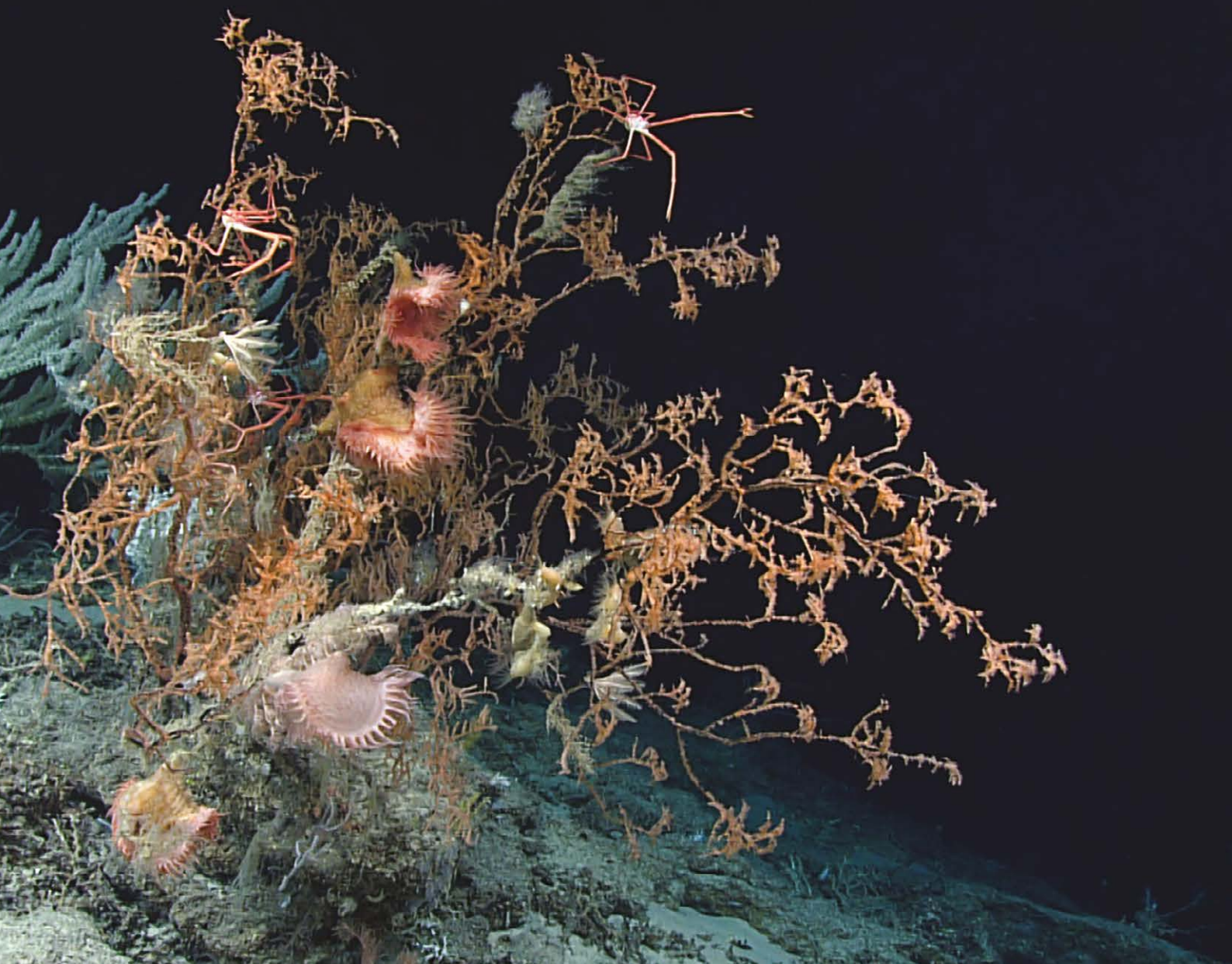


Science for the Kunming-Montreal Global Biodiversity Framework in the Atlantic Ocean region: An iAtlantic perspective

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Key messages:

- Ocean science and knowledge plays an essential role informing the numerous and complex mechanisms established to govern and manage the Atlantic Ocean.
- Conservation and sustainable use efforts for the Atlantic Ocean region, and beyond, must consider highly interconnected and complex ecosystems, facing multiple and cumulative threats.
- With four overarching goals and 23 specific targets, the Kunming-Montreal Global Biodiversity Framework (GBF) acts as a global catalyst for collaborative ocean action to tackle the triple planetary crisis of climate change, pollution, and biodiversity loss.
- The iAtlantic project is a generator of science, data, and knowledge, as well as a critical provider of capacity development. Its results are directly relevant for marine elements of the GBF targets, especially those focused on ecosystem restoration, protected areas, climate change impacts and fisheries.
- Opportunities exist to enhance ocean science for the Atlantic Ocean region and support progress towards the GBF targets and overarching goals.
- This policy brief provides a snapshot of the GBF, the role of marine science in its implementation, and examples of new knowledge that iAtlantic can offer to support achievement of its targets.



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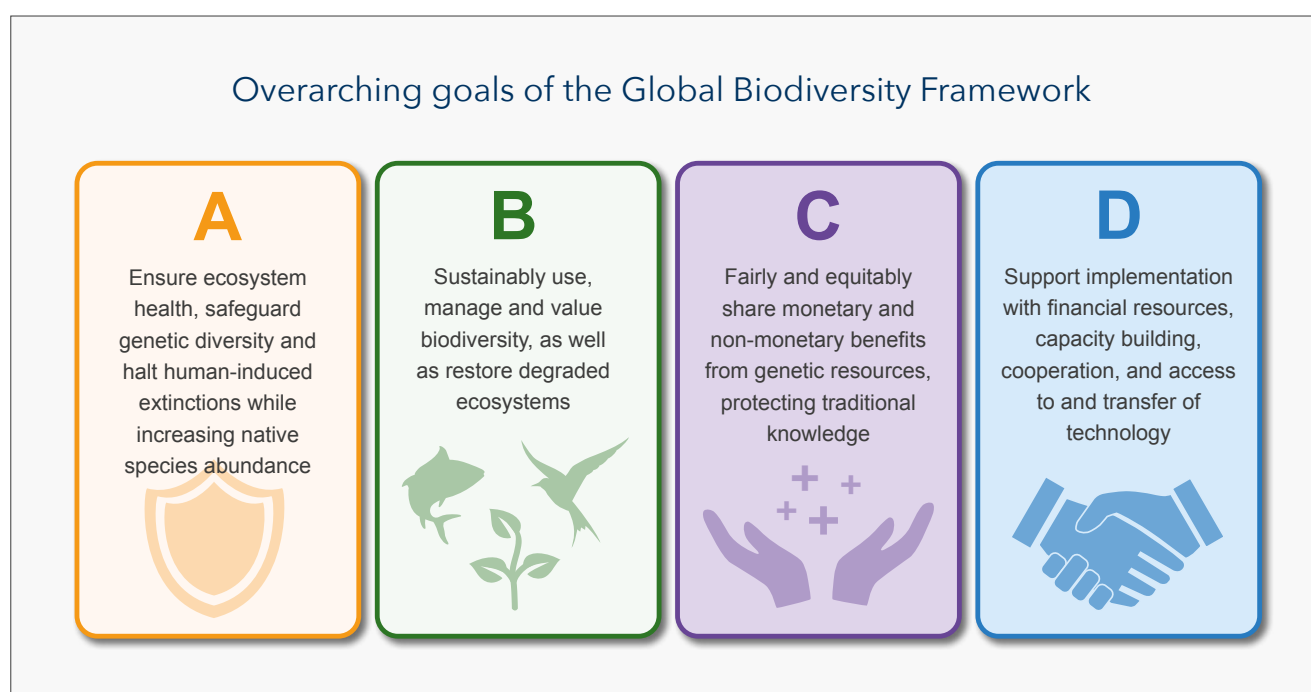
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Front cover image: Black corals and associated fauna, NW Atlantic. NOAA Office of Ocean Exploration and Research, Windows to the Deep Expedition 2019.

The Kunming-Montreal Global Biodiversity Framework

The planet faces a triple crisis: climate change, pollution, and biodiversity loss. This encompasses the marine realm and – our focus here – the Atlantic Ocean. Degradation of marine and coastal ecosystems continues to reach alarming new levels, further stressed by global climate change¹, threatening the planet and all its species². The root cause of the crisis is the adverse impacts of human activities both on land and at sea. Consequently, political attention on reversing biodiversity loss, supporting ocean conservation, and increasing management efforts has also reached a new high.

Covering terrestrial, freshwater and marine areas, the Convention on Biological Diversity (CBD) Kunming-Montreal Global Biodiversity Framework (GBF) was adopted in December 2022, replacing the 20 Aichi Biodiversity Targets included in CBD 2011-2020 Strategic Plan for Biodiversity³. The GBF focuses on four overarching goals for 2050 and 23 specific targets with a deadline of 2030.



iAtlantic is a multidisciplinary research programme seeking to assess the health of deep-sea and open-ocean ecosystems across the full span of the Atlantic Ocean⁴. It aims to deliver knowledge that is critical for responsible and sustainable management of Atlantic Ocean resources in an era of unprecedented global change. iAtlantic is undertaking an ocean-wide approach to understanding the factors that control the distribution, stability, and vulnerability of deep-sea ecosystems. Work spans the full scale of the Atlantic basin, from the tip of Argentina in the south to Iceland in the north, and from the east coasts of USA and Brazil to the western margins of Europe and Africa. Central to the project's success is the international collaboration between researchers throughout the Atlantic region.

iAtlantic research is directly relevant to seven of the GBF targets, namely 2,3,4,7,8,10 and 20 (see Table 2), as well as generally to targets 1 (spatial management) and 21 (best available knowledge for decision making). Because all GBF targets are related and interconnected, advancements towards one target will underpin progress towards others. The goals and targets presented here provide a summarised version of the GBF.

GBF targets directly supported by iAtlantic research

Target 2 *Ensure that by 2030 at least 30% of areas of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration, to enhance biodiversity and ecosystem functions and services, ecological integrity, and connectivity.*

Under Target 2, restoration is the practice of actively managing the recovery of a degraded or destroyed ecosystem, targeting, and enhancing ecosystem functioning and services. Understanding the state of the ecosystem and opportunities for restoration will be key to determine management objectives and select restoration measures.

Target 3 *Ensure and enable that by 2030 at least 30% of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed.*

Target 3 is commonly known as the '30x30' target. For the ocean this primarily means the establishment of marine protected areas, which currently cover 8% of the global ocean, with 19% of national waters and 1% of international waters protected⁵. Science is especially relevant for the identification and establishment of area-based management tools in the Atlantic through the new UN treaty on high seas biodiversity or when considering regional environmental management plans via the International Seabed Authority.

Target 4 *Ensure urgent management actions to halt human induced extinction of known threatened species, support the recovery and conservation of species, as well as maintain and restore genetic diversity, and effectively manage human-wildlife interactions to minimise human-wildlife conflict for coexistence.*

Target 7 *Reduce pollution risks and the negative impact of pollution from all sources, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects.*

Target 8 *Minimise impacts of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, including through nature-based solutions and/or ecosystem-based approaches, while minimising negative and fostering positive impacts of climate action.*

Target 8 aims to minimise the impacts of climate change and ocean acidification on biodiversity and increase ocean resilience, including through nature-based solutions and ecosystem-based approaches. The ocean plays a vital role in mitigating the full extent of climate change impacts by absorbing excess heat and providing a sink for carbon emissions.

Target 10 *Ensure that fisheries are managed sustainably, through the sustainable use of biodiversity, including through a substantial increase of the application of biodiversity friendly practices.*

Target 10 focuses on the sustainable management of fisheries to support resilience and food security. Management should apply practices to maintain ecosystem functions and services through the conservation and restoration of biodiversity, thereby underpinning long-term productivity.







Target 20 *Strengthen capacity building and development, access to and transfer of technology, and promote development of and access to innovation and technical and scientific cooperation, including through South-South, North-South arrangements.*

The Global Biodiversity Framework and conservation efforts within the Atlantic

The GBF complements the efforts of other conventions with a duty to protect the environment, and therefore iAtlantic research outputs are also relevant to additional policy processes. The GBF aligns with and complements the UN Sustainable Development Agenda 2030 which, with its sustainable development goals, provides the overarching framework for cross-cutting conservation and sustainable use actions. Several other global and regional policies are also in place with specific sectoral or conservation aims.

The global ocean governance framework is often characterised as being hindered through jurisdictional complexity and lacking an integrated management approach⁶. At the same time, conservation and sustainable use efforts in the Atlantic Ocean must consider highly interconnected ecosystems, such as deep-sea and cold-water coral reefs, hydrothermal vent communities and those living on seamounts, abyssal plains and in the water column. These ecosystems share numerous interdependencies and face multiple, cumulative and simultaneous threats.

TABLE 1: KEY ACTORS AND ORGANISATIONS IN THE ATLANTIC REGION

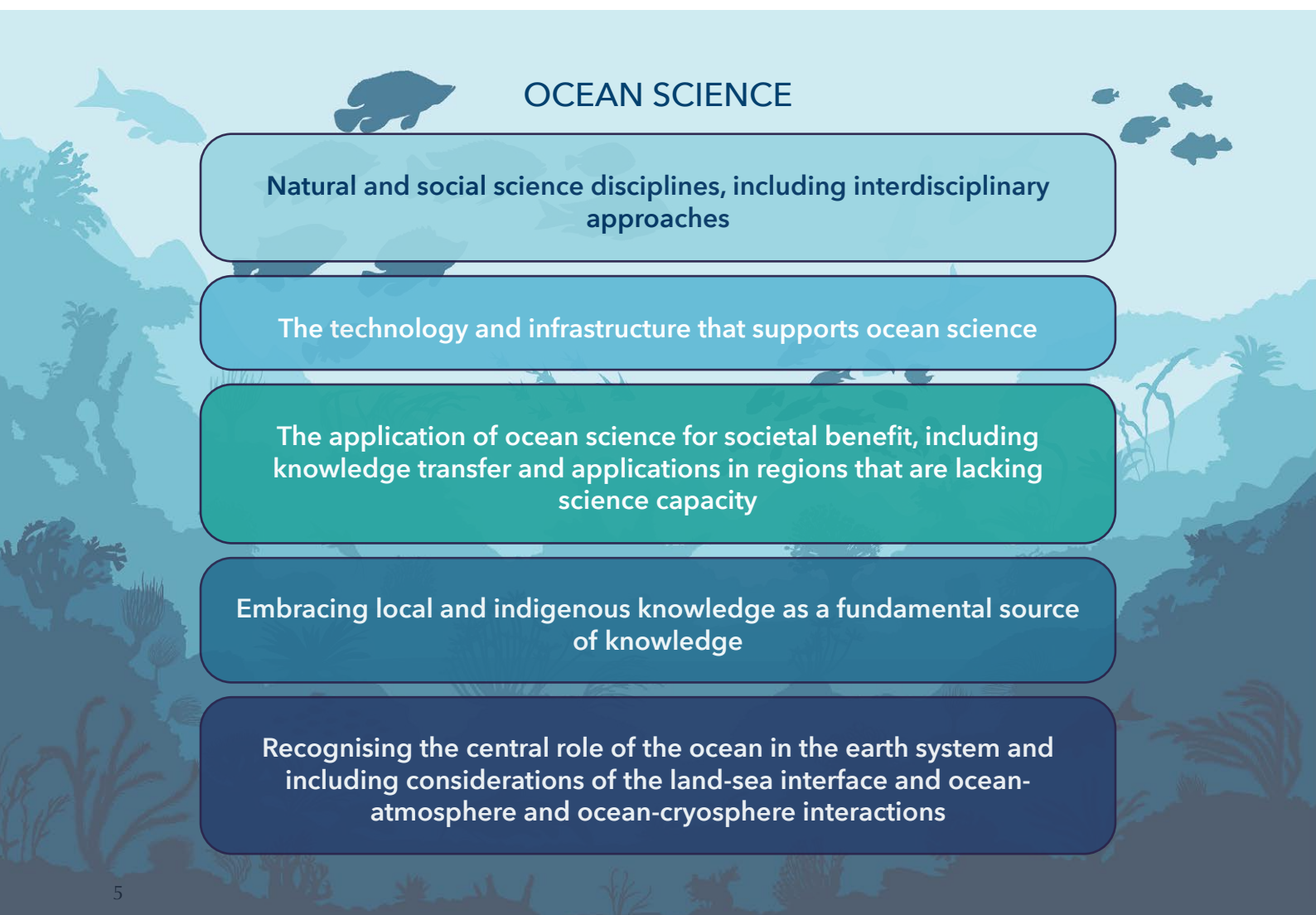
Focus	Key actors / organisation	Measures and aims
	The International Maritime Organization (IMO)	Legally binding to IMO signatories, it aims to manage shipping related activities including prevention of discharges and pollution from ships (MARPOL special area), and establishing Particularly Sensitive Sea Areas (PSSAs) for areas identified in need of special protection due to ecological, socio-economic, or scientific significance.
	The International Seabed Authority (ISA)	Legally binding to signatories of the UN Convention on the Law of the Sea (UNCLOS), it aims to regulate deep-sea mining activities, including through Regional Environmental Management Plans (REMPs) and the designation of Areas of Particular Environmental Interest (APEIs).
	The United Nations Framework Convention on Climate Change (UNFCCC)	International agreement with the aim to prevent dangerous human interference with the climate system. Open to all States parties and regional economic organisations.
	International agreement on marine biodiversity in Areas Beyond National Jurisdiction (commonly referred to as the 'BBNJ Agreement')	International agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction. Open to all States parties and regional economic organisations. Negotiations concluded in March 2023 and the treaty opened for signature in September 2023 in preparation for ratification.
	Regional fisheries management organisations (RFMOs) and regional FAO regional fisheries bodies (RFBs)	Forums by which States coordinate to manage commercial fish stocks, establishing various conservation and management measures.
	Regional Seas Conventions (RSCs) and Action Plans	Forums for States to cooperate and coordinate efforts for the protection of the marine and coastal environment, especially from land and sea-based pollution sources, in specific regions of the ocean.

Science for ocean governance

Understanding the state of the Atlantic Ocean and its ecosystems is necessary for setting realistic goals and designing effective conservation strategies – across management regimes. While marine research is ongoing and knowledge is increasing, existing knowledge gaps on the region’s biodiversity – including species distribution, abundance, and ecological interactions – could impact governance and management decision making. Effective management and conservation outcomes depend on timely, high quality, accurate baseline data. Decision-making under conditions of change relies on modelled data and forecasting to understand the outcome of potential management measures under specific scenarios and to identify suitable management approaches and target actions. Validation, monitoring and adaptive management should then follow. This is especially relevant when considering spatial management measures, as impacts on ocean ecosystems are spatially heterogenous and thus require site-specific management approaches.

“Best available science”

When it comes to ocean management and conservation, there is currently no adopted international legal definition of best available science. Nevertheless, the term – and variations of it – are applied within the legal framework of ocean governance, including the UN Convention on the Law of the Sea (UNCLOS), the 1995 Fish Stocks Agreement, the Scientific and Technical Body of the ISA, and the newly agreed UN treaty on biodiversity in ABNJ⁷. The UN Decade of Ocean Science for Sustainable Development defines ocean science as shown below:



iAtlantic science in support of the Global Biodiversity Framework

The iAtlantic project has made great advances in understanding the oceanographic dynamics (seawater circulation patterns, temperature, acidity, nutrient and oxygen levels) in the North and South Atlantic and how this influences habitat and species distribution in the deep ocean – in the past, under current conditions and under future climate scenarios. Results have identified changing physical conditions that signal ecosystem change and potential tipping points, including trophic shifts, changing species distribution patterns, and fluctuations in species abundance.

Table 2 provides a non-exhaustive summary of key results stemming from the iAtlantic project, identified as directly relevant for the achievement of GBF overarching goals and selected targets. Where available, the key related reports and scientific papers are referenced; many results are still in the process of being published.

TABLE 2: SELECTED iATLANTIC SCIENCE IN SUPPORT OF THE GLOBAL BIODIVERSITY FRAMEWORK	
iAtlantic key result	Relevant 2050 goals / GBF targets
<i>Seafloor mapping and habitat distribution/modelling</i>	
571,634 km ² of Atlantic bathymetry data were added to the publicly accessible global record.	D 20
Basin-wide classification of seabed types defined nine different seabed environments across the Atlantic Ocean, which potentially correspond to locations of high biodiversity and could inform target areas for conservation or further research. ^{9,10}	B 2,3,10
Regional habitat suitability models developed in 8 iAtlantic study areas for species of conservation and commercial interest. Species distributions at regional scale (100-1000 km ² extent) are typically driven by water mass properties and by proxies for food supply. ^{11,12}	B 2,3,10
Habitat suitability models developed for 17 taxa show present-day distributions and future predictions (2081-2100) under three climate change scenarios. VME indicator and commercial taxa distributions show a decrease in predicted suitable habitat in the future. Model predictions show deep-sea fish, shark, shrimp and sea pens shift towards higher latitudes, while most cold-water corals are predicted to shift towards lower latitudes.	B 2,3,8,10
New metrics proposed for quantifying environmental variability that improve predictive power of habitat suitability models, and that provide ecological insights in niche requirements of species of interest.	D 2,3,10
Machine learning approaches developed for creating habitat maps, at scales ranging from the entire Atlantic basin to local, high-resolution surveys. ^{10,13,14}	D 20
New imaging techniques revealed the remarkable stability of some deep-sea ecosystems (e.g., hydrothermal vent assemblages) under dynamic physical conditions. ²⁰	B D 2,3,20
<i>Species connectivity in the deep ocean</i>	
Research into how deep-sea hydrothermal vent species are related across the Atlantic indicates that species migration along the Mid-Atlantic Ridge is extremely limited, long-distance (trans-oceanic) migration in cold seep mussels is rare, and larval exchange between populations of vent gastropods and deep-water corals is very limited. This is important information for the protection of vent communities from deep-sea mining, and for deep-sea coral reefs threatened by trawling. ⁸	A B 2, 3, 4,10

Drivers of ecosystem change	
Discovery of large temporal shifts and potential tipping points in ecological timeseries data, particularly around the late 1990s and early 2000s, coincident with larger-scale oceanographic trends from the surface of the open ocean to the abyss. Many study areas show breakpoints or declines in commercially important species (e.g., Atlantic halibut, monkfish, albacore and bluefin tuna). ^{15,16}	A B 8,10
Identification of a tropicalisation trend of warm-water affinity species becoming more abundant across the Atlantic from Eastern Canada to the Malvinas current, and from the subpolar north Atlantic to south Brazil and Africa. ¹⁷	A B 8,10
Analysis of the trends in quantity and quality of protein in fisheries catches from the SW Atlantic shows that species tropicalisation has implications for society, fishers and fishing management regimes.	B 8,10
Steady increases in species important for marine wildlife tourism (e.g., humpback whales) were investigated and are likely related to larger scale population recovery trends post-whaling. ¹⁸	A B 10
Methodological and statistical approaches proposed by iAtlantic can be applied in the future to many additional existing samples and time-series in the Atlantic, thus setting important methodological groundwork for future large-scale ecosystem assessment. ¹⁹	D (2,3), 20
Impacts of human activities and multiple stressors	
New understanding of the impacts of sediment plumes potentially generated during deep-sea mining activities, alone and in combination with climate change effects, on pelagic fauna, cold-water corals and vent organisms. These experiments provided new evidence and data on the important negative ecosystem impacts that can be expected from deep-sea mining operations. ^{21,22,23,24}	A B 2,3,7,8
Laboratory experiments assessed the potential impacts of climate change and human pressures on early life stages of cold-water corals, providing important data that can help us predict consequences of multiple stressors on the dispersal and connectivity of coral populations in the Atlantic.	A B 7,8
Completion of the first long-term (>6 months) multi-stressor experiment to test the interaction between projected changes in ocean temperature, carbonate chemistry and dissolved oxygen concentrations and their impact on the cold-water coral <i>Lophelia pertusa</i> (physiological and growth responses, impacts on skeletal structure).	A B 7,8
<i>In situ</i> experiments show how changes to upper ocean ecosystems from climate change (i.e., increase in squid biomass) and overfishing (i.e., reduction of fish biomass) may affect ecosystems thousands of metres below the ocean surface, demonstrating the close connection between food input and deep-sea ecosystem processes.	A B 8,10
New data on the baseline ecosystem functioning of abyssal plain ecosystems provides insights on how changing food supply rates may alter benthic ecosystems at abyssal depths in the Atlantic. ⁴¹	A B 8
Data from <i>ex situ</i> experiments suggest that the increased ocean temperature and decreased food quality predicted for the end of the century will decrease the carbon storage capacity of the deep seafloor.	A B 8
Various studies reveal impacts of oil and gas exploitation activities on deep-sea ecosystems, ranging from excess sedimentation and pollution, to implications for larval dispersal and ecosystem connectivity. ^{25,26,27}	A B 4,7

<i>Conservation planning and ocean management</i>	
Development of Atlantic basin-scale management scenarios for established sustainable management and conservation objectives relevant to the Atlantic marine environment. ²⁸	B 2,3,(10)
Enhanced deep-sea biodiversity assessments and regional management scenarios were used to expand existing marine protected area networks in the Azores and South Africa. ²⁹	B 2,3
<i>Monitoring and modelling a changing ocean and climate</i>	
New capacity to monitor oxygen levels in the South Atlantic and improving ecosystem relevance of long-term oceanographic monitoring in the North Atlantic. ³⁰	D 8,20
Basin-scale ocean and climate models improved and used to research the variability and trends of the AMOC, with particular emphasis on northern vs southern hemisphere impacts. Ultra-high resolution models scaled down the information to underpin ecosystem studies in specific regions, making these useful for ecosystem-level research. ^{31,32,33}	D 8,20
<i>Technology development and transfer</i>	
Development and in-field testing of low-cost video survey technology for benthic habitat surveying, suitable for deploying from vessels of opportunity. Transfer of this technology to South Atlantic project partners. ³⁸	D 2,3,20
New high-resolution imaging and processing techniques reveal 3D complexities of key deep-sea habitats and its influence on local species diversity and distribution. ^{34,35,36,37}	D 2,3,20
Development of a GIS-based GeoNode platform that allows users to search for, visualise, download and share over 370 (and counting) geospatial datasets in the Atlantic. These include pre-existing geospatial datasets relevant to iAtlantic research as well as new research outputs produced by the project. ³⁹	D 20
iAtlantic was instrumental in supporting the development of an All-Atlantic Ocean Data (AAOD) community portal on the GEOSS Portal. Launched in December 2021, the AAOD aims to consolidate, strengthen and grow the international Atlantic observing community. ⁴⁰	D 20

Opportunities for science to support ocean governance in the Atlantic Ocean

Going forward, achievement of the GBF targets and overarching goals for the Atlantic Region will need to build further on scientific findings and increased knowledge of the Atlantic region. Research and knowledge creation through primary research and data collection initiatives combined with data sharing and standardisation will be vital to address gaps in understanding, underpin cross-cutting management efforts and improve knowledge-based decision making. Opportunities for enhancing scientific efforts include:

- **Long-term research programmes that track ecosystem dynamics and changes in the Atlantic Ocean should be established** to support scientists to identify trends, assess the effectiveness of conservation and management measures, and understand the impacts of climate change and human activities on Atlantic marine ecosystems. Considering the complex governance framework, **knowledge creation should not only focus on natural sciences but also include legal and governance aspects**, as well as understanding of available management approaches. Collaboration across disciplines will leverage diverse expertise and resources, leading to more comprehensive and effective outcomes for decision makers.

- An **assessment of research and knowledge gaps related to the Atlantic basin and the GBF and its targets** should be conducted. The outcomes of such an assessment will be important to select priorities for future research initiatives as well as inform the development of technologies and innovation. Tools such as DNA sequencing, satellite data, modelling and artificial intelligence can enhance data analysis, species identification and habitat prediction.
- **Capacity development programmes and initiatives, including research projects such as iAtlantic, that enhance the skills and knowledge of researchers (and stakeholders) involved in Atlantic Ocean conservation will help to create a community of practice around the GBF and its targets.** Such initiatives also are important to facilitate technology transfer and knowledge sharing, particularly in developing countries, to enable effective monitoring, enforcement and sustainable practices.



The South African research vessel SA Agulhas II in Antarctica for the 2019 GoodHope expedition, which provides training every year for South African marine science students via the SEAmester programme. Image courtesy A. Oelofse.

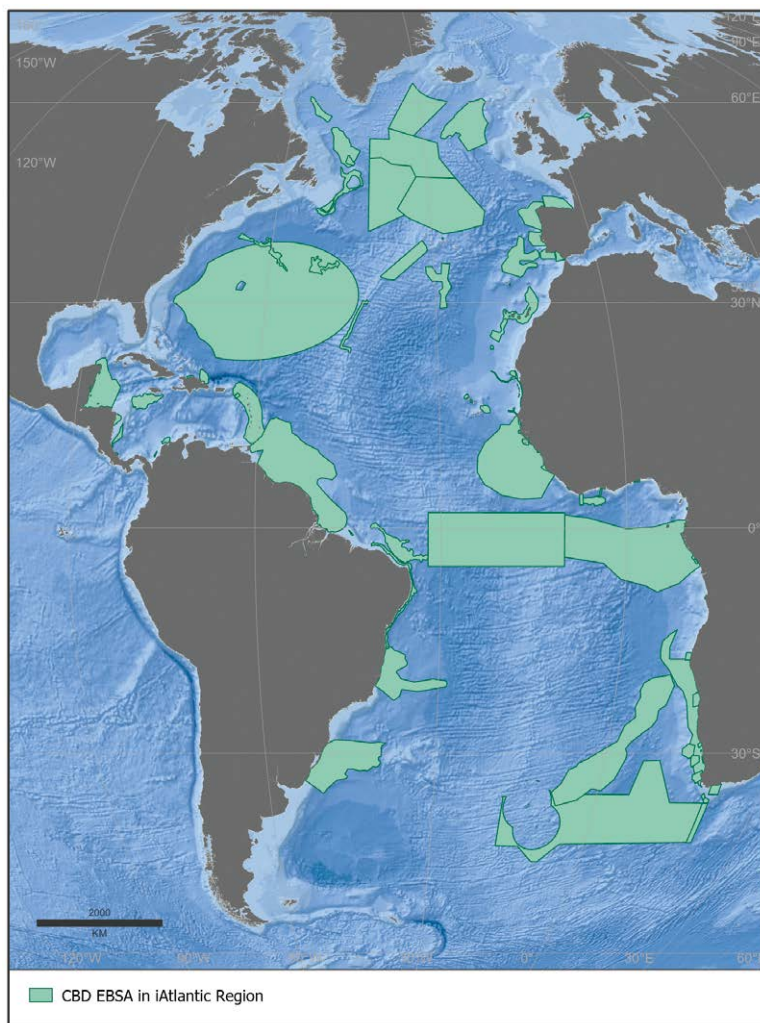
- **Capacity development programmes can include short-term targeted training as well as long-term educational initiatives, potentially embedded in established educational institutions such as universities and research centres.** Programmes should focus on education and training but go beyond this by supporting joint research projects, internships and exchange programmes that allow students and researchers, especially from the Global South, to contribute to conservation efforts while gaining practical experience. Support should be provided for the development of local expertise in Atlantic coastal countries, including scientists, technicians and policymakers.



- **Mechanisms for open data sharing and accessibility (standardisation) will foster collaboration,** enable broader analyses, and support evidence-based decision-making for conservation and management efforts. Researchers and institutions should ensure their data is publicly available, following appropriate protocols for data security – including through policy processes (e.g., the Clearing House Mechanism of the future BBNJ Agreement).

Left: The sponge Caulophagus cf. arcticus serves as a welcoming habitat for crustaceans at 3000 m depth in the Norwegian Basin. Image courtesy ROV6000, GEOMAR, Kiel.

- Within the CBD framework, in 2008 States parties adopted a set of scientific criteria to describe ecologically or biologically significant marine areas (EBSAs), with a view to provide the scientific knowledge and evidence base for enhanced area-based protection or management by Parties and competent international authorities. **To date, 338 EBSAs have been identified, including 88 EBSAs overlapping the study area of the iAtlantic project.** These include static features such as individual seamounts, groups of static features such as seamount chains, ephemeral features such as seasonal foraging areas and dynamic oceanographic features such as upwelling zones. Scientific reviews of the status of these areas, the significant species, and ecosystems they support, and their resilience to climate change will be important. Going forward, **documented rates of biodiversity loss within EBSAs should be used to highlight and inform the need for management measures within the Atlantic region.**



Above: EBSAs in the iAtlantic region. Map courtesy J.Cleary, Marine Geospatial Ecology Lab, Duke University

- **A shared (i.e., Atlantic-wide) science-policy-society interface can facilitate effective communication and dissemination of research findings to a wide range of audiences,** including policymakers, stakeholders, and the public. Such an independent platform could take a non-biased leadership role to coordinate research efforts across independent initiatives, act as a data manager and repository host, as well as ensure that scientific knowledge is translated into accessible formats to support decision making and towards the GBF.

Additional resources

iAtlantic website: www.iatlantic.eu

Full list of iAtlantic publications: www.iatlantic.eu/our-work/publications/

iAtlantic open access publications archive: zenodo.org/communities/iatlantic-projectcollection

Atlantic data repository: pangaea.de/?q=iatlantic

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