

POLICY BRIEF

What do we know about taxonomic diversity beyond national jurisdiction?

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Highlights

- Our understanding of “biodiversity beyond national jurisdiction” has changed significantly since the adoption of UNCLOS and the UN Fish Stocks Agreement.
- Records of 20,355 species in ABNJ can be found in OBIS. Most species are represented by <10 records and many have one record. There are records of nearly 3000 species unique to ABNJ.
- Civil society has played a significant role in generating and sharing the datasets that form the backbone of our current understanding of taxonomic diversity in ABNJ.
- There are major taxonomic and geographic gaps in our understanding of species diversity in ABNJ.
- Assessing the full extent of the impacts of climate change and other anthropogenic activities on marine biodiversity will require much more in-depth understanding of the composition, distribution and ecology of global marine biodiversity.
- A new ILBI should provide structural support for existing data repositories and incentivize participation by academia and other civil society actors in ABNJ biodiversity data collection and sharing.

1. Introduction

In 1982, the United Nations (UN) adopted the “Constitution for the Oceans”, the UN Convention on the Law of the Sea (UNCLOS). Only five years before, scientists had discovered the first hydrothermal vents (Lonsdale 1977) and the existence of *Prochlorococcus*, the most abundant photosynthetic organism on Earth, responsible for ~10% of our oxygen, remained unknown. Since the crafting of the convention almost 40 years ago, much has been learned about the diversity of marine life in areas beyond national jurisdiction (ABNJ). Since that time, our view of marine biodiversity has come a long way, from a

focus on important fish stocks and iconic whales to a much broader diversity of marine species, habitats and ocean health issues. We now consider marine biodiversity from microbes to migratory megafauna and from the scale of an individual water sample to entire ocean basins. This broader and more inclusive definition of biodiversity is the necessary focus of the first “B” in the Biodiversity Beyond National Jurisdiction (BBNJ) process. Understanding the data and knowledge we have about one aspect of BBNJ, the taxonomic diversity of species found outside of national jurisdiction, is an important starting point for our discussions of BBNJ and effective management of

the global ocean.

While still incomplete, our understanding of the taxonomic groups that need to be considered in ABNJ management has increased significantly since UNCLOS was drafted. For instance, Annex I of UNCLOS lists 32 highly migratory species (HMS) at the species level and 12 complete taxonomic families, for a total of 193 HMS. The Annex includes marine mammals and fish, but makes no mention of sea turtles or seabirds. According to Lascelles et al., (2014) a total of 829 marine migratory species utilize ABNJ. More than one third of those species are seabirds, and it includes all seven species of sea turtle. Many of those not included in Annex I are listed as threatened according to the International Union for Conservation of Nature (IUCN) Red List (Lascelles et al. 2014). More recent efforts to describe the scope of migratory species in ABNJ (see mico.eco) have increased the total number to over 950, well over 4x the original number listed under UNCLOS. This focus on migratory species is just one illustrative example of how our conception of BBNJ has expanded over the last three and a half decades.

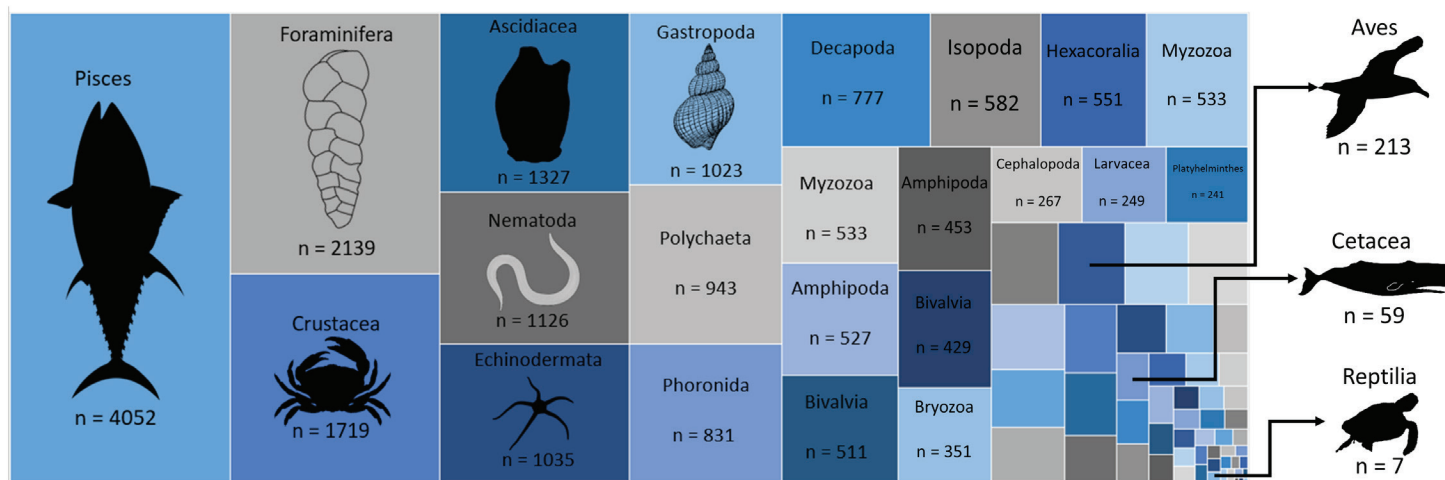
Not only has our understanding of biodiversity beyond national jurisdiction significantly changed and increased since 1982, but so has our need for such information. ABNJ makes up 64% of the oceans, nearly half of the planet's surface and over 90% of its habitable volume. As such, ABNJ plays a critical role in our efforts to achieve societal objectives as described through policy processes like the Sustainable Development Goals and the Aichi Biodiversity Targets. Those goals and targets cannot be achieved without consideration of ABNJ, nor can they be achieved without some baseline biological and ecological data and monitoring strategies to understand how we are progressing - otherwise, how would we know if we had achieved them? Similarly,

intergovernmental assessments of ecosystem health (e.g., the Intergovernmental Panel on Climate Change, the Intergovernmental Panel on Biodiversity and Ecosystem Services, and the Regular Process) all require baseline data on the composition and spatiotemporal distribution of biodiversity. Finally, management and governance of ABNJ requires an understanding of the scope of biodiversity to identify and limit taxonomic gaps in governance.

All of the above is premised on one thing: that we share a common understanding of what is meant when we say "biodiversity beyond national jurisdiction". While the UN Fish Stocks Agreement (UNFSA), an implementing agreement to UNCLOS, calls for the protection of biodiversity in the marine environment (Articles 5 & 6, UNFSA), neither the Implementing Agreement nor UNCLOS define it. Further, as shown above, our understanding of BBNJ has drastically changed since UNCLOS and UNFSA were agreed. The main definition we have from intergovernmental authorities for what biodiversity is comes from the Convention on Biological Diversity which describes it as: "... the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." (CBD, 1992). While helpful, this does not describe, in any detail, what is encompassed by the term.

Here, in an effort to support the negotiations over a new international legally binding instrument (ILBI) for the conservation and sustainable use of BBNJ, we seek to describe the scope of our current taxonomic

Figure 1: proportional representation of the species richness of each of the 73 taxonomic groups for which there are OBIS records in the high seas (data from: <http://iobis.org/>).



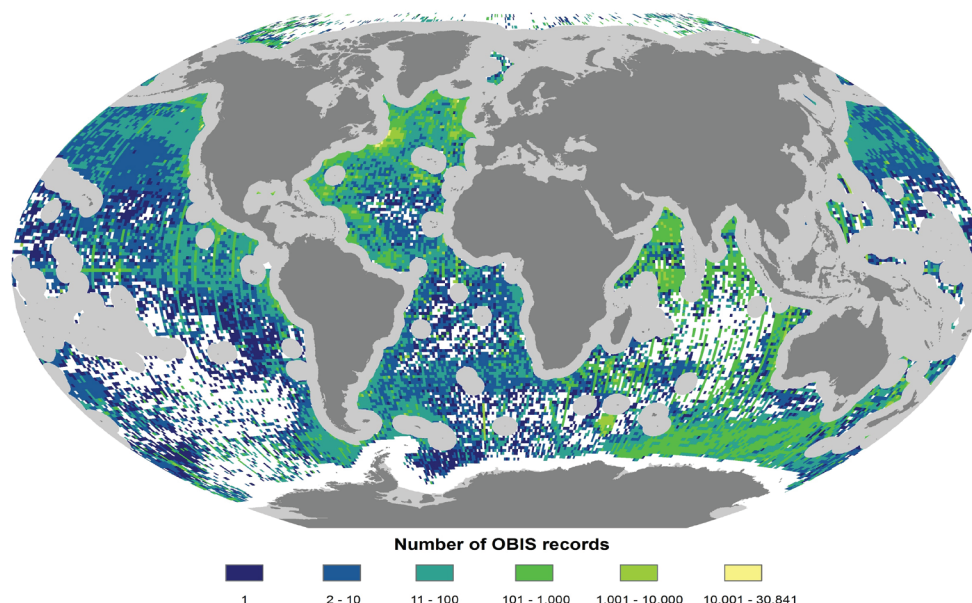


Figure 2. The spatial distribution and density of high seas biodiversity records (20,355 species) in OBIS (data from: <http://iobis.org>).

knowledge and thus also inform our understanding of “biodiversity beyond national jurisdiction”.

In the field of ecology, there are three general scales of diversity calculations: alpha diversity is the local number or richness of species, beta diversity is the relationship between regional and local estimates of species diversity; and gamma diversity is the large landscape or seascape estimate of species diversity across an entire ecosystem often called species turnover (after Whittaker 1960). There are also a large number of mathematical indices used to quantify species richness (the raw number of species), evenness (the distribution of species) and diversity (relative variation of species). Here we focus on the simplest quantification of species or taxonomic richness, the count of how many individual species are observed in an area. Marine biodiversity is more than just taxonomic diversity and includes everything from genes to ecosystems, but species are a critical component and the focus of many management and policy processes.

Delineating the boundaries of our knowledge of marine species in ABNJ

In 2000, the 10-year Census of Marine Life (CoML) program was implemented to focus the work of a broad consortium of international scientists on exploration and data collection for the global oceans. One of the important and lasting outcomes of this international activity was the permanent establishment of the Ocean Biogeographic Information System (OBIS) under the Intergovernmental Oceanographic

Commission (IOC). OBIS is the most comprehensive data repository of spatially-explicit information about taxonomic diversity in the marine realm (<http://iobis.org/>). As of July 2018, OBIS contained records of 20,355 species observed in ABNJ belonging to 639 taxonomic orders and 216 classes (see <http://iobis.org/explore/#/area/285> for the latest information). Of the 73 taxonomic groups identified by OBIS in ABNJ, fish (or Pisces) are the most diverse, followed by Foraminifera and Crustacea. Importantly, the majority of ABNJ species identified in OBIS have <10 records (many with only one record), and nearly 3000 are found exclusively beyond national jurisdiction.

This, however, is a significant underrepresentation of the actual breadth of biological diversity in the open-ocean, much of which is found at the microbial and viral taxonomic levels. Estimates of the maximum bacterial diversity in the world’s oceans are estimated to be around 2,000,000 which is 100 times greater than the number of species currently reported in ABNJ (Curtis et al., 2002). Studies exploring the genetic diversity of virus in marine systems have found up to 250 viral phylotypes in 0.25L of open-ocean water (Flaviani et al. 2017), and marine viruses are considered to be much more abundant than marine microbes (Parikka et al. 2017). It is thought that viral species richness could be a few hundred thousand species (Angly et al. 2006). The immense quantity of potential microbial and viral diversity in the oceans could significantly change our understanding of total ocean marine life and diversity.

In addition to the asymmetry of our current taxonomic understanding of BBNJ towards vertebrates or macroinvertebrates, most records are from waters adjacent to EEZs and surface waters. This mimics our vertical and horizontal understanding of the

distribution of all OBIS data which decrease with distance from shore and depth (Webb et al. 2010). Figure 2 depicts this heterogeneity, with far more observations in the northern hemisphere, particularly in the Atlantic basin. Large areas of the central Indian and south Pacific Oceans stand out as being highly data-deficient.

BBNJ data contributors

Enumerating the sources of the species observation data underpinning our current understanding of taxonomic diversity in ABNJ is critical to developing policy and management measures related to BBNJ. As described above, these data are the foundation on which area-based management tools, environmental and strategic assessments, and policy targets are built. By describing who is providing the data, we hope to inform how a new ILBI incentivizes and supports the collection and sharing of this essential resource. The current data from ABNJ in OBIS are drawn from 947 datasets contributed through 366 institutions (<http://iobis.org/>). While OBIS does not house all biodiversity observations in ABNJ - notably missing fisheries data collected by many national agencies and Regional Fisheries Management Organizations - it represents the most comprehensive compendium of information on marine species diversity in existence. We examined

Figure 3: The diversity of ABNJ contributions to OBIS by Institution (I), Datasets (D) and Observations (O). Together, Academia and Civil Society make up the majority of contributing institutions, 45% of all datasets and 36% of all observations.



the origin of observations located in ABNJ in OBIS and classified the contributing institutions into six categories: academia; other civil society organizations, governmental, semi-governmental, intergovernmental and other/uncategorized.

We found that academia and other civil society organizations play a significant role in generating and sharing the datasets that form the backbone of our current understanding of global marine biodiversity in ABNJ. Of the 366 contributing institutions, 31% are academic institutions, while another 20% are other civil society organizations. These two groups also account for 36% of the total number of high seas biodiversity records under OBIS, only surpassed by governmental organizations, which have contributed 51% of the records. Critically, academia and other civil society bodies have contributed the most individual datasets to OBIS (n=430), followed by governmental organizations (n=318). This is important, as observations within a dataset tend to be more homogenous than those between datasets, suggesting that numbers of datasets are important to our overall understanding of taxonomic diversity in ABNJ. It is also worth noting that the datasets contributed by different governmental organizations can largely be traced back to 10 nations.

When considered jointly, the contribution of civil society to the repository of ABNJ biodiversity information is very significant, and represents an important contribution to any effort to govern the global ocean. Regardless of the origin of the data, we encourage all data collectors and data holders to make their biodiversity data available through internationally supported, open-access information systems.

Policy recommendations

As human uses of the open-ocean intensify and diversity (Merrie et al. 2014) and climatic conditions change the biophysical and chemical properties of the global ocean, marine species are more exposed than ever to changes in their productivity (Cheung et al. 2010), distribution (Perry et al. 2005; Dulvy et al. 2008; Cheung et al. 2009), phenology (Genner et al. 2009) and body condition (Cheung et al. 2013). Recent studies predict a global redistribution of marine biodiversity under climate change (Cheung et al. 2009; Molinos et al. 2016). This redistribution of resources has already led to conflicts in sectoral management leading to trade disagreements. There is also evidence that this redistribution of biota may decrease the effectiveness of area-based

management strategies if not accounted for (Johnson et al. 2017). Assessing the full extent of the impacts of climate change and other anthropogenic activities on marine biodiversity will require much more in-depth understanding of the composition, distribution and ecology of global marine biodiversity.

While our understanding of open-ocean systems and biodiversity has grown immensely in recent decades through contributions of data to open-access repositories, there has been a slowdown in the rate of collection of biodiversity records in ABNJ since the end of the CoML in 2010 (see <http://iobis.org/explore/#/area/285>). These data are necessary to generate the biological and ecological knowledge upon which conservation and sustainable use of marine biodiversity beyond national jurisdiction depend. OBIS and other similar international data repositories play a critical role in filling the existing knowledge gaps by aggregating and disseminating data; specific funding mechanisms to support this existing critical infrastructure should be outlined within a new agreement. However, the biodiversity data in these systems is aggregated from a network of hundreds of institutions and, in the case of OBIS, through regional and thematic nodes which represent the frontline between data collection and policy. Both the data repositories, like OBIS and its sub-nodes, and the largely civil-society institutions they rely on for data contributions, are critically underfunded - potentially jeopardizing the success of a new treaty.

The collection and aggregation of actionable marine biodiversity knowledge is important to both cross-sectoral management as well as each sectoral component of the BBNJ process. Most maritime sectoral industries which operate in ABNJ are required to assess and manage the direct and indirect impacts of their activities on habitats and target and non-target biodiversity. Industrial operations, from deep-sea mining to commercial fisheries, may result in a deterioration of physical habitat or the ecological fabric of marine biological communities (Ortuño Crespo & Dunn, 2017; Van Dover et al., 2017). Tracing the impacts of anthropogenic or natural forcings in marine systems and biodiversity pivots on our ability to collect data at the right spatial, temporal and taxonomic scales and resolutions. The types of information which are needed for sectoral or cross-sectoral monitoring and management include, inter alia, species abundance and distribution estimates, data on the composition of biological communities and how the members of said communities are associated.

New funding mechanisms and incentives should be developed to encourage data collection in ABNJ under the new international legally binding instrument. Acknowledging and supporting the critical role that civil society plays in the collection of this information is fundamental to ensuring that management and policy arenas have the information needed to deliver and track the conservation and sustainable use of BBNJ. We strongly suggest that existing international institutions and data sharing mechanisms be strengthened to support future needs of an ILBI. We believe that strengthening the direct marine biodiversity data exchange mechanism of OBIS and the data coordinating efforts of the Earth Observing community (e.g., the Global Ocean Observing System (GOOS) under the IOC, the Group on Earth Observation - Biodiversity Observation Network (GEO-BON) and its Marine Biodiversity Observation Network (MBON) and the GEO System of Systems (GEOSS)) will be critical to the success of a new agreement. We suggest that an important vehicle for such support could come through development of a fund managed by OBIS to encourage data collection and integration, increased and structural support for the GOOS Regional Alliances through the IOC, targets for support of ocean observation as part of the UN Decade of Ocean Science for Sustainable Development, allowing support for data collection and integration into open-access repositories through projects funded by the Global Environmental Facility.

A further mechanism needed to deliver sufficient data to support a new ILBI is industry partnership in data collection and aggregation. Private corporations currently account for a tiny fraction of the data in OBIS, but are major users of and data collectors in ABNJ. The release of biodiversity data from deep-sea mining contractors via the International Seabed Authority's data management strategy will be a welcome step in this direction; one that we would strongly encourage other sectoral organizations to follow.

Two further critical challenges must be addressed to allow for the development of a bedrock of data to support conservation and sustainable use of BBNJ: geographic gaps and lack of standardization. It is apparent that our current knowledge of taxonomic diversity in ABNJ is skewed towards the northern hemisphere. To ensure that the full breadth of biological diversity in the high seas is represented in data repositories, it is critical that support for data collection and capacity development, and incentives to contribute data to open-access repositories are

geographically weighted accordingly. Finally, for data to be useful in management and policy arenas, it must be comparable- and to be comparable, there need to be standards applied during data collection, storage and analysis. GOOS plays a critical role in this regard by developing and encouraging the use of Essential Ocean Variables and Implementation Plans to provide a roadmap to secure a sustainable ocean observing system that can deliver the data necessary to inform use of the global ocean. We strongly urge that structural support for GOOS and the GRAs be supplied through the IOC to help deliver the biodiversity data necessary to implement all aspects of a new ILBI.

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