is not the same as "utilization of MGR" defined under the BBNJ Agreement (art 1(14)). It is unclear whether the obligation extends to use of DSI on MGR in ABNJ associated with the knowledge and how it will relate to the retroactive application of the treaty to collection and utilization activities (scenarios 2 and 3).

Aside from interpretation, several gaps in procedures and processes unique to the context of ABNJ will also require guidance from treaty bodies. These include how to manage: identifying knowledge holders when there is no guidance under national measures; situations where there is more than one knowledge holder of the same TK; circumstances where new knowledge holders are identified after completing FPIC and MAT with another IPLC or knowledge holder; the link between the BBNJ Identifier of the MGR and the TK with which it is associated; procedures relating to secret and publicly available TK; whether the obligations extend to TK associated with DSI on MGR of ABNJ; and benefit sharing from TK of unknown origin (or where MAT is not possible).

Until there is further guidance from treaty bodies, it is unclear how the TK obligation will operate in practice and how it relates to MGR and DSI obligations. In the meantime, there is a narrow and a broad interpretation that may assist practitioners to align their practices with intent of the BBNJ Agreement. A narrow reading suggests that the obligation is only triggered by the collection activity of physical MGR within ABNJ (Fig. 14.8). This means that FPIC and MAT would only be required if the research project in the pre-collection notification intends to use TK associated with MGR in ABNJ. In other words, this applies in circumstances where the knowledge is used to target the MGR in ABNJ for their genetic material properties. As the BBNJ Identifier is automatically issued for the pre-collection activity, FPIC and MAT will pre-date the identifier, but the identifier could be subsequently linked to databases concerning TK associated with MGR of ABNJ from that particular collection. From a practical

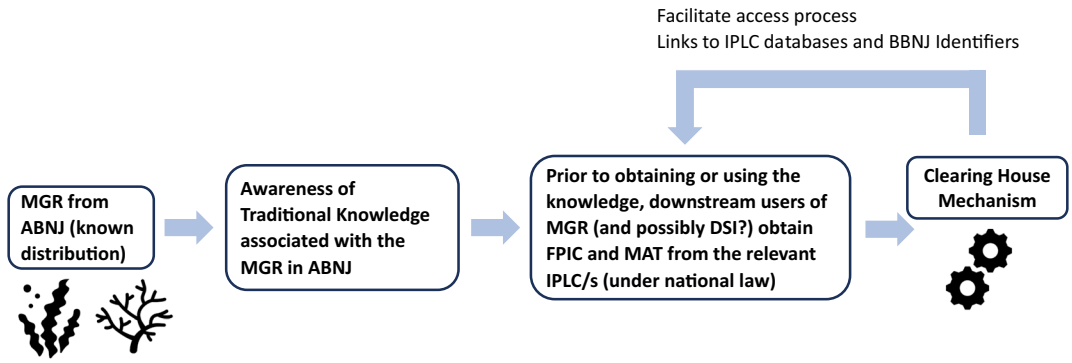

Fig. 14.9 Broad interpretation—obligation is triggered when someone seeks access to, or use of, traditional knowledge associated with MGR known to be located in ABNJ (irrespective of collection)

perspective, the timeframes for obtaining FPIC and MAT prior to collection may take months or years—long before the period of notification. This approach assumes that the researchers will know which MGRs they are targeting as part of the collection, which is often not the case for biodiscovery (scenario 1). It also assumes that the MGR will be where they expect them to be. Researchers and TK holders may go through years of negotiating FPIC and MAT without finding the targeted MGR. This narrow interpretation may promote misappropriation of TK (because it does not capture subsequent uses of collected MGR and associated knowledge) and it is also likely to delay or deter ABNJ research without any benefit to the TK holders. It puts the onus for engaging with TK holders for FPIC and MAT on the researchers who search for the samples, rather than downstream users that seek to utilize the MGR for economic or other benefits.

A broad interpretation suggests that the obligation is triggered by access to, or use of, TK associated with MGR known to be located in (rather than actually collected from) ABNJ (Fig. 14.9). This interpretation breaks the geographical and temporal link between the TK and the collection activity. The relevant time for seeking FPIC and MAT is when it becomes known that there is TK about the properties of MGR with a known distribution in ABNJ. In practice, the same knowledge may relate to the same MGR that travels within national jurisdiction. The regulatory mechanisms (FPIC and MAT) are the same under the Nagoya Protocol and BBNJ Agreement; therefore, one potential complication is that two separate FPIC and MAT processes for the same community may be required for the same research project, i.e. for TK associated with MGR both in ABNJ and AWNJ. There are many reputation and economic benefits for biotechnology companies to proactively seek FPIC and MAT and the broad interpretation ensures that the responsibility falls on these downstream users, rather than the researchers who are collecting the samples and who do not necessarily know what the "value" of the resource will be.

14.4 Conclusion

In general terms, all actors involved in acquiring, storing and utilizing MGR or associated DSI and TK, including academia, government and industry, need to understand BBNJ Agreement obligations and comply with the laws of the Parties that implement them. Given that there are practical aspects of the framework that are yet to be determined by the CoP, this will require proactive development of procedures and systems to compile, curate and provide necessary information to Parties, including DMPs and the BBNJ Identifier, when undertaking activities regulated under Part II. It is likely that this information will be provided at the first instance to the Party that has jurisdiction or

control over the relevant activity, but there may be opportunities for directly sharing information with the CHM.

The BBNJ Agreement presents a linear vision of science (Lawson et al., 2025) which belies many inherent complexities. It is crucial that the R&D process for MGR is not imagined as a linear progression where such work would automatically result in commercialization. Most R&D pathways are non-linear with many side branches that may be abandoned or pursued, iterative loops and long breaks in the process. Often several research threads are pursued in parallel, and the intended application is completely changed between the start and end of the process. Although many existing research practices are consistent with the notification and information sharing requirements, many challenges arise for non-linear scenarios, including utilizing MGR and DSI from collections prior to the BBNJ Agreement, complex uses of multiple DSI, automation in collection and use, change of use from harvest fisheries to R&D and access and use of TK associated with MGR of ABNJ.

The negotiators of the BBNJ Agreement aimed for a balanced approach so that the MGR requirements could be "future proof" but also avoid unintended non-compliance from disproportionate or impractical requirements. To ensure that the negotiators concluded the work by the resumed fifth session, there was a delicate dance of determining the level of detail that would need to be included in the BBNJ Agreement and other matters that would be decided after entry into force. Collaboration and consultations between scientists, commercial end users and other stakeholders will be important to provide information to treaty bodies about the practical effects on the R&D process and innovation during the development of further procedures and guidance for implementation. These include considering current international scientific good practice, and building a timely, efficient and fit-for-purpose CHM that can evolve over time as technologies develop. Continued and robust engagement of a wide range of stakeholders on the importance of engaging with notification and benefit sharing may ensure more effective compliance.

Such consultations would benefit from timely information on emerging scientific advances and ensuring that "good scientific practices" represent a wide range of scientific disciplines. Aiming to support harmonization of scientific good practice could lead to institutions providing relevant data in a FAIR format, including information on the planned cruise, the eventual cruise report and information on location of MGR and DSI. The BBNJ Agreement demonstrates the importance of provenance of MGR good data management, diligent use of the BBNJ Identifier system, and FAIR data, including harmonization and standardization of approaches, and interoperability between datasets and repositories. The agreement provides an opportunity therefore to support data harmonization efforts across various repositories and databases. While many of the treaty requirements for MGR and DSI that demand robust data and sample management reflect existing good practice, there are likely to be cost implications. To that end, the financial mechanism could consider the need for increased funding for MGR repositories for accessioning and maintaining MGR collections long term. Consistency with other multilateral environmental agreements, such as the CBD, the Nagoya Protocol and GBF concerning DSI, will be essential for R&D, which uses data, sequences and samples/materials from multiple jurisdictions. It is critical that the scientific community strengthen the ongoing consultation and dialogue with various stakeholders, policymakers and entities that could be impacted by the future guidance on DSI.

Finally, there is a significant need for capacity building and the transfer of marine technology to foster scientific and technical advances. The BBNJ Agreement's fair and equitable sharing of benefits of MGR exemplifies the ways in which a wide range of stakeholders can engage in collaboration with the scientific community (Muraki Gottlieb & Girguis, 2022). In addition to the information that will be open to the public, there are additional opportunities that

the scientific community can contribute (e.g. transfer of marine technology, technical and scientific cooperation, knowledge exchange) that go beyond providing information and samples. Institutions, philanthropies, private sector, NGOs, and academia have a crucial role in determining the need and allocating sustained and adequate resources. To ensure such strong partnerships, awareness raising is paramount and the scientific community can harness such opportunities to significantly contribute to the fair and equitable sharing of benefits.

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Muriel Rabone is a researcher based on the deep-sea ecology and systematics group of the Natural History Museum, London. She also studies the neglected tropical diseases: schistosomiasis and paragonimiasis.

Dr. Tammy Horton is an expert in deep-sea taxonomy, ecology and biodiversity, with 20 years' research experience, including participation in research cruises. She has extensive experience in the use and care of marine invertebrate specimen collections, having begun her academic career working at the Natural History Museum, London, and as manager of the Discovery Collections at NOC since 2009. Dr Horton has substantial experience of working with industry, particularly in providing advice to the oil and gas industry and the International Seabed Authority on the importance of robust taxonomy in faunal surveys.

Fran Humphries has specialized in marine and biodiversity law and policy for over two decades in government, academia and consultancies. She is an associate professor at Griffith Law School, Griffith University, Australia, with a background in fisheries management and marine law. She has led large international research consultancies on access and benefit sharing of biological resources for governments, UN organizations and other institutions. She was on the International Council of Environmental Law delegation for the Biodiversity Beyond National Jurisdiction (BBNJ) Agreement negotiations.

Christopher H. C. Lyal is a taxonomist with a strong level of policy engagement with the Convention on Biological Diversity, particularly regarding the Nagoya Protocol and Digital Sequence Information. He has undertaken international consultancies and been a delegate in CBD COPs representing the UK, and participated a several CBD expert groups. He has also advised on the implementation of the BBNJ agreement.

Hiroko Muraki Gottlieb is a licenced lawyer in the USA with a diversified career in global businesses, intergovernmental organizations, non-governmental organizations and academic institutions. She brings a unique blend of expertise in climate change and biodiversity conservation strategy, environmental law (domestic and international), policymaking, regulatory compliance and stakeholder engagement. She is the representative for the Ocean and led the International Council of Environmental Law to the BBNJ Agreement negotiations as the Head of Delegation and holds appointments with the Department of Organismic and Evolutionary Biology at Harvard University and Elisabeth Haub School of Law at Pace University.

Dr. Amber H. Scholz is a microbiologist and head of the Science Policy and Internationalization Department at the Leibniz Institute DSMZ in Braunschweig, Germany. She leads projects on international science policy especially on access and benefit sharing and digital sequence information and founded the DSI Scientific Network and Germany Nagoya Protocol HuB.

Thomas Vanagt is a marine biologist with a specific interest in marine genetic resources. He works towards closing the gap between policymakers, academic users and industrial actors.

Marcel Jaspars is a professor of Organic Chemistry at the University of Aberdeen where he leads the Marine Biodiscovery Centre which focusses on marine resources for novel pharmaceuticals, and to investigate fundamental questions in marine chemical ecology and biosynthesis. Marcel has been active at national and international levels to develop the science, its applications/industrial uptake and associated policy involved in marine biodiscovery and biotechnology. He provides scientific advice to the UK, EU and UN for global policy processes on ocean conservation and digital sequence information via reports, papers and taking part in discussion meetings.