When a plan comes together

Achievements and highlights from the Global Ocean Biodiversity Initiative's grant under the International Climate Initiative, 2016-2023

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For more information: www.gobi.org

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IKI INTERNATIONAL CLIMATE INITIATIVE

based on a decision of the German Bundestag

The wider GOBI community comprises more than 40 research and conservation organisations around the world. A specialised subset of these organisations were implementing partners in GOBI's grant from the International Climate Initiative (2016-2023), coordinated by the GOBI Secretariat:

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Foreword

I am proud to reflect on the successful completion of GOBI's 7-year project under the International Climate Initiative. Unusually, for such a complex and ambitious endeavour, each of the project elements boasts its own success story; in combination, the strands represent a sustained, significant and unique contribution to furthering global ocean biodiversity protection. This has been achieved despite the disruption of the Covid-19 pandemic and is testimony to the drive, determination and vision of key individuals working in our partner organisations. Very importantly, the results complement and feed into ocean policy priorities, which have evolved rapidly during the lifetime of the project. To that end, GOBI has provided reliable and appropriate scientific and technical support, as well as leaving a legacy whose relevance will endure. But what is 'appropriate' support? Our interpretation is that it should be relevant information that is impartial, objective, targeted, peer reviewed and well communicated. We are privileged to have worked with and advised several UN agencies as part of this scientific effort and appreciate their engagement and support.

Prof. David Johnson, GOBI Coordinator
September 2024

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Introduction

The Global Ocean Biodiversity Initiative (GOBI) is an international partnership of organisations, established in 2008 to advance the scientific basis for conserving biological diversity in the marine environment. In particular, GOBI has contributed expertise, knowledge and data to support the efforts of the Convention on Biological Diversity (CBD) to identify ecologically or biologically significant marine areas (EBSAs) by assisting a range of intergovernmental, regional and national organisations to use and develop data, tools and methodologies. GOBI also undertakes research to generate new science that will enhance the value of EBSAs and their utility for promoting environmental protection and management for specific areas of the world's oceans. The intention is ultimately to reduce the rate of biodiversity loss through the application of ecosystem approaches to the management of human activities, and to support the establishment of networks of representative marine protected areas in national and international waters.

From 2016 to 2023, GOBI received a EUR 6.5M grant from the German Government's International Climate Initiative (IKI) to use the information contained within EBSA descriptions as the basis for promoting environmental protection and management for specific areas of the global ocean. This seven-year programme of work has helped determine the strengths, challenges and limitations of available marine ecosystem data around the world, whilst developing new tools, methodologies and resources to fill knowledge gaps and inform the conservation and sustainable use of marine resources at national, regional and international levels. Spanning six research themes, the project has explored and validated approaches to understanding the distribution of key marine species and ecosystems in the world's ocean, including through the development of regional biogeographies and establishing more comprehensive visualisations of marine connectivity and migratory corridors. The project has identified areas of the ocean that are particularly important for marine mammals and seabirds and has strengthened our understanding of the genetic connectivity between deep-sea hydrothermal vent ecosystems, including how these ecosystems need to be protected from the impacts of human activities such as deep-sea mining.

An overarching aim of the project was to make a significant contribution to the knowledge required to underpin protected area networks in the global ocean and make this available to appropriate policy instruments, as well as to support advances in specific regions – including work focused on fostering broader recognition of the importance of a unique upwelling system in the Eastern Tropical Pacific. In the final phase of the project, the new tools developed by GOBI were applied in a regional setting, providing the basis for more coordinated conservation and sustainable use planning in the north-west Indian Ocean.

The timing of GOBI's work under this project has been opportune as governments have reacted to the stark messages of global environmental assessments and negotiated the new UN high seas biodiversity treaty (BBNJ Agreement), agreed the Kunming-Montreal Global Biodiversity Framework under the CBD, and continued discussions to develop regulations for seabed mining at the International Seabed Authority.

This document presents the highlights and achievements from GOBI's IKI grant, reflects on lessons learned, and considers the legacy that GOBI's work has contributed to global and regional ocean governance processes.

Hammerhead shark, Hawaii.
Image courtesy Jonas Allert

Biogeographic regionalisation in the Indian Ocean and western South Pacific

Lead partner: Piers Dunstan, Commonwealth Scientfic and Industrial Research Organisation

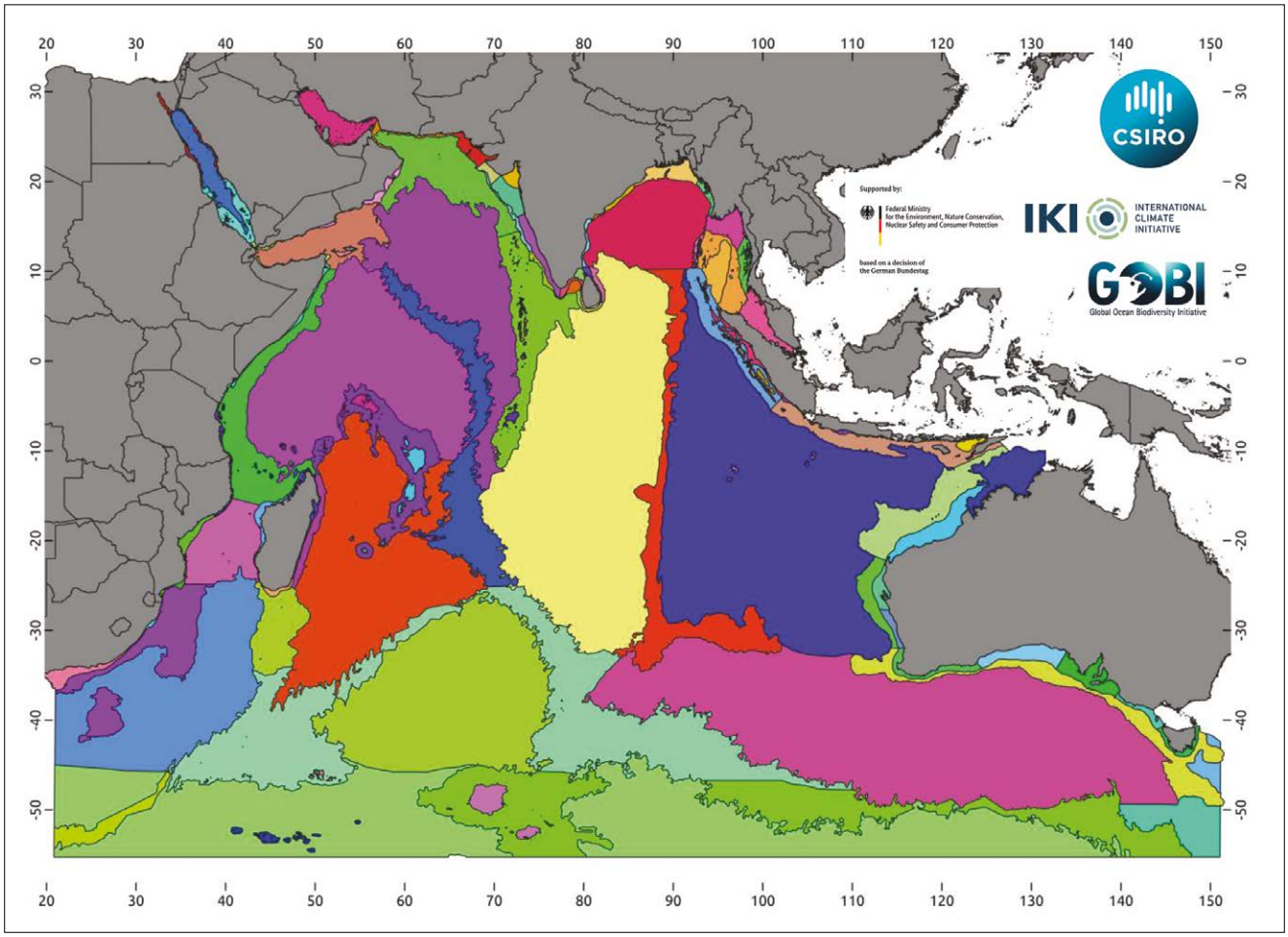
Biogeographic provinces are large regions representing broad-scale biodiversity patterns that are relatively stable over space and time, and that contain distinct environmental conditions and biological contents that result from historical and present-day factors. Natural resource users and managers can use biogeographic maps as a proxy for species and their assemblages in a variety of applications, including the conservation and sustainable use of biodiversity and ecosystems, and their associated goods and services. The process of biogeographic regionalisation simplifies the complex spatial organisation in nature (e.g., habitats) and represents it on a map to improve understanding and inform decision-making – for example, to ensure connectivity and ecological coherence in the design of marine protected area networks. The overarching goal of this component of GOBI's work was to inform the placement of area-based management tools in the high seas by developing a robust description of the distribution of biodiversity and the human activities that may impact it.

The Indian and Pacific Ocean both abut the coral triangle – often considered to be the global centre for marine biodiversity. They are locations for developed industries (e.g. tuna fisheries) and emerging sectors (e.g. deep-sea mining) and represent large ocean areas with significant numbers of coastal States who are often absent from global marine science discussions. GOBI explicitly engaged with these States to ensure their views and priorities were reflected on the global stage.

Biogeographic regionalisation exercises for the western South Pacific Ocean and the Indian Ocean were carried out to increase scientific understanding of species distribution relationships within and between bioregions. Using experience gained from the Australian national marine biogeographic regionalisation process as well as from similar approaches on the Antarctic margins, in the Bay of Bengal and around the Pacific and Indian Oceans, the work used statistical analyses[1] and expert workshops to produce a combined biogeographic regionalisation that spans both pelagic and benthic realms, which can be used to aid decision making across multiple sectors.

[1] Woolley et al. (2020)

The Indian Ocean is home to many ocean islands, like this one in the Maldives. Image courtesy Fabrice Dudenhofer/Ocean Image Bank



Above: Benthic biogeographic regionalisation developed for the Indian Ocean. Each biogeographic province is represented by a different colur, identified on the basis that each province contains distinct biodiversity. Image courtesy CSIRO.

The new biogeographic regionalisations for the south-west Pacific and Indian Oceans[2] incorporate understanding of shallow, deep and pelagic species, ecosystems, physical environments and their likely boundaries based on current information. These expert-based biogeographic regionalisations are supported by development of statistical analysis of datasets of selected species groups to identify bioregions specific for each taxon, with data from the EBSA process and additional regional biogeography based on new invertebrate and fish collections from CSIRO, University of Tasmania, Museum Victoria and regional partners.

Key to the success of the process was the collaboration with stakeholders from the region throughout the process, including data holders, marine resource users, public and private sector environmental agencies, and relevant national, regional and international governance authorities. Following initial compilation and analyses of physical environmental data, expert workshops were held in both the Indian Ocean (Seychelles, South Africa) and SW Pacific (Fiji) to develop, refine and finalise the bioregions for these ocean areas. This helped to ensure that the work produced a set of appropriate, inclusive, integrated and transparent management tools for the region.

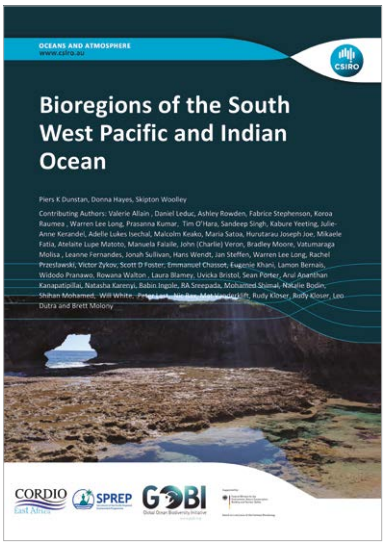
In a second phase, the biogeographic regionalisation for the Indian Ocean was used to develop a marine protected prioritisation tool for use in the area beyond national jurisdiction. Maps of predicted biodiversity patterns produced through new modelling techniques were combined with bioregional boundaries and the boundaries of areas already recognised for their biodiversity importance (EBSAs and VME closures), alongside the footprint of human use and other anthropogenic pressures (largely fisheries and proposed deep-sea mining sites). The approach ran through a series of conservation prioritisation scenarios that added more complexity to analyses for each new scenario, moving from a broad 'biodiversity only' scenario that included all pelagic and benthic species, to prioritisations specific to pelagic and benthic biodiversity. The result is a systematic analysis of priority areas for identifying key biodiversity areas in ABNJ in the Indian Ocean.

Impact and legacy

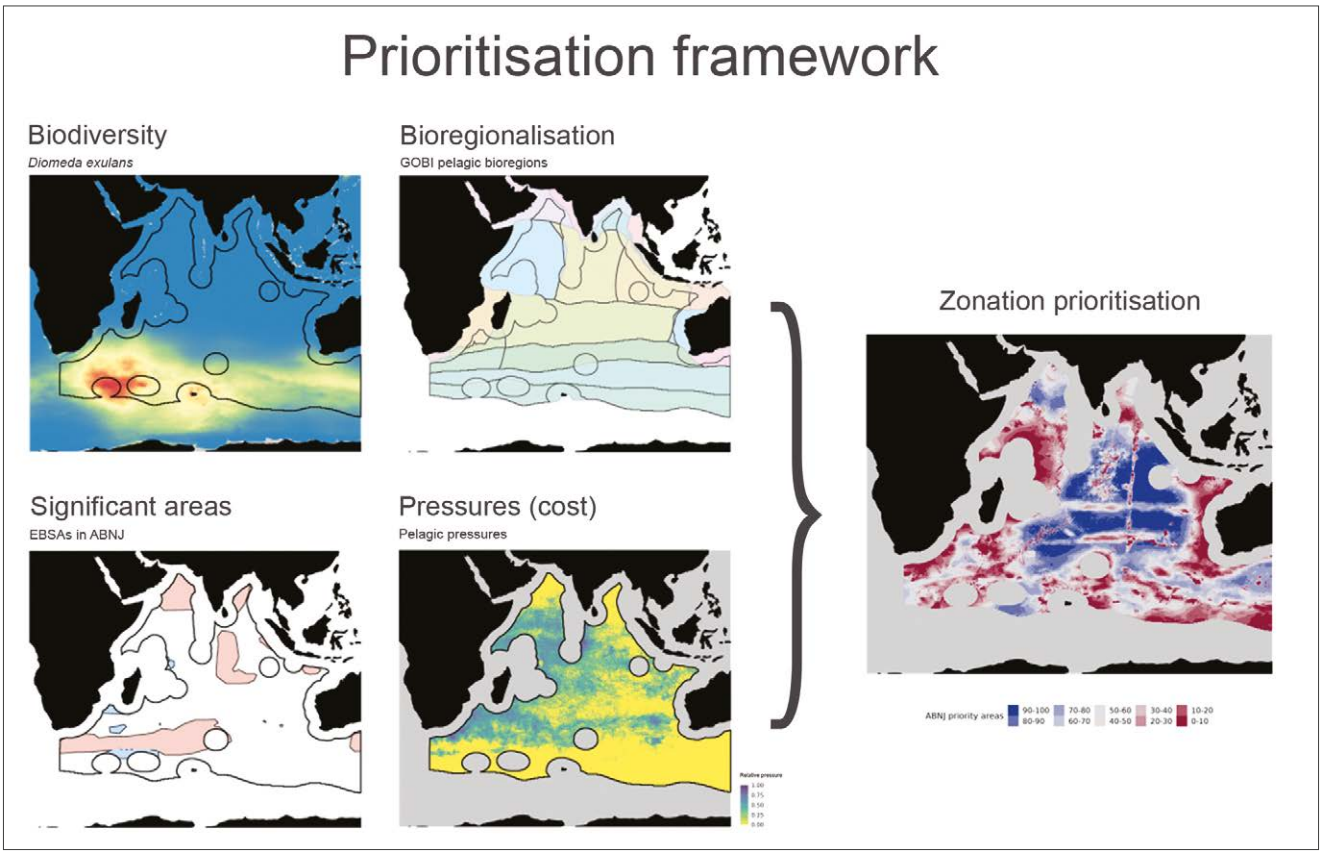
Biogeographic regionalisations produced by GOBI for the Indian Ocean and western South Pacific (and the data within) have found a wide range of applications in both regions. The reports and datasets have been used by competent authorities in

[2] Dunstan et al. (2020a) and Dunstan et al. (2020b) respectively

fisheries ecosystem assessments and development of strategies for mapping Vulnerable Marine Ecosystems, as well as in the assessment of fisheries risk in relation to climate change. Governments in the regions have used the bioregionalisation outputs to aid marine spatial planning and management of biodiversity in national waters, with the 23 member States of the Indian Ocean Rim Association (IORA) formally endorsing the biogeography produced for the Indian Ocean. In area beyond national jurisdiction, the methodologies have been adopted by the International Seabed Authority to support the assessment of cumulative impacts from deep sea mining in the Regional Environmental Management Plan (REMP) for the Mid Atlantic Ridge, and the Indian Ocean bioregionalisation data have been used to support development of the draft Indian Ocean REMP.



Above left: Participants at the second GOBI bioregionalisation workshop for the Pacific, Fiji, April 2019. Above right: a summary report of the bioregionalisation methodologies used is available - see Dunstan et al. (2020c) in the references list at the end of this document.



Above: Prioritisation framework for identifying key areas for conservation within ABNJ in the Indian Ocean. This incorporates information on biodiversity for pelagic and benthic species, biogeographic regionalisation schemes for the Indian Ocean, areas recognised for their biodiversity significance (e.g., EBSAs & VME closures) and spatial footprints for existing pressures in ABNJ. Image courtesy CSIRO.

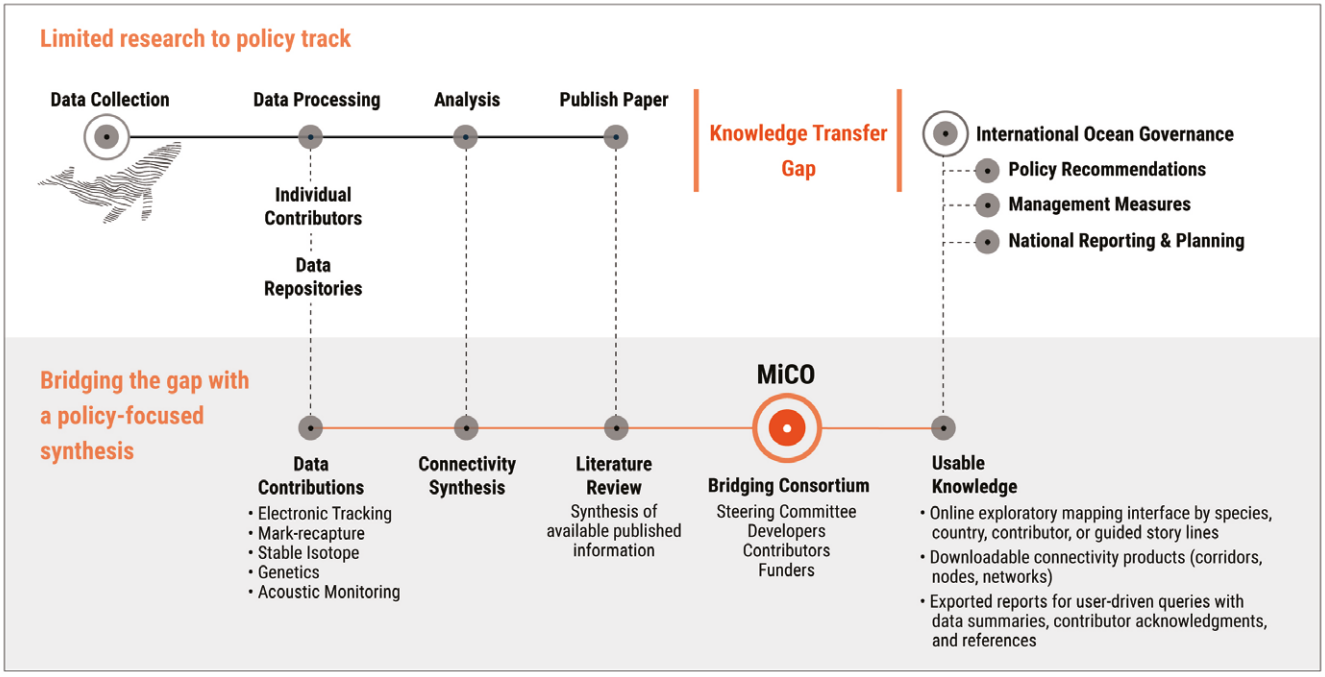
Ecosystem connectivity, area-based planning and network approaches in areas beyond national jurisdiction

Lead partners: Pat Halpin, Duke University & Daniel Dunn, University of Queensland

Migratory species depend on critical habitats throughout their seasonal movements, including breeding and foraging sites as well as the pathways between them. Loggerhead sea turtles, for example, can be found nesting on a beach in Japan, but they forage along the Pacific coast of Mexico. During migrations, individual animals travelling through national waters (i.e., within Exclusive Economic Zones) and areas beyond national jurisdiction (ABNJ) may encounter a variety of stressors, from predation and adverse weather to human impacts including habitat destruction, direct and incidental fishing mortality, ship strikes, noise, hazardous substances and other pollutants. The potential cumulative impact of regional-scale stressors may impact populations and are a function of migratory connectivity: how individuals and populations are geographically linked throughout their migratory cycles. Awareness of how a population is connected, how connectivity influences demographic rates, and designing conservation and management measures appropriate for the level of risk associated with various degrees of connectivity, are all critical to the conservation and sustainable use of migratory species.

Advances in animal tracking technology are enabling far greater data collection on migration patterns than ever before. However, while the amount of data continues to grow exponentially, efforts to synthesise disparate research efforts and provide access to information on migratory connectivity for management and policy have lagged behind, leading to an acute lack of information on migratory species' use of ABNJ.

To address this, the Migratory Connectivity in the Ocean (MiCO) initiative was conceived under GOBI's IKI grant to connect global policy and conservation processes with actionable knowledge on migratory connectivity. MiCO provides an easily accessible geospatial knowledge hub to facilitate the inclusion of marine connectivity into international management and policy frameworks (including area-based planning processes), and to inform future research and investment needs. In particular, this work seeks to support competent authorities such as CBD and the Convention on Migratory Species of Wild Animals (CMS) to move from descriptions of individual sites to a network approach that considers representativity and connectivity.



Above: MiCO bridges the current knowledge gap between science and policy by aggregating and producing actionable knowledge that can be directly used by managers and policy makers, as well as informing future research needs. Infographic courtesy MiCO.

Above: Hawksbill sea turtle at Grand Cayman, Caribbean. Image courtesy Jason Washington / Ocean Image Bank.

Two studies carried out by the MiCO team consolidated the thinking on this issue: Dunn et al. (2019)[3] outlined ways that global ocean policy would benefit from considering migratory connectivity, while Hays et al. (2020)[4] compiled case studies for how marine animal tracking data have already helped shape conservation policy and management.

MiCO convened a large community of international partners – including data warehouses, national observing systems, taxa conservation groups, museums, environmental non-governmental organisations, universities, intergovernmental commissions and UN bodies – who contributed connectivity data, expertise and guidance. The resulting MiCO geospatial knowledge hub (www.mico.eco) contains information on more than 100 species of marine turtles, marine mammals, seabirds and fish, and their connections worldwide, derived from a literature review[5] of more than 25 years of published tracking data spanning 173 marine species. This represents the single largest publicly available dataset on connectivity of marine migratory species in the world. A follow-on paper[6] summarises the immense connectivity of marine mammal, seabird, sea turtle and fish movement networks developed from the literature, which provides a first synoptic baseline and an analysis of biases and gaps in the data. GOBI's work on connectivity included a particular focus on the movements of sea turtles based on a telemetry dataset of 1,235 individually tagged animals, which has furthered our understanding of their spatial ecology and the networks that tie multiple jurisdictions and areas beyond national jurisdiction[7].

Alongside the development of the MiCO system, the team carried out an assessment[8] of the migratory species information gathered through the CBD EBSA process, with the aim to support the transition from describing individual EBSAs to the description

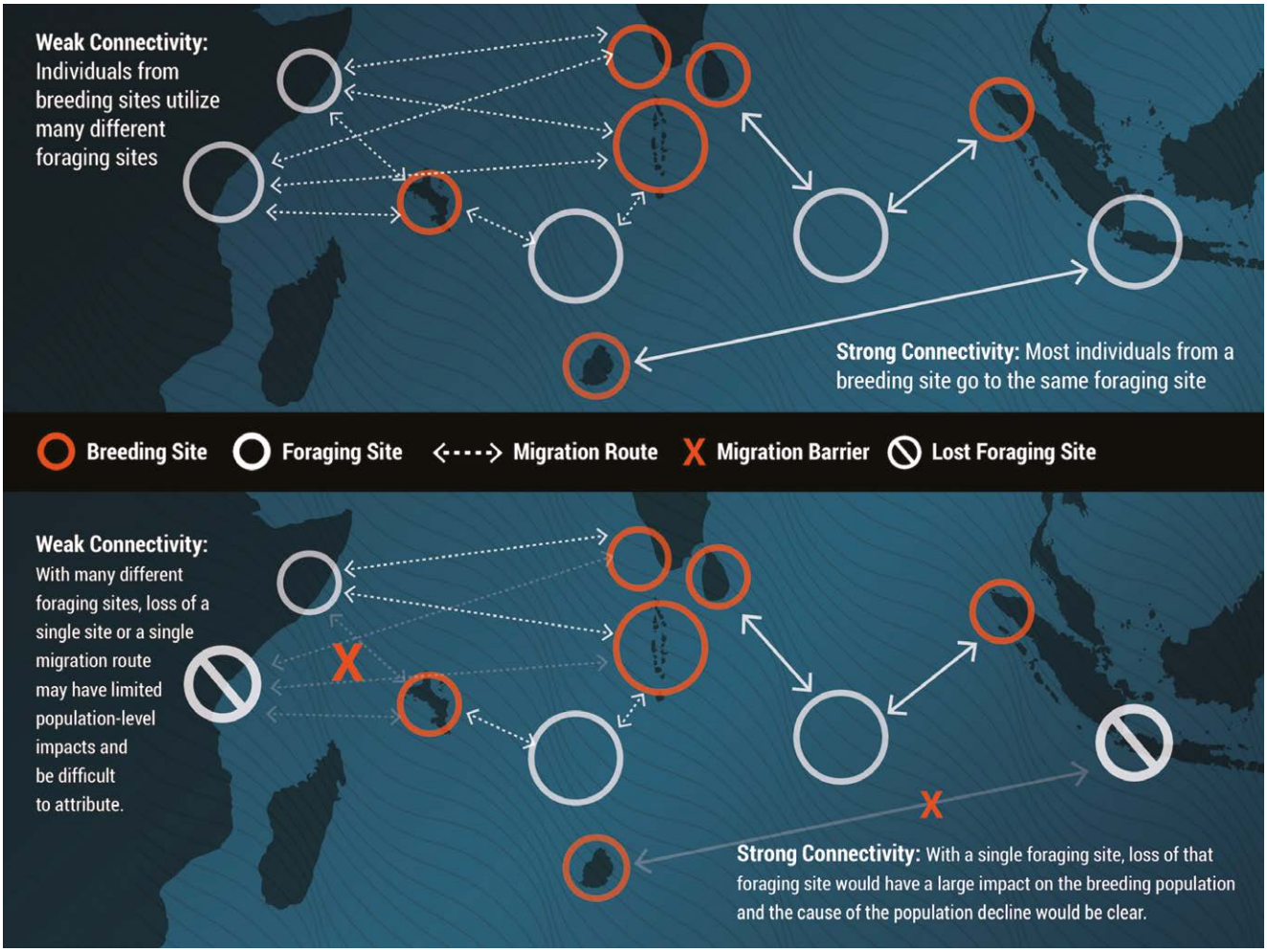
[3] Dunn et al. (2019)
[4] Hays et al. (2020)
[5] Kot et al. (2023)
[6] Bentley et al. (in revision; 2024)
[7] Kot et al. (2022)
[8] Dunn et al. (in review at *npj Ocean Sustainability*)

of a network that meets the CBD criteria for a global network of protected areas. Building on an initial gap analysis of the EBSA portfolio, they found that the vast majority of EBSA descriptions mention marine mammals, sea turtles, seabirds or fish, and approximately a quarter were delineated specifically for due to the use of an area by one or more of these species. Interestingly, half the descriptions contain some information about enhanced management, but this is highly variable and decreases with size and inclusion of areas beyond national jurisdiction.

MiCO has promoted many examples of how migratory connectivity data are already a critical component within marine policy and highlights their potential to strengthen conservation measures. Recommendations from this aspect of GOBI's work include: 1) targeting research where significant gaps exist, 2) sharing standardised data to accelerate knowledge transfer, and 3) increasing opportunities to build closer relationships among stakeholders from different sectors (e.g., academia, government, non-profit organisations, industry) to reinforce collaboration.

Impact and legacy

Connectivity issues – both physical and ecological – are gaining recognition in international policy processes, including in the targets of the CBD Kunming-Montreal Global Biodiversity Framework, in the Resolutions of the Convention on Migratory Species of Wild Animals, in the development of regional environmental management plans under the International Seabed Authority, and in the new BBNJ Agreement. Provision of accessible, reliable and accurate information about connectivity and the movement of animals in the marine environment is crucial to effectively managing species, habitats, seascapes, and the migratory corridors between them, as well as in the establishment of networks of protected areas to conserve them. GOBI – through its work in developing MiCO and associated products – has provided information on connectivity and migratory species to all these processes as well as to States and regional bodies seeking to better understand connections between national waters and adjacent areas beyond national jurisdiction. The MiCO platform continues to be developed and expanded, and remains a free and open resource for policymakers and scientists alike.



Above: Stressors and their impacts on connectivity. Infographic courtesy MiCO.

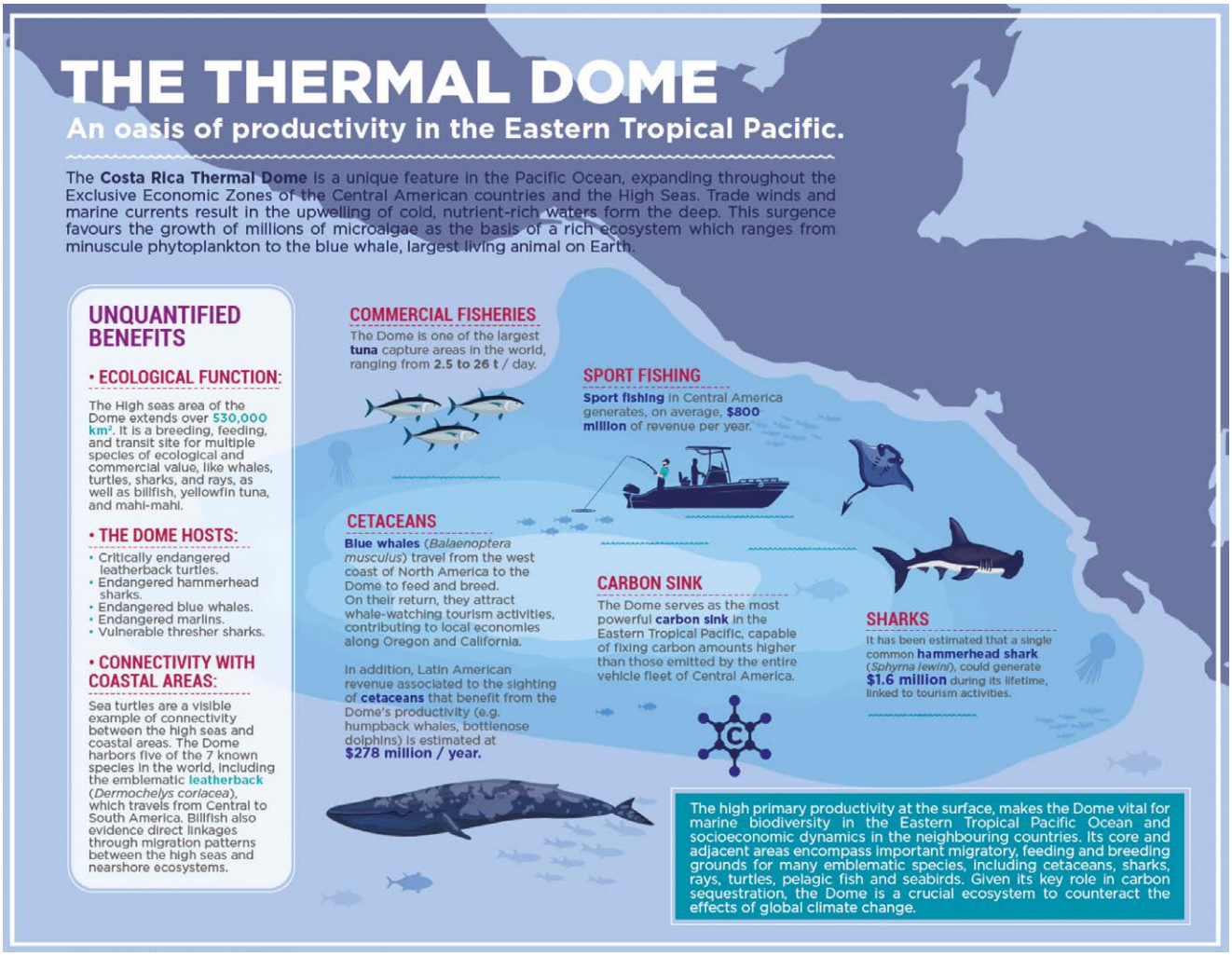
Developing a model regional ocean governance scheme: Costa Rica Thermal Dome

Lead partner: Jorge Jiménez, MarViva Foundation

The Costa Rica Thermal Dome (CRTD) is a unique oceanographic feature in the eastern tropical Pacific Ocean, spanning the national waters of several Central American countries as well as the adjacent high seas. Here, trade winds and marine currents drive the upwelling of cold, nutrient-rich waters from the deep ocean into warmer surface waters, fuelling the growth of millions of microalgae to form the basis of a rich ecosystem that supports a diversity of life, from the smallest of plankton through to the largest living animal on Earth, the blue whale.

The high primary productivity of the Dome makes it a vital hotspot for marine biodiversity in this region of the Pacific and it forms a key component of the broader Papagayo Upwelling System and Adjacent Areas EBSA identified by the CBD. Its core and adjacent areas encompass important migratory, feeding and breeding grounds for many charismatic species, including cetaceans, sharks, rays, turtles, pelagic fish and seabirds. The Dome provides a major carbon sink, crucial to counteracting the effects of global climate change. It also provides significant socioeconomic benefits to neighbouring countries, with industries such as commercial and recreational fishing, and wildlife-based tourism relying on the rich biodiversity of the Dome's waters to bring millions of dollars to the national economies. The Dome represents one of the largest tuna capture areas in the world, and sport fishing generates revenue of $800 million/year for the adjacent Central American countries.

However, with industrial interests comes the risk of overexploitation and the Dome is not immune to the impacts of excessive fishing and increasing volumes of tourist boats. The area is also exposed to significant marine traffic transiting one of the busiest maritime trade routes in the world, to and from the Panama Canal, which inevitably results in pollution risk and ship strikes on marine mammals.



Above: Illustration of the key sociio-economic benefits provided by the Costa Rica Thermal Dome. Public awareness campaigns using infographics like this were important in helping secure public support for improved ocean governance in the region. Image courtesy MarViva Foundation.

The high seas portion of the Dome extends over 530,000 km², with a wider margin falling into national waters. The location and size of the Dome varies annually and seasonally, responding to changes in regional wind and current dynamics. It is generally located in ABNJ from June to February each year and tends to migrate so that its margins overlap a portion of the national waters of at least one neighbouring Central American country during the rest of the year. In terms of governance and resource management therefore, it presents a complicated picture: falling both (partially) within and outside of multiple national jurisdictions to varying degrees on both a seasonal and annual timescale, with strong socioeconomic considerations involving multiple countries and sectors.

For the GOBI team working in this region, a first step was to design and launch a major information and awareness-raising campaign to highlight and champion the many ecological and societal benefits of the Dome, including the important (but often overlooked) connection between high seas ecosystems and society. A major public poster campaign drew attention to the key features and natural services provided by the Dome; an educational campaign drew attention to its charismatic marine species, and a dedicated seagoing expedition collected data, tagged and tracked migratory species, and provided a platform to film a documentary about the Dome[9] and the threats to it. These efforts, combined with an extensive review of the scientific literature on the region, culminated in the creation of the Costa Rica Thermal Dome Atlas[10] – a comprehensive summary of knowledge on the Dome – which was distributed to a broad spectrum of stakeholders in Central America and internationally. It is the first technical publication to gather scientific information on the Dome's biodiversity and ecosystems, including information on the most challenging threats and policy recommendations to promote effective governance and management of navigation

[9] High Seas Journey to the Costa Rica Thermal Dome (English subtitle version): www.youtube.com/watch?v=cpFO731F7No
[10] Ross Salazar et al. (2019)

routes and fisheries. The Atlas is accompanied by the Costa Rica Thermal Dome Geoportal[11], an online multimedia tool enabling visualisation of information about the oceanographic, ecological and commercially relevant features of the Dome through more than 25 interactive maps.

Alongside the public awareness campaign, the GOBI team worked closely with Central American national governments, regional authorities, industry bodies and conservation groups to facilitate discussions on potential management strategies and measures for the high seas portion of the Dome. Following a series of workshops and meetings with technical and political representatives, and a long campaign to highlight the biodiversity of the Dome and its relationship with coastal socioeconomic and ecological dynamics, political momentum for better management of the area was secured. A Ministerial Agreement from the Central American Commission on Environment and Development (CCAD) to incorporate the Thermal Dome in the Regional Marine Agenda by means of a Regional Work Plan was achieved in May 2019 – all eight CCAD countries (Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Belize and the Dominican Republic) acknowledged and agreed to support the regional initiative to advance towards the definition of a governance model. This paved the way for a draft Regional Work Plan to be developed by the GOBI team, which was presented as a proposal to CCAD in 2021, formally validated by the CCAD technical liaisons and presented before ministerial authorities. Data and knowledge from GOBI's work has also informed specific thinking on potential means to help mitigate shipping hazards in the Dome region[10].

Impact and legacy

GOBI's work in the Costa Rica Thermal Dome provides important lessons in developing sustained regional momentum for managing an ecologically important area of the ocean lying across multiple jurisdictions and providing tangible socioeconomic benefits to several national economies. In particular, experiences from the Dome can inform the implementation of the BBNJ Agreement, providing a clear example of how natural features in ABNJ have direct connection to and impact on activities in national jurisdictions, and vice versa. It also demonstrates the incentives for States to collaborate and cooperate to secure biodiversity gains and maintain ecosystem services.

[11] https://domo.geoportal.marviva.net/
[12] Castillo Rodrigues et al. (2023)

Above: Measuring the vital statistics of sea turtles during the Costa Rica Thermal Dome expedition in 2017. Image courtesy Kip Evans/MarViva Foundation.

Tracking seabirds across the world's ocean

Lead partner: Tammy Davies, BirdLife International

Arctic tern. Image courtesy Joane Morten.

Seabirds are one of the most threatened groups of birds. However, because of their highly dispersed and mobile ecology, their distributions and behaviour at sea have hitherto not been well understood. Remote tracking data are vital to help understand how they use the oceans and identify important sites for their conservation. GOBI supported the development and expansion of the Seabird Tracking Database (STDB)[13] – the largest collection of seabird tracking data in existence. It brings together data from almost half of all seabird species through the unique collaboration of seabird scientists from around the world.

The Seabird Tracking Database is a key tool for marine conservation work and has seen a considerable growth in data over the past 7 years, from a baseline of 10 million data points in 2017, with data for 115 species contributed by 172 researchers. Today, there are now more than 35 million data points for 166 species contributed by 252 researchers, tracked from more than 450 colonies across 55 countries. GOBI supported improvements to the underlying data management system and the development of a front-facing website, which showcases the conservation impact of the database and highlights species tracking data gaps to direct future efforts.

A series of technical and policy workshops convened by the GOBI team brought together seabird experts in the western and north-western Indian Ocean to further the collection of seabird tracking data in the region and promote its application in conservation actions. On a broader scale, seabird tracking data supported by GOBI has been used in more than 30 successful proposals for marine protected areas and other area-based management efforts, perhaps most notably in the establishment of the North Atlantic Current and Evlanov Sea basin (NACES) marine protected area, designated by the OSPAR Commission in the North-east Atlantic in 2021 and subsequently expanded to include the benthic component two years later.

Seabirds are of course only one group of animals in the marine ecosystem, and there are a number of initiatives to identify areas of the ocean that are important for other taxa, such as marine mammals, sea turtles, sharks and rays. Highlighting a need to identify and consolidate synergies between these initiatives, the GOBI team brought relevant groups together for a productive workshop on these synergies, including multi-taxa hotspots, and discussion on how collective input can be more strategically directed at policy fora.

GOBI has also furthered the scientific understanding of threats to seabirds, carrying out a global, systematic, quantitative assessment of the threats to all 359 seabird species. The results[14] highlighted the main pressures driving seabird population declines (invasive species, bycatch and climate change) and outlined priority actions for seabird conservation. A series of five workshops in 2021

[13] www.seabirdtracking.org
[14] Dias et al. (2019)

sought to identify an engagement and mitigation strategy for the major identified threats to seabirds: overfishing, harvesting/hunting, marine plastics, renewable energy infrastructure, and oil and gas/light pollution.

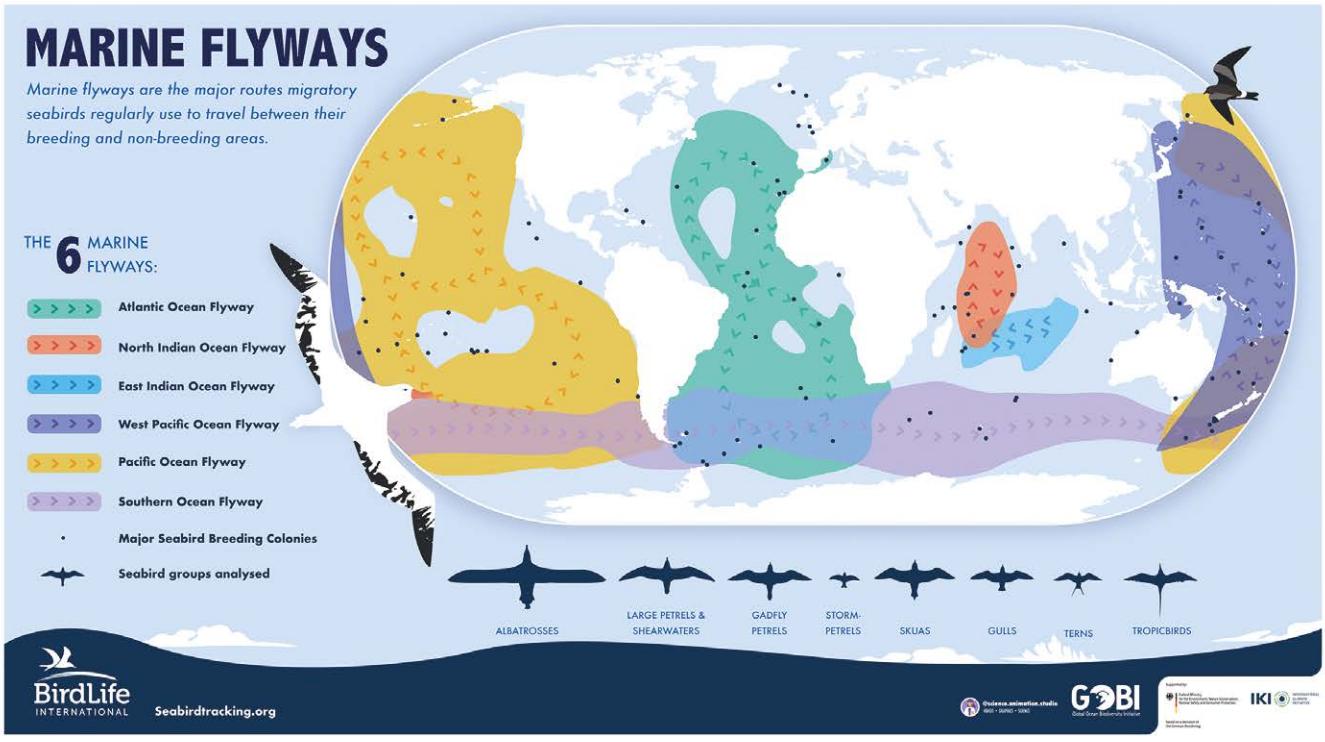
GOBI recognised an opportunity to use seabird tracking data to demonstrate the importance of connectivity and responsibility for high seas conservation. To identify the major and predictable routes travelled by seabirds between breeding and non-breeding sites, the team compiled a vast amount of tracking data from the STDB for long-distance migrants. Six Marine Flyways were identified, illustrated through a series of infographics, interactive online case studies and a short animation[15]. The Marine Flyways concept was launched on World Migratory Bird Day 2023 and the Global Bird Weekend. The Marine Flyways framework will be used to build connectivity into on-going work relating to site identification and protection and to secure intergovernmental support for marine conservation, via relevant policy processes such as the Kunming-Montreal Global Biodiversity Framework, resolutions under the Convention on Migratory Species of wild animals, and the BBNJ Treaty.

Impact and legacy

Information on seabird threats and conservation needs, as well as broader information from the Seabird Tracking Database, has been shared with a wide range of competent authorities, agencies and stakeholder organisations including CBD (both through the EBSA process and in the development of the Kunming-Montreal Global Biodiversity Framework), Nairobi Convention, Western Indian Ocean Regional Ocean Governance programme, Consortium for the Conservation of Coastal and Marine Ecosystems in the Western Indian Ocean, IUCN, Indian Ocean Tuna Commission, International Seabed Authority, and a long list of national governments and agencies who have used seabird data to help support marine spatial planning efforts and MPA designation.

White-faced storm petrel. Image courtesy Paul F. Donald.

[15] www.seabirdtracking.org/special/marine-flyways/



Above: Flyways are the major routes followed repeatedly and consistently by migrating birds between their breeding and non-breeding areas. Although there is a lot of variation between species and populations, flyways are the main migration routes that the majority of birds use. The Flyways approach provides a useful framework for coordinated intergovernmental action and has successfully led to partnerships to collaboratively address major land-based threats for species and sites. Infographic courtesy BirdLife International.

Conserving biodiversity at deep-sea hydrothermal vents

Lead partner: Cindy Van Dover, Duke University

Mid-ocean ridges – the zipper-like boundary between tectonic plates in several of the world's oceans – are home to hydrothermal vents: patchy areas of the seafloor where mineral-rich fluids are expelled into the water column. Fuelled by this cocktail of chemicals, diverse communities of tube worms, clams, snails and shrimp thrive around the hydrothermal vent chimneys. Relative to most of the surrounding deep sea, hydrothermal vent ecosystems are biologically more productive and support endemic invertebrate and fish taxa with biochemical, physiological and ecological adaptations to the vent environment.

The unique physical and chemical conditions at deep-sea hydrothermal vents have led to the formation of mineral deposits that have become the focus of commercial interest. The emerging deep-sea mining industry has the potential to generate a range of environmental disturbances that would have serious negative impacts on the health of hydrothermal vent fauna and their habitats, disrupt natural connections between vent systems, and impact other marine life such as fish and migratory species. The consequences of mining activity on such a fragile habitat and the broader ramifications for the deep-sea ecosystem are only now beginning to be understood.

GOBI's hydrothermal vents team set out to significantly increase our understanding the risks of deep-sea mining activity to active hydrothermal vents, and the nature of the precautionary measures necessary to protect them. The outcomes of this work have direct application to the International Seabed Authority (ISA), the UN-affiliated body with the mandate to ensure the effective protection of the marine environment from harmful effects that may arise from deep-seabed related activities in areas of the seabed beyond national jurisdiction. Throughout the duration of GOBI's IKI grant, the ISA has been developing regional environmental management plans for mid-ocean ridge areas in the Atlantic and Indian oceans, as well as a set of draft regulations to manage future deep-sea mining activities.

Birthday Vent at Puy des Folles Seamount on the Mid-Atlantic Ridge. Image courtesy Schmidt Ocean Institute (CC BY-NC-SA).

Quantitative risk assessment for deep-sea mining is challenging given the data-poor state of knowledge of deep-sea ecosystem structure, process, and vulnerability. GOBI scientists carried out an extensive survey of experts to rank risk sources and perceived vulnerabilities of habitats associated with different types of deep-sea mineral deposit. The outcomes[16] underscored the need for risk assessments to progress from expert opinion with low certainty to data-rich and ecosystem-relevant scientific research assessments to yield much higher certainty. Scientific experts who were polled identified benthic habitats associated with seabed minerals as most vulnerable to habitat removal, with a high degree of certainty. Resource-associated benthic and pelagic habitats were also perceived to be at risk from sediment plumes generated during mining activities, although there was not always consensus regarding vulnerabilities to specific risk sources from different types of plumes. Even for risk sources where habitat vulnerability measures were low, high uncertainties suggest that these risks cannot yet be dismissed.

A precautionary approach to protecting biodiversity on mid-ocean ridges is to design and implement a network of areas protected from the effects of mining, as highlighted by other research[17]. Such a network should capture representative populations of vent endemic fauna within regions of connectivity and across persistent barriers, but determining where such connectivity and barriers exist is challenging. In collaboration with genetic and hydrographic experts, the GOBI team undertook biophysical connectivity modelling among fragmented hydrothermal vent habitats along the northern Mid-Atlantic Ridge to better understand how and on what scale larvae from hydrothermal vent fauna can disperse (i.e., connecting different vent populations), and where breaks in or barriers to that dispersal likely occur[18]. This knowledge is critical to understanding the impacts that an activity such as deep-sea mining might have on the natural system, and to inform the design and implementation of a network of protected areas. Results showed that while vent larvae may disperse significant distances from a vent site, numerous natural barriers to dispersal are an important factor in determining genetic diversity in vent populations along the ridge. This work highlighted that there is a need to protect the pelagic habitat of the dispersive larval stages that are essential for maintenance of the fragmented benthic populations, as well as the vent sites themselves.

Large seafloor areas have been approved for exploration for seafloor mineral deposits by the ISA, creating an urgent need for regional environmental management plans. Networks of areas where mining and mining impacts are prohibited are key elements of these plans. The GOBI team developed options for marine reserve design on the northern Mid-Atlantic Ridge[19], specifically adapted to the distinctive biophysical environments (i.e., flanks, axial valleys, faults, hydrothermal vents, etc). The design included future climate-proofing considerations and a suite of metrics to measure network performance against conservation targets and network design criteria.

Swarms of the shrimp Rimicaris exoculata *bathing in the warm waters at the Rainbow hydrothermal vent field on the Mid-Atlantic Ridge. Image courtesy Ifremer EXOMAR expedition 2005.*

Ultimately, justification for protecting all hydrothermal vent ecosystems[20] was put forward by the international scientific community at a series of workshops relating to environmental management of seafloor massive sulphide mining. Recommendations were made to the ISA to inform the development of a Regional Environmental Management Plan (REMP) for the northern portion of the Mid-Atlantic Ridge, with the principles also being relevant for the REMP being developed for the mid-ocean ridge in the south-west Indian Ocean. To further support the case for protection of active vents, a detailed characterisation of known vent sites on the northern Mid-Atlantic Ridge within ISA jurisdiction was carried out using criteria already established by competent international authorities[21]. All known vent fields in the region met multiple criteria for vulnerability, sensitivity, and ecological or biological significance and need protection. Further assessment and comparison of the specific measures for the 155 managed active hydrothermal vents[22] revealed that the current conservation of active hydrothermal vent ecosystems remains fragmented and discordant across jurisdictions and biogeographical provinces, resulting in overall insufficient protection, especially in ABNJ.

Impact and relevance

Results from this work continue to inform discussions at the ISA on the design and location of management measures for mid-ocean ridge environments that become targets for deep-sea mining activity. The need for robust scientific information to underpin decision-making, and inclusion of scientific experts in discussions on spatial management strategies for deep ocean environments is also brought into sharp focus and will relate to similar exercises in other ocean basins.

[16] Washburn et al. (2019)
[17] Wedding et al. (2019) doi:10.1098/rspb.2013.1684
[18] Yearsley et al. (2020)
[19] Dunn et al. (2018)
[20] Van Dover et al. (2018)
[21] Gollner et al. (2021)
[22] Menini et al. (2023)

Establishing Important Marine Mammal Areas

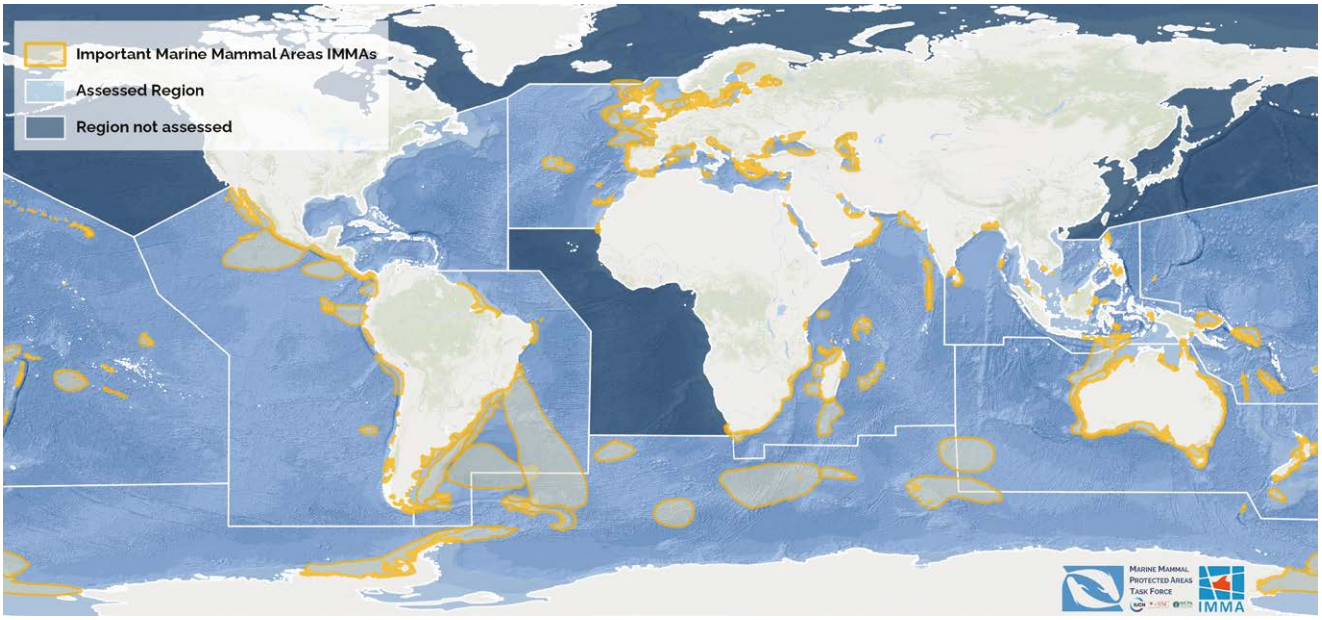
Lead partners: Giuseppe Notarbartolo di Sciara & Simone Panigada, Tethys Research Institute

Marine mammals are a key component of the marine ecosystem. They live most of their lives in the water, preferring undisturbed natural environments and showing sensitivity to disturbance. Some species depend on shallow fishing grounds, nearshore warm waters and beaches to breed and calve; others spend their lives travelling the global ocean or diving to great depths to feed. Whales and dolphins in particular have complex social structures and behaviours passed from one generation to the next. Like most long-lived animals, they are slow growing, late to mature, and invest heavily in the upbringing of only a few offspring. This combination of characteristics renders them vulnerable to – and slow to recover from – sudden, unpredictable or prolonged disturbance to the marine environment.

Modelled on BirdLife International's Important Bird and Biodiversity Areas (IBAs), Important Marine Mammal Areas (IMMAs) are discrete portions of habitat, important to marine mammal species, that have the potential to be delineated and managed for conservation. The concept of IMMAs was developed by the IUCN Marine Mammal Protected Areas Task Force in 2015 as a tool to help governments, intergovernmental organisations, conservation groups, industry and the public to prioritise conservation measures for marine mammals.

IMMAs are identified through a robust technical process centered around regional workshops that bring together scientists with large and robust datasets that can support scientifically agreed criteria. Data from EBSA descriptions provide a starting point for this process, augmented and enriched by local and regional expertise and knowledge. The outcome of each workshop – a suite of candidate IMMAs – is then subjected to rigorous independent expert review, which provides consistency and validates whether proposed areas satisfactorily meet the IMMA criteria. Approved IMMAs are posted on the IMMA e-Atlas[23] with accompanying information and shapefiles, which are freely available.

[23] www.marinemammalhabitat.org/imma-eatlas/



The IMMA e-Atlas provides visualisation of the IMMA portfolio as well as access to information about individual sites. To date, there are 280 IMMAs identified across the global ocean. Map courtesy IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force.

GOBI supported seven regional IMMA workshops during the period 2016-2023: Pacific Islands; North East Indian Ocean and South East Asian seas; Western Indian Ocean and Arabian Sea; Black Sea, Turkish Straits System and Caspian Seas; Australia, New Zealand and South East Indian Ocean; South East Tropical and Temperate Pacific Ocean; and South West Atlantic Ocean. Collectively, these workshops covered an ocean area of 198,000,000 km^2 or 55% of the global ocean and identified 201 IMMAs, including habitat of 73 qualifying marine mammal species (34% of which have IUCN Threatened status), through the collective efforts of 205 workshop participants from 50 nations. To date, through additional funding sources, the IMMA portfolio has expanded to 280 sites, representing an assessment of 80% of the global ocean area.

Following on from the regional IMMA workshops, four areas were selected for pilot actions: the Republic of Palau, the Andaman Islands in India, the Bazaruto Archipelago to Inhambane Bay area in Mozambique, and Karachi and the Indus River estuary in Pakistan. In each area, field visits by the GOBI IMMA team focused on working with local experts to raise awareness about local IMMAs, analyse pressures and threats to the resident marine mammal species, stimulate inclusive discussions on the most appropriate conservation tools or approaches to address the specific needs of the local IMMAs, and distil management options or recommendations. For example, interactions with government and civil society stakeholders during the team's 2019 visit to Mozambique contributed to halting plans for hydrocarbon exploration and extraction activities in the prime habitat of the last remaining healthy dugong population of East Africa.

Impact and relevance

The importance of work on IMMAs was recognised by the UN Convention on Migratory Species of Wild Animals (CMS) through a formal Resolution adopted at the 12th Meeting of the Conference of the Parties (CMS COP12) in 2017: Resolution 12.13 ('Important Marine Mammal Areas – IMMAs'), acknowledging the IMMA criteria and identification process, and – among other things - requesting Parties and inviting all Range States, intergovernmental organisations and partners to identify specific areas where the identification of IMMAs could be particularly beneficial. IMMA identification efforts in the Black Sea region in 2021 was also recognised by the CMS ACCOBAMS agreement. IMMA information has also been provided to (and acknowledged by) the CBD and used by several national governments in marine planning processes – including the US Navy concerning the use of naval sonar. The global IMMA layer can be viewed on industry platforms such as Proteus and Vanguard and alongside fishing and other data from Global Fishing Watch.

Marine mammals are considered indicator species for the health of the ocean, as well as charismatic species that can help focus the conservation spotlight. The creation of a network of IMMAs represents a cost-effective approach to large-scale conservation of marine biodiversity and whole ecosystems, providing valuable lessons for other conservation initiatives and a model for similar processes to be established for identifying Important Shark and Ray Areas (ISRAs) and Important Marine Turtle Areas (IMTAs).

Contribution to international dialogues and policy development

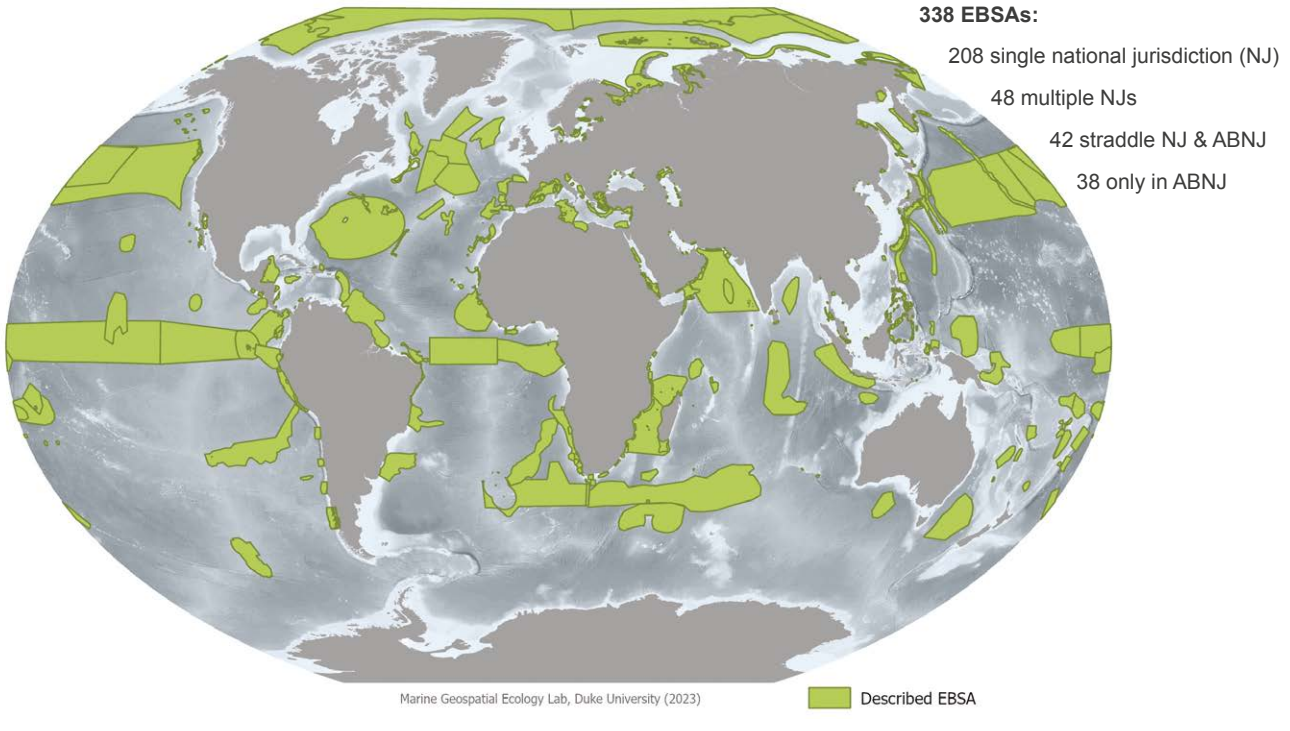
The core ethos of GOBI's collective effort is to support inter-governmental ocean governance. A fundamental strength of the our work under the International Climate Initiative has been to provide directed support to CBD in close cooperation with the CBD Secretariat. This has involved using project information and results to inform moderating, template drafting, side events, and interventions at CBD meetings on a range of issues under the CBD marine agenda. Specifically, GOBI has continued to support the CBD process to describe and identify ecologically or biologically significant marine areas, which was established in 2008. CBD has convened 15 regional EBSA workshops during the period 2011-2019; the GOBI community has provided scientific expertise and technical support at all of them, including the three workshops that took place during the project period. Now comprising 338 sites worldwide (shown on the map below), the EBSA portfolio represents a global effort to collate the best available scientific and technical information on marine biodiversity[24]. Inevitably, science has also progressed during that time, with new expeditions to previously unexplored regions of the ocean and return visits to favoured research sites. The generation of new data and discoveries, often enabled by technological advances, novel methodologies and new instrumentation, means that there is new knowledge that could (and should) contribute to the EBSA effort. Recognising this need but acknowledging the lack of formal process to update EBSA descriptions or propose new areas, CBD Parties embarked on a discussion about how these modalities could be introduced. GOBI has actively participated in these discussions as well as providing specific technical input via the CBD Informal Advisory Group on EBSAs.

[24] Secretariat of the Convention on Biological Diversity (2021)

The global portfolio of ecologically or biologically significant marine areas (EBSAs)

EBSAs cover 20.33% of global ocean

EBSA regional workshop process has covered 75.74% of the world's ocean



Participants at the GOBI international workshop on ecologically or biologically significant marine areas (EBSAs) in areas beyond national jurisdiction, held in Santa Cruz, California in November 2022.

In November 2022, GOBI convened an expert workshop[25] that highlighted the importance of the modality discussions on EBSAs within the CBD. Bringing together leading scientists, this event scoped opportunities for the future evolution of the EBSA portfolio in area beyond national jurisdiction. Participants reflected on official EBSA descriptions, scoped potential areas for new work and recognised scientific and political challenges, providing a report as information for the CBD's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA). A series of draft recommendations on the future evolution of the EBSA process will be considered by CBD Parties at the 16th meeting of the Conference of the Parties (COP16) in October 2024.

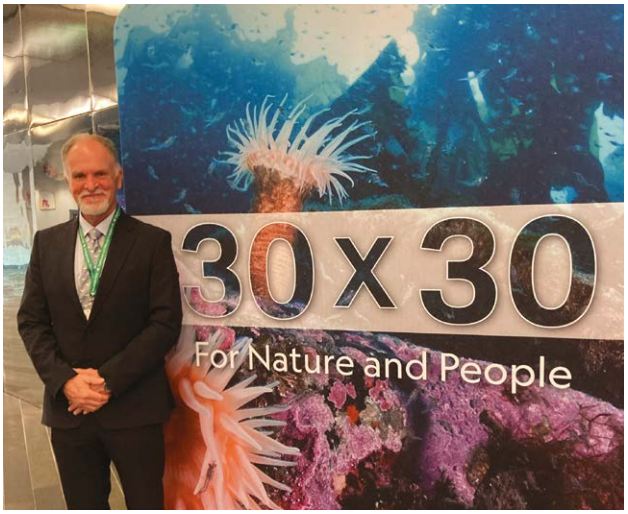
The timing of GOBI's IKI project coincided with development of the Kunming-Montreal Global Biodiversity Framework (GBF), adopted by CBD Parties at COP15 in December 2022. GOBI contributed to the development and adoption of this important biodiversity conservation instrument, providing input to scientific guidance on targets and indicators – specifically those associated with species and area-based protection – but noting the interconnected nature of the GBF and its holistic ambition.

GOBI's work has also informed the work of the UN Convention of Species of Wild Animals (CMS) and the International Seabed Authority (ISA). Work on migratory species (through MiCO (p6), seabird tracking (p12) and IMMAs, p16) has fed into the CMS Scientific Council and has helped frame specific CMS Resolutions. GOBI's research on hydrothermal vents has informed the ISA's draft Regional Environmental Management Plan deliberations, not least the scientific rationale for the protection of all active hydrothermal vents. In future it is recognised that best available science should underpin ocean protection and provide a common language to secure an ecosystem approach.

In June 2023, Parties to the United Nations agreed a new international legally binding international instrument to conserve and sustainably use biodiversity in areas beyond national jurisdiction (the BBNJ Agreement). GOBI experts participated in the 18-year process leading up to the new treaty and are now actively engaged in the varied discussions on its implementation, in particular the establishment of area-based management tools (ABMTs) and the relevance of EBSA information, taxa-based assessments and migratory connectivity. Representativity is an important criterion for ABMTs within the BBNJ Agreement (ref to Annex 1) and GOBI's work on biogeographic regionalisation (p3) and site prioritisation is highly relevant to establishing a future network of ABMTs in ABNJ. The Costa Rica Thermal Dome is promoted by many groups as a suitable potential candidate area for ABMTs, and the CRTD Atlas produced by GOBI (p10) provides an authoritative scientific baseline that has been shared with Central American countries and agencies.

GOBI has also worked at the regional level, providing evidence for new protected areas (e.g., NACES, p12), regional planning (e.g., for the Indian Ocean rim countries, p4) and facilitating regional cooperation (e.g. for the Costa Rica Thermal Dome in central America, p11). A GOBI workshop convened in Oman towards the end of the project[26] demonstrated the potential application of GOBI tools and methodologies in the north-west Indian Ocean

[25] GOBI international workshop on ecologically or biologically significant marine areas (EBSAs) in areas beyond national jurisdiction: 6-9 November 2022, Santa Cruz, California
[26] GOBI workshop on new tools to support ocean conservation, planning and sustainable use in the NW Indian Ocean: 2-4 October 2023, Muscat, Sultanate of Oman



region – a region chosen as it is not specifically covered by a single Regional Seas Convention or Regional Fisheries Management Organisation. Bringing together representatives from a range of organisations working to manage and conserve marine biodiversity in the NW Indian Ocean, the workshop highlighted key methodologies and tools developed by the project: the seabird tracking database, IMMAs, MiCO, the application of biogeographic regionalisation techniques, and site prioritisation approaches. It demonstrated how information can be accessed and applied, how modelling and proxies can assist in data-poor regions, and how global work can support regional initiatives. The workshop created an opportunity for regional stakeholders to discuss common issues, share experiences, identify gaps (in data as well as capacities), and make key connections to inform proposals for future work.

As an independent scientific project, GOBI's work under IKI has generated information and provided new scientific insights, but actions and policy decisions fall under the purview of States and competent international organisations. To that end, GOBI has made sustained efforts to create opportunities for information dissemination at official meetings of CBD, CMS, ISA and the new BBNJ Agreement as well as at relevant scientific conferences and gatherings (World Congress on Marine Biodiversity, International Marine Protected Areas Congress, International Marine Conservation Congress, World Conservation Congress), engagement with appropriate thinktanks (Marine Regions Forum meetings, IUCN thematic workshops) and by maintaining information exchange amongst the wider GOBI community (website, newsletters, dialogues). Capacity building has also been an important element of our team's work, with GOBI representatives taking an active role in national and regional capacity development activities coordinated by the CBD Sustainable Ocean Initiative[27].

The GOBI project under the International Climate Initiative is unique. Its success reflects efforts to drive and support international scientific collaboration, providing guidance on the interpretation of UN resolutions, generating new knowledge, developing regional analyses and assisting regional capacity building in collaboration with relevant organisations and stakeholders. Governments increasingly recognise the urgent need for concerted international cooperation and collaboration. Data alone are insufficient: aggregation, integration, visualisation, analysis and expert interpretation are required to develop reliable, evidence-based information about ecological baselines, patterns and trends at a range of spatial and temporal scales. Going forward, an understanding of complex marine ecosystems and their natural variability, as well as the impacts of human activities, will be needed to support implementation of the BBNJ Agreement and to help achieve the GBF Targets.

[27] www.cbd.int/soi

Top left: Some of the GOBI team and CBD Secretariat at the World Conference on Marine Biodiversity in Montreal, 2018. Lower left: David Johnson at CBD COP15, Montreal, 2022. Below: GOBI Secretariat (David Johnson and Vikki Gunn) at the 3rd BBNJ Intergovernmental Conference in New York, 2019.

Project publications and outputs

The following papers and reports were produced by the project team with the support of GOBI's grant from the International Climate Initiative.

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Global Ocean Biodiversity Initiative

Providing the scientific basis for conserving biological diversity in the global ocean

The Global Ocean Biodiversity Initiative is an international partnership of organisations committed to advancing the scientific basis for conserving biological diversity in the marine environment. In particular, GOBI contributes expertise, knowledge and data to support the Convention on Biological Diversity's efforts to identify ecologically and biologically significant marine areas (EBSAs) by assisting a range of intergovernmental, regional and national organisations to use and develop data, tools and methodologies.

GOBI also undertakes research to generate new science that will enhance the value of EBSAs and their utility for promoting environmental protection and management for specific areas of the world's oceans. The intention is ultimately to reduce the rate of biodiversity loss through the application of ecosystem approaches to the management of human activities, and to support the establishment of networks of representative marine protected areas in national and international waters.

The GOBI partnership and activities are coordinated by a Secretariat team, provided by Seascape Consultants Ltd. GOBI was funded by the International Climate Initiative (IKI) during the period 2016-2023, and is currently supported by direct funding from the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV).

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