



Food and Agriculture
Organization of the
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Report of the
Areas Beyond National Jurisdiction Deep Sea Meeting 2019

7–9 May 2019 • Rome, Italy

ABNJ Deep Seas Project

Sustainable Fisheries Management and Biodiversity Conservation of Deep-sea Living
Marine Resources and Ecosystems in the Areas Beyond National Jurisdiction



GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

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SEA MEETING 2019

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Food and Agriculture Organization of the United Nations
Rome, 2020

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PREPARATION OF THIS DOCUMENT

This is the report of the ABNJ Deep Sea Meeting 2019. The meeting is an activity of the ABNJ Deep Seas Project (*Sustainable Fisheries Management and Biodiversity Conservation of Deep Sea Living Resources in Areas Beyond National Jurisdiction* Project), a five-year project supported by the Global Environment Facility (GEF), and implemented jointly by FAO and UN Environment. The UN Environment project component is executed through the UN Environment World Conservation and Monitoring Centre. The Project is designed to enhance sustainability in the use of deep-sea living resources and biodiversity conservation in the ABNJ through the systematic application of an ecosystem approach. It brings together over 20 partners who work on deep-sea fisheries and conservation issues in the ABNJ globally. The partnership includes regional organizations responsible for the management of deep-sea fisheries, Regional Seas Programmes, the fishing industry and international organizations. The ABNJ Deep Sea Meeting 2019 was organized by FAO, in collaboration with UN Environment. The meeting was attended by 34 participants and FAO, representing nine of the project partners, among other collaborating organizations. The meeting report was written by the ABNJ Deep Sea Project team. Special thanks go to Sofia Franklin, Gwyneth Byrd, Nina Bhola for their assistance in the preparation of the meeting, and much gratitude is expressed to the session moderators and speakers.

ABSTRACT

The Common Oceans ABNJ Deep Seas Project is funded by the Global Environment Fund and implemented by FAO and the UN Environment Programme. The partnership brings together a broad range of partners, including regional fisheries bodies responsible for the management of deep-sea fisheries, fishing industry partners, and international organizations to achieve sustainable fisheries management and biodiversity conservation of deep-sea living resources in the ABNJ. To showcase existing knowledge, practices and innovative research for sustainable deep-sea fisheries management and biodiversity conservation in the ABNJ, the Food and Agriculture Organization of the United Nations (FAO), in collaboration with UN Environment World Conservation Monitoring Centre (UNEP-WCMC) and the SponGES Project consortium, organized a meeting – the ABNJ Deep Sea Meeting 2019 – that took place on 7-9 May 2019, at FAO Headquarters in Rome, Italy. Over 40 participants, including representatives from partner organizations and other stakeholders from multiple sectors within the ABNJ, attended the three-day meeting. While significant progress has been made in the management of deep-sea fisheries and in the protection of vulnerable marine ecosystems, the ABNJ still faces threats from climate change, ocean acidification, biodiversity loss, and pollution. Building on the achievements of the Common Oceans ABNJ Deep Sea Projects and the SponGES Project, the participants were invited to give presentations on key topics and discuss emerging issues concerning ABNJ governance and deep-sea research, monitoring and management.

CONTENTS

1. BACKGROUND	1
1.1. <i>Areas beyond national jurisdiction and deep-seas</i>	1
1.2. <i>Areas beyond national jurisdiction deep-sea resources</i>	1
1.2.1. Deep-sea Fisheries	1
1.3. <i>Areas beyond national jurisdiction deep-sea management</i>	2
2. AREAS BEYOND NATIONAL JURISDICTION DEEP SEAS PROJECT	3
2.1. <i>Introduction</i>	3
2.2. <i>Areas of work.....</i>	3
3. AREAS BEYOND NATIONAL JURISDICTION DEEP SEA MEETING 2019	4
3.1. <i>Introduction session.....</i>	4
3.1.1. <i>FAO’s work and deep-seas</i>	4
3.1.2. <i>Regional Fisheries Management Organization Roles and Responsibilities – the case of the North East Atlantic Fisheries Commission</i>	5
3.1.2. <i>The importance of deep-sea ecosystem science and research.....</i>	6
3.1.3. <i>Capacity building in the ABNJ.....</i>	7
3.2. <i>Theme 1: Areas Beyond National Jurisdiction governance and policy</i>	8
3.2.1. <i>Review of legal instruments relevant to areas beyond national jurisdiction deep-seas</i>	8
3.2.2. <i>Areas Beyond National Jurisdiction Governance Structures.....</i>	9
3.2.3. <i>Challenges for new deep-sea regional fisheries management organizations.....</i>	9
3.2.4. <i>Introducing the concept of policy for semi-closed areas</i>	11
3.2.4. <i>Industry initiatives in the areas beyond national jurisdiction</i>	12
3.2.5. <i>Opportunities and challenges for cross-sectoral area-based management tools in areas beyond national jurisdiction</i>	13
3.2.6. <i>Theme 1 discussion</i>	13
3.3. <i>Theme 2: deep-sea science and monitoring</i>	14
3.3.1. <i>Deep-sea sponge aggregations under a Gaia’s perspective: functional connections.....</i>	14
3.3.2. <i>Vulnerable Marine Ecosystem science and significant adverse impacts: example of the Northwest Atlantic Fisheries Organization</i>	15
3.3.3. <i>General Fisheries Commission for the Mediterranean management of vulnerable marine ecosystems and deep-sea fisheries.....</i>	17
3.3.4. <i>Bottom fisheries in the high seas</i>	18
3.3.5. <i>Assessing the impacts of anthropogenic activities on deep-sea sponges.....</i>	21
3.3.6. <i>Biodiversity, biotechnology and the blue economy.....</i>	21
3.3.7. <i>Areas beyond national jurisdiction deep-sea ecosystem services valuation</i>	22
3.3.7. <i>Monitoring change and ecosystem risk assessments</i>	24
3.3.8. <i>OSPAR, climate change and ecosystems: ecological and biological impacts</i>	25
3.3.9. <i>Deep-ocean climate change impacts on habitat, fish and fisheries.....</i>	26
3.3.10. <i>Deep-sea industry contributions to science.....</i>	28
3.3.11. <i>Mapping and characterizing deep-sea habitats in the United States exclusive economic zone and how this science data have influenced management decisions</i>	29
3.3.12. <i>Theme 2 discussion</i>	29
3.4. <i>Theme 3: deep-sea management</i>	30
3.4.1. <i>The Commission for the Conservation of Antarctic Marine Living Resources and fisheries measures.....</i>	30
3.4.2. <i>A review of Ecosystem Approach to Fisheries application in the areas beyond national jurisdiction</i>	32
3.4.3. <i>Science needed to support deep-sea fisheries management: the case of the Northwest Atlantic Fisheries Organization.....</i>	33
3.4.4. <i>Economic incentives and rights-based management in deep-sea fisheries.....</i>	34
3.4.5. <i>Existing spatial measures in fisheries: a South Pacific Regional Fisheries Management Organisation case study</i>	36
3.4.6. <i>Using marine spatial planning in the areas beyond national jurisdiction</i>	39

3.4.7	Ecologically or Biologically Significant Marine Areas: an area-based planning tool to inform non-fisheries area-based management in the areas beyond national jurisdiction	39
3.4.8	Visualizing data from different sectors in the areas beyond national jurisdiction	40
3.4.9	Theme 3 discussions.....	41
4.	HORIZON 2020 DEEP-SEA SPONGES PROJECT	41
4.1.	<i>The utility of species distribution modelling for data-poor regions and species: case study of deep-sea sponges</i>	<i>41</i>
4.2.	<i>Genetic diversity and connectivity in deep-sea sponges of the North Atlantic: connecting organisms with conservation strategies.....</i>	<i>42</i>
4.3.	<i>The importance of sponge grounds in enhancing diversity of associated epibenthic megafaunal communities in the deep-sea</i>	<i>42</i>
4.4.	<i>Deep-sea sponge ecosystem services valuation</i>	<i>43</i>
5.	EAF-NANSEN PROGRAMME.....	44
5.1.	<i>The EAF-Nansen Science Plan and Theme 7</i>	<i>44</i>
5.2.	<i>Survey information supporting fisheries management decisions in the South East Atlantic Fisheries Organization area</i>	<i>44</i>
5.3.	<i>Characterizing the marine ecosystem and morphology of the Saya de Malha Bank: EAF-Nansen survey of the Mauritius-Seychelles Joint Management Area</i>	<i>45</i>
6.	ABNJ DEEP SEA MEETING 2019 CONCLUSIONS	46
	REFERENCES	48
	Appendix 1 Meeting participants.....	50
	Appendix 2 Meeting Agenda	53

ABBREVIATIONS AND ACRONYMS

ABNJ	Areas Beyond National Jurisdiction	PPR	Project Progress Report
ABP	Area-Based Planning	PSC	Project Steering Committee
BBNJ	Biodiversity Beyond National Jurisdiction	PSMA	Port State Measures Agreement
CBD	Convention on Biological Diversity	RFMO/A	Regional Fisheries Management Organizations or Arrangements
CCAMLR	Conservation of Antarctic Marine Living Resources	RSN	Regional Fishery Body Secretariats Network
CECAF	Fishery Committee for the Eastern Central Atlantic	RSP	Regional Seas Programme
COFI	Committee on Fisheries	SDG	Sustainable Development Goal
CCRF	Code of Conduct for Responsible Fisheries	SEAFO	South East Atlantic Fisheries Organisation
CPPS	Comisión Permanente del Pacífico Sur (Permanent Commission for the South Pacific)	SIOFA	Southern Indian Ocean Fisheries Agreement
CSIRO	Commonwealth Scientific Industrial Research Organization (Australia)	SIODFA	Southern Indian Ocean Deep-sea Fishers Association
EAF	Ecosystem Approach to Fisheries	SPRFMO	South Pacific Regional Fisheries Management Organization
EBSA	Ecologically or Biologically Significant Area	UNCLOS	United Nations Convention on the Law of the Sea
EEZ	Exclusive Economic Zone	UNEP	United Nations Environment Program
FAO	Food and Agriculture Organization of the United Nations	UNEP-WCMC	UNEP-World Conservation Monitoring Centre
GFCM	General Fisheries Commission for the Mediterranean	UNGA	United Nations General Assembly
GOBI	Global Ocean Biodiversity Initiative	UNFSA	United Nations Fish Stock Agreement
GOF	Global Ocean Forum	VME	Vulnerable Marine Ecosystem
ICFA	International Coalition of Fisheries Associations	WOC	World Ocean Council
IGO	Inter Governmental Organization	WSSD	World Summit on Sustainable Development
IMO	International Maritime Organization		
IOC	Intergovernmental Oceanographic Commission		
ISA	International Seabed Authority		
IUCN	International Union for Conservation of Nature		
IUCN-FEG	IUCN Commission on Ecosystem Management Fisheries Expert Group		
IUU	Illegal, Unreported and Unregulated		
LTO	Lead Technical Officer		
MCS	Monitoring, Control and Surveillance		
MDG	Millennium Development Goals		
M&E	Monitoring and Evaluation		
MPA	Marine Protected Area		
NAFO	Northwest Atlantic Fisheries Organization		
NEAFC	North East Atlantic Fisheries Commission		
NPFC	North Pacific Fisheries Commission		
NOAA	National Oceanic and Atmospheric Administration		
OPP	Ocean Partnerships Project		
PIR	Project Implementation Review		
PMU	Project Management Unit		

1. BACKGROUND

This report draws on discussions during the areas beyond national jurisdiction (ABNJ) Deep Sea Meeting 2019 that was convened in Rome, Italy from 7-9 May 2019. The report serves as a record of the presentations and discussions that took place, and provides supplementary information on governance, management of natural resources, and associated biodiversity conservation in the ABNJ. The Meeting brought together invited experts and a range of stakeholders with interests and/or activities in the ABNJ. Many participants also partnered with the Food and Agriculture Organization of the United Nations (FAO) to support the implementation of the relevant United Nations General Assembly (UNGA) resolutions and associated agreements and guidelines, including the *International Guidelines for the Management of Deep-sea Fisheries in the High Sea* (FAO Deep-Sea Fisheries Guidelines) (FAO, 2009).

1.1. Areas beyond national jurisdiction and deep-seas

The 1982 United Nations Convention on the Law of the Sea (UNCLOS) (UN General Assembly, 1982) sets out the legal framework for ocean governance, and establishes the basic duties and rights of States in relation to all maritime activities, including in the ABNJ. The water column beyond national jurisdiction, starting beyond the exclusive economic zone (EEZ) of the coastal state is known as the high seas (UNCLOS, Article 86). The seabed and ocean floor beyond the continental shelf limits of coastal countries is known as the Area, and the management of which is through the International Seabed Authority (ISA). Therefore, the ABNJ is widely considered to include both the high seas and the Area.

Marine areas beyond national jurisdiction make up 62 percent of the ocean's surface and provide a range of services, including fisheries, biodiversity, biotechnology, minerals, and transport routes for shipping, among others. There are various definitions of what constitutes "deep-seas", which can refer to a specific depth or any depth beyond the shelf and slope (e.g. bathypelagic and abyssal areas of the oceans), however the FAO Deep Sea programme generally considers depths greater than 200 m in the ABNJ to be deep-sea, and this distinction framed the presentations and discussions at the Deep Sea Meeting.

1.2. Areas beyond national jurisdiction deep-sea resources

The potential for natural resource use from the world's oceans is vast, and technological advances in the last decades have allowed humans to harvest this potential in the ABNJ areas for fisheries, mineral exploration, and recently the use of deep-sea species for pharmaceutical products. Typically, due to the extreme environments of some areas in the ABNJ, living marine resources in the ABNJ deep-seas are characteristically slow-growing, have low productivity, and are fragile to habitat disturbances.

1.2.1. Deep-sea Fisheries

A variety of finfish, and some shellfish, have been exploited by bottom fishing in the ABNJ. A majority of these fish resources are taken from continental shelves, such as the Patagonian shelf, the Grand Banks, the northeast Atlantic high seas grounds, and the southern Emperor and the northwest Hawaiian seamount chains. Additional species are harvested at upper- and mid-slope depths in the North Atlantic (e.g. Rockall Plateau and the Mid-Atlantic Ridge). Some key deep-sea species caught in these areas include, but are not limited to, roundnose grenadier, black scabbardfish, slickheads, Greenland halibut, toothfish, alfonsino, and orange roughy.

The FAO *International Guidelines for the Management of Deep-sea Fisheries in the High Seas* (2008) refers to deep-sea fisheries as “the total catch (fish and bycatch) [that] includes species that can only sustain low exploitation rates; and the fishing gear is likely to contact the seafloor during the normal course of fishing operations”. It is generally considered that resources exploited by bottom fishing in the ABNJ have no unifying biological characteristics, and it is the variety of the resource species, rather than their commonalities, that is most evident.

1.3. Areas beyond national jurisdiction deep-sea management

Since the early 2000s, the UNGA and FAO have served as the mechanisms through which the international community addresses possible impacts of deep-sea ABNJ activities, with a strong focus on the impacts of ABNJ bottom fisheries on vulnerable marine ecosystems (VMEs). However, it has been widely acknowledged, particularly in the last decade, that multi-disciplinary approaches and multilateral cooperation between the relevant international organizations is necessary to address compounding impacts on deep-sea ABNJ ecosystems. This momentum arose from international discussions that recognized the urgent need to manage risks on ABNJ and deep-sea fauna and flora (UN General Assembly, 2002), and that was solidified in a specific call by the UNGA for international organizations such as the FAO, ISA, UN Environment, and many others, to consider ways to integrate and improve ways to manage risks to marine biodiversity in the ABNJ (UN General Assembly, 2002).

The International Seabed Authority (ISA) is mandated by UNCLOS to organize and control all mineral-related activities in the international seabed area, or the Area, which is determined to be the seabed and ocean floor (and subsoil thereof) beyond the limits of national jurisdiction. Its principle function is to regulate deep-sea mining and to ensure that the marine environment is protected from adverse impacts of mining activities. In doing so, the ISA establishes Areas of Particular Environmental Interest (APEIs) that are protected from mining activities while also laying out standards and processes that must be followed before mining can commence in the ABNJ, also known as the “Mining Code”. To date, only exploratory activities for polymetallic nodules, polymetallic sulphides, and cobalt-rich crusts are occurring in the ABNJ.

The UNGA generally serves to monitor the developments in the law of the sea, and adopts annual resolutions on oceans and the law of the sea, as well as on fisheries and fisheries-related issues. UNGA resolutions themselves are not legally binding, but they call on States and regional fisheries management organizations or arrangements (RFMO/As) to implement them in a binding capacity. In the context of deep-sea fisheries, UNGA resolutions 59/25, 61/105, 64/72, and 66/68 lays out provisions for States and RFMO/As to implement in order to reduce or eliminate significant adverse impacts on VMEs. In particular, it stipulates that national legislation should include the authorization of deep-sea fishing only in areas that have been assessed for possible significant adverse impacts, any area where VMEs have been detected or suspected should be closed to high seas fishing, and deep-sea fishing protocols should be developed that include VME thresholds, indicator species, etc.

The management of deep-sea fishing in the high seas occurs through RFMO/As who have the legal mandate over specific fish stocks and impacts thereof within their areas of competence, and whose rules and measures apply to any vessel flagged to a Member Country. As of 2019, 77 percent of the ABNJ is managed by regional bodies regulating deep-sea bottom fisheries (or deep-sea RFMO/As) and within those areas, only certain areas, or “footprints” are open to fishing by Member Countries. Exploratory protocols apply to any area outside of those “footprints”, which require that impact assessments be conducted and reviewed prior to the authorization of any commercial fishery. Even within open fishing areas within RFMO/As, VME protection protocols exist for all deep-sea RFMO/As that include provisions to cease fishing and move from the area where an “encounter” has occurred: i.e. if VME indicator species above a certain threshold is detected in the fishing hauls. In doing so, the encounter area is closed to further bottom fishing activities and is established as a VME closure. This is the type of area-based management tool implemented by deep-sea RFMO/As for fisheries.

2. AREAS BEYOND NATIONAL JURISDICTION DEEP SEAS PROJECT

2.1. Introduction

The *Sustainable Fisheries Management and Biodiversity Conservation of Deep Sea Living Resources in Areas Beyond National Jurisdiction* Project (ABNJ Deep Seas Project) is a five-year project supported by the Global Environment Facility (GEF), and implemented jointly by FAO and UN Environment, the latter through the UN Environment World Conservation and Monitoring Centre (UNEP-WCMC).

The Project is designed to enhance sustainability in the use of deep-sea living resources and biodiversity conservation in the ABNJ through the systematic application of an ecosystem approach. It brings together over 20 partners who work on deep-sea fisheries and conservation issues in the ABNJ globally. The partnership includes regional organizations responsible for the management of deep-sea fisheries, Regional Seas Programmes, the fishing industry and international organizations. The Project aims to:

- strengthen policy and legal frameworks for sustainable fisheries and biodiversity conservation in the ABNJ deep seas;
- reduce adverse impacts on VMEs and enhanced conservation and management of components of EBSAs;
- improve planning and adaptive management for deep sea fisheries in ABNJ; and
- develop and test methods for area-based planning.

The ABNJ Deep Seas Project started in September 2015 and is one of four projects under the GEF Common Oceans Programme¹.

2.2. Areas of work

The ABNJ Deep Seas Project has a global focus that addresses deep-sea fisheries and impacts on associated biodiversity in all oceans to draw lessons learned and experiences from established RFMO/As and practices that are shared and built on in three key pilot regions through capacity-building initiatives: the southeast Atlantic, the western Indian Ocean, and the southeast Pacific.

The first component of the Project looks at legal and policy frameworks for sustainable fisheries management and biodiversity conservation in the ABNJ deep-seas, through the implementation of existing frameworks into national legislation and to competent authorities, with through the use of global and regional networks. A key activity of this component was the organization of this global Deep Sea Meeting 2019 to bring together stakeholders from different sectors in the ABNJ to share experiences and discuss challenges and ways forward for deep-sea management.

The second component of the Project looks specifically at reducing adverse impacts on VMEs and enhanced conservation and management of components of Ecologically or Biologically Significant Areas (EBSAs), through the application of management tools to mitigate threats to sustainable deep-sea fisheries and biodiversity.

The third component of the Project focuses on improving the planning and adaptive management of deep-sea fisheries in the ABNJ, and this includes the development and dissemination of scientific and other technical information. For example, the development of global reviews on key commercial deep-sea fish species, including their biology, fisheries, and management.

¹ www.commonoceans.org

The fourth component is implemented by UNEP-WCMC and works in close partnership with the Regional Seas Secretariats in the South East Pacific and Western Indian Ocean to develop a framework for undertaking cross-sectoral marine spatial planning in the ABNJ in order to support the delivery of the ecosystem approach.

3. AREAS BEYOND NATIONAL JURISDICTION DEEP SEA MEETING 2019

3.1. Introduction session

The overall objective of the Meeting was to provide a platform for informative presentations and interactive discussions from stakeholders representing multiple sectors within the ABNJ, to synthesize the opportunities and challenges faced by these sectors, and to support sustainable deep-sea fisheries management and biodiversity conservation in the ABNJ.

The meeting was opened by Manuel Barange, Deputy-Director of the FAO Fisheries and Aquaculture Department, who noted that the ABNJ Deep Seas Project began in 2014 at an opportune time in the ABNJ deep-sea fisheries agenda when the momentum of action arising from the UNGA resolutions (in particular Resolution 61/105) and the adoption of the FAO Deep-Sea Fisheries Guidelines was slowing and the discussions on a proposed international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity in ABNJ were gaining traction.

Árni Mathiesen, Assistant Director-General of the FAO Fisheries and Aquaculture Department, provided the welcoming remarks and highlighted that the clear mandates and responsibilities laid out by UNCLOS, UNFSA, and the related RFMO/A measures mean States have a responsibility to sustainably manage deep-sea fish stocks and conserve associated biodiversity. While significant progress has been made in the last decade with regards to this, work is still needed to enhance our scientific understanding of deep-sea ecosystems and the compounding impacts from extraction activities on those ecosystems and environmental change.

Takehiro Nakamura, Senior Officer and Coordinator of the Marine Ecosystems Unit of UN Environment, provided remarks on behalf of UN Environment as an implementing partner to the ABNJ Deep Seas Project, and briefly described the work of his organization in relation to engagement and cooperation among different sectors in the ABNJ – particularly through the Regional Seas Programmes (RSPs).

3.1.1 *FAO's work and deep-seas*

Merete Tandstad, Senior Fisheries Officer of the FAO Fisheries and Aquaculture Department, presented FAO's work on deep-sea fisheries through its FAO Deep-sea Fisheries Programme. FAO was requested by the UNGA to develop the FAO Deep-sea Fisheries Guidelines as a result of increased focus globally on the sustainability of deep-sea fisheries. The objective of the Guidelines is to present tools and guiding principles for the application of relevant UNGA resolutions, and to facilitate and encourage the efforts of States and RFMO/As towards the sustainable use of marine living resources the protection of associated vulnerable marine biodiversity. The Guidelines were designed in the concept of an ecosystem approach to fisheries management, and also offers technical solutions to UNGA policies. Specifically, the Guidelines provide clarity on new terminology related to the resolutions: VME criteria, examples of VME indicator species, and provisions for impact assessments, encounter protocols, and exploratory protocols.

The FAO Deep-sea Fisheries Guidelines are integrated through various projects and activities that are implemented by the FAO Fisheries and Aquaculture Department under a broad FAO Deep-sea Fisheries programme. While the main objective of the FAO Deep-sea Fisheries programme is to facilitate the implementation of the Guidelines, it includes several projects that complement each other and also focus on other aspects of deep-sea fisheries management and biodiversity conservation. In summary, the main objectives of the Programme are to:

- Support the implementation of the FAO Deep-sea Fisheries Guidelines;
- Provide expert technical guidance, tools, and resources to improve management practices;
- Design state-of-the-art data collection and sharing systems related to VMEs;
- Facilitate dialogue, collaboration, and networks among key stakeholders in order to strengthen and improve effective management of deep-sea fisheries; and
- Capacity development and technical support across components.

The current Programme has three active projects, funded by different donors, of which the ABNJ Deep Seas Project is one. The other two projects are a project funded by Japan on fisheries management and marine conservation within a changing ecosystem context, and a European Union funded Horizon 2020 project on deep-sea sponges², of which FAO is leading a work package on the conservation and management of deep-sea sponges in the north Atlantic.

Before the establishment of the ABNJ Deep Seas Project, the Deep-sea Fisheries programme lead the implementation of information-sharing and capacity building activities with key ocean regions. Namely, the Programme organized eight technical workshops on deep-sea fisheries and VMEs for key regions: the Mediterranean, the western central Atlantic, the eastern central Atlantic, the southeast Atlantic, two for the Indian Ocean, and two for the North Pacific. These workshops had the key objective to raise awareness and exchange experiences on VME conservation and management, and in doing so reviewed relevant current global practices and regional management measures. The Programme also led the development of the VME Portal and DataBase³, which was called for in UNGA resolution 61/105, and hosts information on VME measures from the deep-sea RFMO/As from 2006 to present. The DataBase includes an interactive map that displays the spatial delineations of VME closures and other area-based measures. It was noted that this particular product is updated and presented in a shared and transparent process, making it clear that the information contained in the Portal and DataBase belong to the RFMOA/s. Other key activities under the programme include the development of regional deep-sea species identification guides, a data collection manual, global reviews of key commercial deep-sea species, and other documenting the progress made for deep-sea management and scientific knowledge.

3.1.2 Regional Fisheries Management Organization Roles and Responsibilities – the case of the North East Atlantic Fisheries Commission

Darius Campbell, Executive Secretary of the North East Atlantic Fisheries Commission (NEAFC), presented a summary of the roles and responsibilities of RFMO/As in the deep sea illustrated by the NEAFC characteristics and experience as an illustration of some of the issues in these RFMO/As. The presentation noted RFMO/As vary greatly, some manage tuna or highly migratory stocks while others are more general in their purview (i.e. managing straddling or high seas pelagic stocks demersal/ground fish stocks, which may be relatively shallow, and truly deep-sea stocks).

² <http://www.deepseasponges.org/>

³ <http://www.fao.org/in-action/vulnerable-marine-ecosystems/en/>

RFMO/As focus on making sure that fishery resources are sustained into the future as an economic, food and employment resource, noting that RFMO/As vary between developed and developing country membership, with small island states also being an important aspect in membership of some. Ensuring sustainable fisheries avoids economic and social loss. Conservation objectives were also built into the NEAFC Convention since 2006. Such objectives include conservation and management of deep-sea stocks. While NEAFC follows a process to reach management decisions based on scientific advice and then moves onto regulations and management and control measures to deliver these, NEAFC is unusual as it has an entirely separate and independent source of that scientific advice.

The overall objective of NEAFC is to ensure the long-term conservation and optimum utilisation of the fishery resources in its Convention Area, providing sustainable economic, environmental, and social benefits. NEAFC manages a range of fish stocks, including herring, blue whiting, mackerel, redfish, haddock, and deep-sea species. The management of these fish stocks is informed by the outcomes of a long-standing agreement between NEAFC and the International Council for the Exploration of the Seas (ICES), which provides independent scientific advice to the Permanent Committee on Management and Science (PECMAS). This scientific advice includes total allowable catch or allocations for each stock that are then considered by the NEAFC contracting parties and negotiated into binding conservation and management measures.

The presentation underlined that deep-sea conservation goes beyond managing (deep-sea) fish stocks, but also managing and minimising effects on endangered or non-target species and habitats. NEAFC has a comprehensive approach to minimising significant adverse impacts on VMEs through restrictions on new fisheries outside existing fishing footprints, combined with closed areas where VMEs have been identified or expected, according to the scientific advice from ICES. Many other general RFMOs have similar measures. Other areas of management include control and enforcement, vessel monitoring, electronic reporting of catch and transshipment, flag or Port State control, and measures to eliminate illegal, unreported or unregulated (IUU) fishing, among others. The conservation and management measures of NEAFC also address the protection of VMEs in the NEAFC area, as well as measures to ban targeted fisheries on species at risk, such as sharks.

The biodiversity protection work of NEAFC is further enhanced by a Collective Arrangement (OSPAR Agreement, 2014) (updated in 2018) with the OSPAR Commission, which aims to facilitate cooperation and coordination on area-based management between the two authorities on all conservation and management measures for the North East Atlantic. Through engagement in the early 2000s, OSPAR and NEAFC agreed a memorandum of understanding in 2008, followed in 2014 by the Collective Arrangement for exchange of information and objectives on respective area-based management areas. The meetings under the Collective Arrangement have moved on from basic information exchange to requesting advice on deep-sea sharks (each organisation working within its mandate) and consultation on a new marine protected area (MPA) proposal by OSPAR. The presentation noted that the mismatch between regional organisations and global organisations is creating a barrier to wider participation in the arrangement. The presentation concluded by highlighting that such cooperation was nevertheless occurring more widely in other regions, partly because of the relative ease of reaching agreement in regions with more similar ecosystems and social and economic realities. It was noted that the NEAFC-OSPAR example was of relevance in the broader context of global marine governance developments.

3.1.2. The importance of deep-sea ecosystem science and research

Ellen Kenchington of Fisheries and Oceans Canada (DFO), presented on behalf of Hans Tore Rapp (University of Bergen) on the importance of deep-sea ecosystem science and research. The North Atlantic encompasses a variety of vulnerable deep-sea ecosystems that are delivering key supporting, regulating, and provisioning goods and services. However, the impacts from established and emerging human activities, as well as climate change, have over such ecosystems are largely unknown. The occurrence of these vulnerable ecosystems in fjords, on continental shelves and on seamounts and mid-ocean ridges, often coincides with fishing and other human activities.

An important example is sponge-dominated ecosystems, which until now have received relatively little research and conservation attention. In view of closing this knowledge gap, the European Union funded H2020 project “SponGES” was implemented. The main objective of SponGES is to develop an integrated ecosystem-based approach to preserve and sustainably use vulnerable sponge ecosystems of the North Atlantic. Employing a trans-Atlantic collaborative and multidisciplinary approach, SponGES is addressing these key challenges by: strengthening the knowledge base, improving innovation, predicting changes, and providing decision support tools for management, conservation, and sustainable exploitation of these marine habitats. North Atlantic deep-sea sponge grounds are being mapped and characterized to determine the drivers of past and present distributions, and their diversity, biogeographic and connectivity patterns investigated through a genomic approach. Ecosystem function and the goods and services they provide are being identified and quantified. The project is also unlocking the potential of sponge grounds for innovative blue biotechnology, namely towards drug discovery and tissue engineering. It is improving predictive capacities by quantifying threats related to fishing, deep-sea mining, climate change, and local disturbances. SponGES outputs will form the basis for modelling and predicting future ecosystem dynamics under environmental change, thereby enabling conservation and sustainable management of these marine resources at regional and international levels.

3.1.3. *Capacity building in the ABNJ*

Miriam Balgos of the Global Ocean Forum (GOF) presented on the fourth project under the FAO ABNJ Programme umbrella, which focused on capacity building in the ABNJ. The ongoing BBNJ process has been the fora through which the ABNJ Capacity Project⁴ can support participants, and this is in addition to supporting the regular processes of the UNGA and its oceans and fisheries resolutions. The ABNJ Capacity Project is comprised of three key components: global and regional cross-sectoral policy dialogue and coordination, capacity development, and knowledge management and outreach.

Through its work, the ABNJ Capacity Project focuses on providing support through three key pathways: individual, institutional, and societal, with the ultimate outcome of enhanced individual skills and experiences and knowledge of the ABNJ, improved organizational structures, policies, and procedures for the ABNJ, and increased public awareness and active participation in the ABNJ. Individual pathways include: on-the-job training, early/mid-career education and training, online resources, public awareness and education, networking/exchanges, and formal education. Institutional pathways include: the development of an institutional vision and goals for the ABNJ, monitoring, evaluation, and adjustment, developing long-term financing strategies, developing strategy and plans to meet the assessed needs, and institutional needs assessment. Societal pathways to capacity development include: identification of and communication economic and human benefits from the ABNJ, the use of catastrophic ocean events to stimulate public understanding, communicating information on what has been done to improve ABNJ management, conduct of massive open and online courses on BBNJ, provision of news coverage on the various ABNJ issues to spark conversation and debate, development of opportunities for enhancement of stakeholder behaviour, and identification of ABNJ stakeholders.

In 2016, the ABNJ Capacity Project conducted an assessment of existing capacity for developing countries and small island developing states (SIDs) at national and regional levels through an online survey. The survey revealed: the lack of capacity is a constraint in the management of ABNJ at national and regional levels, scientific and technical capacity is mostly needed at regional and national levels, followed by capacity on policy and legal factors, and financial factors were reported as the highest constraints to collaboration and participation in the ABNJ. Thus, in the context of a possible new implementing agreement under UNCLOS, capacity for these countries is needed to: implement and comply with the possible new agreement, participate in global and regional cooperation, develop

⁴ <http://www.fao.org/in-action/commonoceans/projects/strengthening-capacity/en/>

national legislation, policies and institutional arrangements for the new agreement, undertake marine scientific research and participate in research collaborations, undertake management of the marine ecosystem, including application of tools and approaches such as marine spatial planning (MSP), MPAs, and environmental impact assessments, and support national/local efforts towards a healthy resilient ocean and sustainable economies and livelihoods.

The plenary noted that there are good examples of RFMO/As (NEAFC) and in order to transform them to other regions one must overcome barriers such as lack of communication between national ministries. The value of the NEAFC/OSPAR Collective Agreement was noted. The Collective Agreement facilitates cooperation and coordination on area-based management between overlapping organizations with a fishery and an environmental mandate.

3.2. Theme 1: Areas Beyond National Jurisdiction governance and policy

The first theme of the Meeting aimed to present an overview of existing management frameworks for the ABNJ, by sector, highlight the evolving landscape, and provide an outlook of impacts from ongoing or upcoming global discussions. As such, the session aimed to answer questions such as: What is the ABNJ? What are the opportunities for cross-sectoral linkages? What are the strengths and weaknesses of current ABNJ governance and policy?

3.2.1 Review of legal instruments relevant to areas beyond national jurisdiction deep-seas

Blaise Kuemlangan, Senior Legal Officer at FAO, presented on the Component 1 work of the ABNJ Deep Seas Project, which aimed to improve the implementation of existing policy and legal frameworks, and the incorporation of obligations and good practices from global and regional legal and policy instruments for sustainable fisheries and biodiversity conservation, for competent authorities. In 2017, the ABNJ Deep Seas Project published a review and analysis of international legal and policy instruments related to deep-sea fisheries and biodiversity conservation in the ABNJ (FAO, 2017). The report reviewed the international policy and legal instruments, institutional arrangements, and processes relevant to deep-sea fisheries management and biodiversity conservation. The report placed particular emphasis on identifying those provisions that require implementation through legislation at the national level. The report was comprehensive and reviewed the following deep-sea fisheries instruments, among others:

- UN Convention on the Law of the Sea (1982);
- UN Fish Stocks Agreement (1995);
- FAO Code of Conduct for Responsible Fisheries (1995):
 - International Plans of Action for sharks, seabirds, capacity, and IUU (1999-2001);
 - International guidelines for deep-sea fisheries, small-scale fisheries, catch documentation schemes, flag state performance, and bycatch (2009-2018);
 - Strategies on information for status and trends of capture fisheries and aquaculture (2003-2008);
- FAO Compliance Agreement (1993);
- FAO Port State Measures Agreement (2009);
- United Nations General Assembly resolutions;
- Convention on Biological Diversity;
- CITES; and
- Convention on the Conservation of Migratory Species of Wild Animals, among others.

A key aspect of this work through the ABNJ Deep Seas project was the capacity development component for the key pilot regions with the project: the southern Indian Ocean, the southeast Atlantic, and the southeast Pacific. The published review and analysis were also incorporated into a step-wise guide for the implementation of these instruments and agreement by coastal countries of those pilot regions. A DEEP-FLIP Training was conducted for the member countries of the Southern Indian Ocean Fisheries Agreement (SIOFA) and the South East Atlantic Fisheries Organisation (SEAFO), where planners, implementers, drafters, and enforcement officers involved in fisheries law in the deep-sea environment received training and key guidance on the implementation of relevant international instruments to national law and policy in deep-sea fishing. A post-training assessment revealed the participants learned key concepts to: manage fisheries holistically, better resolve fisheries issues and challenges, work cooperatively with other stakeholders, reduce user group conflicts, increase political will, more effectively manage resources, and contribute to the achievement of SDG targets and other global goals.

3.2.2 Areas Beyond National Jurisdiction Governance Structures

Stefán Ásmundsson, independent expert and former Executive Secretary of NEAFC, gave an overview presentation of the ABNJ and the existing governance structures for the area. Institutional structures with mandates for the high seas include global structures (International Maritime Organization, and the International Seabed Authority, among others) and regional structures (regional seas organizations, and regional fisheries management organizations, among others). It was noted that at present, existing structures were formed according to existing needs: fisheries, navigation, seabed mining, cables and pipelines, scientific research, and military operations. Furthermore, all of these activities are not unregulated and freedom of the high seas is clearly and explicitly limited by international instruments and agreements. These human activities are subjected to conditions laid out by UNCLOS, such as: the duty to set conservation measures on the best scientific evidence available; the duty to cooperate with relevant coastal States and with States utilizing the same resources or different living resources in the same area; States shall cooperate to establish subregional or regional fisheries organizations and only States that are members of these organizations and apply their conservation and management measures will have access to the fishery resources to which those measures apply. Furthermore, these conservation and management measures are directly and legally binding to the member States and for all Parties to UNFSA.

It was emphasized that with regards to high seas fisheries, States have a right under international law to authorize their nationals to fish on the high seas, under specific conditions. Therefore, States cannot legally authorize high seas fisheries unless they fulfil their legal obligations and control their vessels. In summary, it was made clear that the relevant organizations for overall ABNJ governance structures already exist, although many of them need strengthening and, in some cases, new organizations need to be formed. However, many of the existing challenges could be addressed by increasing cross-sectoral cooperation and coordination.

3.2.3 Challenges for new deep-sea regional fisheries management organizations

Tim Costelloe, Acting Chairperson of SIOFA, presented on the general challenges faced by new RFMOs and gave the particular example of SIOFA. The Southern Indian Ocean Fisheries Agreement (SIOFA) was formed in 2006 and entered into force in 2012. SIOFA has a small membership, currently 10 Contracting Parties (CPs), but has a commitment to increase participation and to increase the scope and responsibility for a broader range of stocks. SIOFA's challenges fall into six broad categories:

- 1) Managing expectations of Contracting Parties, industry stakeholders, and NGOs

- 2) Participation and equitable representation of coastal states, fishing states, small island developing states (SIDS) and least developed countries (LDCs)
- 3) Building institutional culture to be collegial, constructive and equitable
- 4) The administrative challenges of founding a new organization
- 5) The formulation of appropriate regulation and management measures
- 6) Boundary disputes and joint management issues

Article 203 of UNCLOS lays out the foundation for special regard to the rights and aspirations of SIDS and LDCs to develop their economies through access to marine resources. Article 278 dictates that all states should cooperate to form equitable outcomes that represent the best interests of the global community. UNFSA mandates a precautionary approach to the exploitation of marine resources and calls for transboundary and highly migratory stocks to be managed collectively. Conversely, discrete stocks existing only in the High Seas are outside the scope of UNFSA, so there is now a challenge as to how to incorporate discrete stocks into the RFMO/A framework, where no clear legal mandate exists for the management of these stocks under existing agreements.

More recently the goals and outputs of RFMO/As now would be tied to the UNGA Resolution 70/1 of 2015 and the Sustainable Development Goals resulting from that resolution, especially Goal 14 “Conserve and sustainably use the oceans, seas and marine resources for sustainable development”.

A major challenge to equal representation of states at RFMO/As is referred to as disparities among ‘equal’ countries affecting smaller and less developed states (SIDS and LDCs) in the formulation and imposition of control measures for the High Seas (Blasiak & Pittman, 2016). This challenge of the disproportionate burden borne by the smaller and lesser resourced administrations of SIDS and LDCs is also present in the management of transboundary stocks, where adjacent states are often pressured by the wealthier nations.

The challenges for SIOFA include the under representation of SIDS and LDCs as participants. Even if they are Contracting Parties (CPs - members) they are often absent from meetings, and when they appear have much smaller delegations than the CPs from developed OECD countries or larger states. A further challenge is to encourage buy-in from non-signatory parties, particularly those who have not ratified some or all of the international agreements, and who may have significant internal markets where no international oversight is present or possible.

A significant challenge then is to build an institutional culture that ensures proportionality of representation and equitable outcomes, ensuring equal representation among OECD states, SIDS and LDCs and the avoidance of dominance by a smaller subset of countries. Cooperation and interest blocs tend to develop based on the perceived common interests of smaller groupings of CPs, but these cooperative alliances tend to be issue-based, with the composition of interest alliances changing on different issues within the meeting agenda. Missing is a bloc or caucus of less advantaged states able to act collectively to block the will of more active and aggressive CPs.

Administrative challenges therefore revolve around issues such as capacity to participate and disparities between ‘equal’ countries, which tend to privilege a relatively small group of well-resourced active states, to the disadvantage of SIDS, LDCs and small administrations. Dominance of the agenda and discourse by the richer countries often means that the avoidance of disproportionate burden to Small Island States and LDCs is overlooked. States can also have a different understanding of how management policy can align to international priorities, such as UNGA resolutions and the SDGs, or may seek to follow the precedent of other RFMO/As without examining the specificity of the management area of a specific RFMO/A. Specificity of discrete stocks can also be raised in opposition to the compatibility of management required of transboundary stocks, but national agendas and skewed interests based on pre-existing claims or management arrangements can lead to conflict, especially in the area of transboundary management, where cross-claims to resources and areas may exist between RFMO/As, adjacent states and deep-water fishing nations.

The experience at SIOFA tends to be that larger and well-resourced delegations have more preparation time available to formulate and study proposals for critique and negotiations. Smaller or less-resourced delegations often have limited time or inclination to propose measures or study proposals in depth. Unless they are able to read proposals quickly with a depth of understanding, SIDS and LDCs may be significantly disadvantaged by constraints in their capacity, and that may be compounded by an incomplete comprehension of the very technical language often presented by OECD states when presenting proposals for measures. The priorities of the active states often follow a very narrow and relativistic viewpoint premised on prevailing Western centred ethics, and often fail to consider properly the alternative claims or sentiments of less developed coastal and adjacent states. SIOFA also is challenged by a plethora of data poor fisheries and unmapped areas, requiring extensive and expensive programs to gather more data to achieve the goal of effectively and sustainably managing the SIOFA area.

The sharing of technology and resources to less advantaged participants is crucial to address the disparities of representation and participation. More-resourced countries have a duty to help the less-resourced but should avoid molding the research priorities or goals of SIDS and LDCs in the work to be done to the donor vision. Adequate funding of science to overcome data deficiencies is needed, but cannot be funded by the RFMO/A without imposing significant additional burden to less advantaged states.

International cooperation and assistance to SIDS and LDCs is mandated by UNCLOS and could be incorporated in the formulation of CMMs, in the administration of the RFMO/A and in the provision of financial support to promote the inclusion of SIDS and LDCs in Chairing roles and other positions of significance within SIOFA. Conditions for representativeness and equity must be set that allow for the voices of the less advantaged and less active CPs to be heard and understood.

The creation of legally binding instruments must take account of all viewpoints and not just those of the active well-resourced participants, and should avoid disproportionate burden to adjacent Small Island States or LDCs. If burden is unavoidable, compensation should be transferred from the more advantaged to the less advantaged.

3.2.4 Introducing the concept of policy for semi-closed areas

Abdellah Srour, Executive Secretary of the General Fisheries Commission for the Mediterranean (GFCM), and Miguel Bernal, Fisheries Officer for GFCM, presented on the recommendations and decisions of GFCM pertinent to deep-sea fisheries and biodiversity conservation.

Enclosed or semi-enclosed seas constitute special environments that are much more susceptible to human impacts than the open oceans. UNCLOS and the UN Environment regional seas programmes pay particular attention to these seas, with specific text on the need for cooperative action among States bordering an enclosed or semi-enclosed sea to coordinate the conservation, exploration, and exploitation of the living resources of the sea. The special environments of enclosed or semi-enclosed seas have features in common with large lakes and enclosed estuaries, notably a limited degree of exchange with the oceanic environment, and a high degree of input of materials and influences from adjacent land masses. These physical characteristics lead to a limited capacity of the environments and resources of semi-enclosed seas to absorb the impacts of human activities within their watersheds and littoral zones, and make conventional food web studies and fishery assessments of limited value in the absence of the specific incorporation of the effects of environmental change. Common keys to susceptibility of semi-enclosed seas to anthropogenic effects include (Caddy, 1993):

- The scale of riverine, atmospheric, and coastal inputs relative to the rate of flushing into the ocean;

- The extent to which sills or basins modify exchange of water with the ocean, and within the sea itself;
- The latitude, depth, and the temperature and stratification of these water bodies; and
- The levels of human populations resident along the littoral and within the catchment basin, human activities and land use practices, determine to a large extent the potential anthropogenic effect on semi-enclosed seas.

The Mediterranean Sea is defined by the International Hydrographic Organization (IHO) as bounded by the coasts of Europe, Africa, and Asia, from the Strait of Gibraltar on the West to the entrances to the Dardanelles and the Suez Canal on the East. The Mediterranean Sea is considered the largest semi-enclosed sea on earth, although it only comprises 0.25 percent volume of the global ocean. Despite this limited size, the Mediterranean includes most of the main oceanographic features of other seas, making it one of the most complex marine environments. It is also considered to be an oligotrophic area, with a low rate of turnover of the water mass, and localized nutrient inputs (e.g. rivers, local upwelling).

Overall general fish productivity of the Mediterranean is low due to the oligotrophic characteristics, with fisheries concentrating in particular areas. There are large human densities along the coastal areas, and high levels of anthropogenic impacts, including pollution, habitat degradation, and fishing. In addition, the Mediterranean is expected to be one of the regions suffering a large impact of climate change, including the increasing expansion of non-indigenous species.

In summary, policy for enclosed and semi-closed seas is not a recent development, however it is being increasingly recognized that the physical characteristics of these seas call for a differentiated approach to management. There is a need to reconsider policy-making against the background of ongoing developments (e.g. such as the BBNJ discussions), to account for the specific nature of semi-closed seas, and GFCM rests at the interface to provide this specialized expertise.

3.2.4. Industry initiatives in the areas beyond national jurisdiction

This presentation provided a description of the purpose of SIODFA, its structure and the background to its creation. The members of the Association are noted and how this membership has evolved from its creation in 2006. The Association is international and members come from Japan, Australia, Cook Islands and South Africa and represent an international fishery. The nature of their fishing operations is described together with their operating requirements. Comment is made on the area where their fishery operates. A major stimulus for the creation of the Association were the moves at the United Nations in regard to ABNJ resource management.

Ross Shotton, Executive Secretary of the Southern Indian Ocean Deepsea Fishers Association (SIODFA) presented on the roles that SIODFA and representative fishing industries have had in the ABNJ discussions and for policy development. SIODFA was formed in 2006 by four companies that were active in deep-sea high seas fisheries of the southern Indian Ocean. The objectives of SIODFA include the promotion of responsible management of deepwater fishery resources of the southern Indian Ocean to ensure sustained harvests to the benefit of mankind while conserving biodiversity, especially deepwater benthos in the area of the fishery and associated and dependent species. Another impetus for the formation of SIODFA was the recognition of the importance of the relevant UNGA resolutions at the time, and the absence of an RFMO for the southern Indian Ocean. Therefore, the interim period before the creation of SIOFA saw the fishing industry in this region leading many of the efforts to collect data, assess impacts, and discuss issues of common interest regarding critical issues and management.

Decades of experience from the deep-sea fishing industry make it evident that deep-sea fisheries in the high seas requires complex human resources management and involves highly skilled vessel operations. As such, deep-sea fisheries have high operating costs. The specialized knowledge of the deep-sea

fishing industry is important for the development of management and conservation plans in these areas of the oceans that are costly and difficult to access.

3.2.5. Opportunities and challenges for cross-sectoral area-based management tools in areas beyond national jurisdiction

Takehiro Nakamura of UN Environment gave a presentation on the opportunities and challenges for cross-sectoral area-based management tools in ABNJ, recalling the work of component 4 of the ABNJ Deep Seas Project. UN Environment is in the process of implementing a European Commission-funded project on integrated management and governance strategies for delivery of ocean-related SDGs. This project focuses on cross-sectoral cooperation to achieve integrated regional ocean governance, operationalizing area-based management for implementation of ocean-related aspects of the 2030 Agenda, and develop regional-level guidelines to facilitate follow-up and review of ocean-related aspects of the 2030 Agenda.

UN Environment has also itemized categories of area-based management tools:

Single-sector Tools	Multi-sector Tools	Supporting Tools
<i>Tools which respond to the needs of a single sector</i>	<i>Tools which aim to address and balance the needs of a range of sectors</i>	<i>Specific approaches used to support the development of an area-based planning tool</i>
Areas of Particular Environmental Interest (APEI)	Marine spatial planning (MSP)	Geographical information systems (GIS)
Fisheries closures/VME closures	Integrated Coastal Zone Management (ICZM)	Cumulative impact assessments
Particularly Sensitive Sea Areas (PSSAs)	Marine protected areas (MPAs)	Ecologically or Biologically Significant Areas (EBSAs)
Marine protected areas (MPAs)		Important Bird and Biodiversity Areas (IBAs)
		Key Biodiversity Areas (KBAs)
		Ecosystem approach to fisheries (EAF)

Opportunities for cross-sectoral area-based planning in the ABNJ include: assessing and addressing cumulative human impacts within the target ecosystems, which is necessary for biodiversity conservation or sustainable environment management, and conflict resolution for resource and ocean space use (e.g. marine spatial planning and ecosystem approaches).

Challenges for cross-sectoral area-based planning in the ABNJ include: cross-sectoral communication, coordination, and cooperation under sectoral governance frameworks, and stakeholder engagement relevant to multiple sectors.

3.2.6. Theme 1 discussion

The plenary noted that the largely independent mandates of the different sector actors, combined with limited communication between them and a lack of appropriate shared forms creates ‘silos’ with sectors and actors operating in isolation, e.g. RFMO/As, the International Seabed Authority (ISA), and the International Maritime Organization (IMO). This has contributed to a lack of integrated, coordinated cross-sectoral adaptive management for ABNJ. This is partially explained by a limited understanding among sectors of the needs and challenges faced by other sectors, how activities in one sector can impact another, and the interdependence of actions taken by common users in the ABNJ space.

In most cases in the high seas, there is very little spatial overlap between the activities occurring in the high seas. When spatial overlap exists, as in the northwest Atlantic with fisheries and the oil and gas industry, or the NEAFC and OSPAR cooperation in the northeast Atlantic, there has been more significant progress in multi/sectoral coordination.

The added complexity of ‘super-adjacent’ areas was noted, where for example mining activities in an extended continental shelf are under the responsibility whereas fisheries activities are under the responsibility of an RFMO/A.

The participants noted the benefits of a cross-sectoral management framework for the ABNJ. The benefits of such an approach to assess cumulative impacts, biodiversity conservation and conflict resolutions was highlighted. The challenges of cross-sectoral approaches were also noted due to, for example, the lack of cross-sectoral communication and cooperation at the sectoral governance level.

The impact of activities that do not originate in the ABNJ was also noted. Current ABNJ governance structures mainly address sectoral activities that occur in the ABNJ and do not take into account land-based impacts, such as climate change and land-based pollution, including plastics. This was considered a gap that needs to be addressed.

The importance of a participatory process in RFMO/As was stressed. The challenges for many LDCs and SIDs to effectively participate was highlighted noting the need to build their capacity for effective participation.

Overall, ABNJ governance is comprehensive at the sectoral level. The majority of the ABNJ is under the jurisdiction of RFMO/As, with corresponding conservation and management measures to address fisheries sustainability and biodiversity conservation goals, however there is room for improvement of cross-sectoral coordination.

3.3. Theme 2: deep-sea science and monitoring

Ellen Kenchington (Fisheries and Oceans Canada, DFO), Rick Fletcher (FAO consultant), Manuel Barange (FAO), and Shirley Pomponi (Florida Atlantic University) each chaired four sub-sessions of Theme 2 on deep-sea science and monitoring. The Theme 2 session aimed to present a snapshot of ongoing conservation initiatives, research projects, and resource uses in the ABNJ by sector, and highlight results from some of these activities and how they fit under the ABNJ governance and policy topics from the first themed session. In doing so, the Meeting aimed to answer questions such as: What is the current state of knowledge on deep-sea biodiversity? How are we managing deep-sea fish stocks and other marine resources? What are the projected impacts of climate change on fisheries and biodiversity?

3.3.1 Deep-sea sponge aggregations under a Gaia’s perspective: functional connections

Manuel Maldonado from the Center for Advanced Studies of Blanes (CEAB-CSIC), and co-leader for Work Package 4 (*Ecosystem function, services and goods*) of the SponGES project gave a presentation on deep-sea sponge aggregations under a Gaia’s perspective and their functional connections.

Following a “Gaia conception” of our planet, scientists have endeavored to decipher the functional roles and the ecological imbrications of major earth ecosystems, such as forests, pastures, deserts, mangroves, estuaries, coral reefs, hydrothermal vents, etc. The advent of manned submersibles and remotely operated vehicles during the past decades has uncovered astonishing aggregations of sponges in the deep sea. These aggregations make unique deep-sea systems that remain largely uninvestigated in terms

of functional significance. Within the SponGES grant, we have designed a specific Work Package to palliate such a lack of knowledge. Through a multidisciplinary approach that encompasses from molecular and ultrastructural techniques to regional oceanographic features, we are attempting to understand the role of sponge grounds in the utilization and recycling of nutrients (Si, N, P, C) that are instrumental to ocean functioning and that can be directly and indirectly translated into economic value. We will summarize some new advances in techniques to conduct manipulative experimental research the in deep sea and will explain case studies illustrating the large-scale ecological, oceanographic and natural resource implications of nutrient utilization by the deep-sea sponge aggregations.

3.3.2 Vulnerable Marine Ecosystem science and significant adverse impacts: example of the Northwest Atlantic Fisheries Organization

Andy Kenny of the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) in the United Kingdom gave a presentation on VME science and assessing significant adverse impacts (SAIs) in the Northwest Atlantic Fisheries Organization (NAFO).

Since 2008 NAFO has advanced its scientific understanding of vulnerable marine ecosystems (VMEs) within the NAFO Regulatory Area (NRA) and Fishing Footprint (Figure 1).

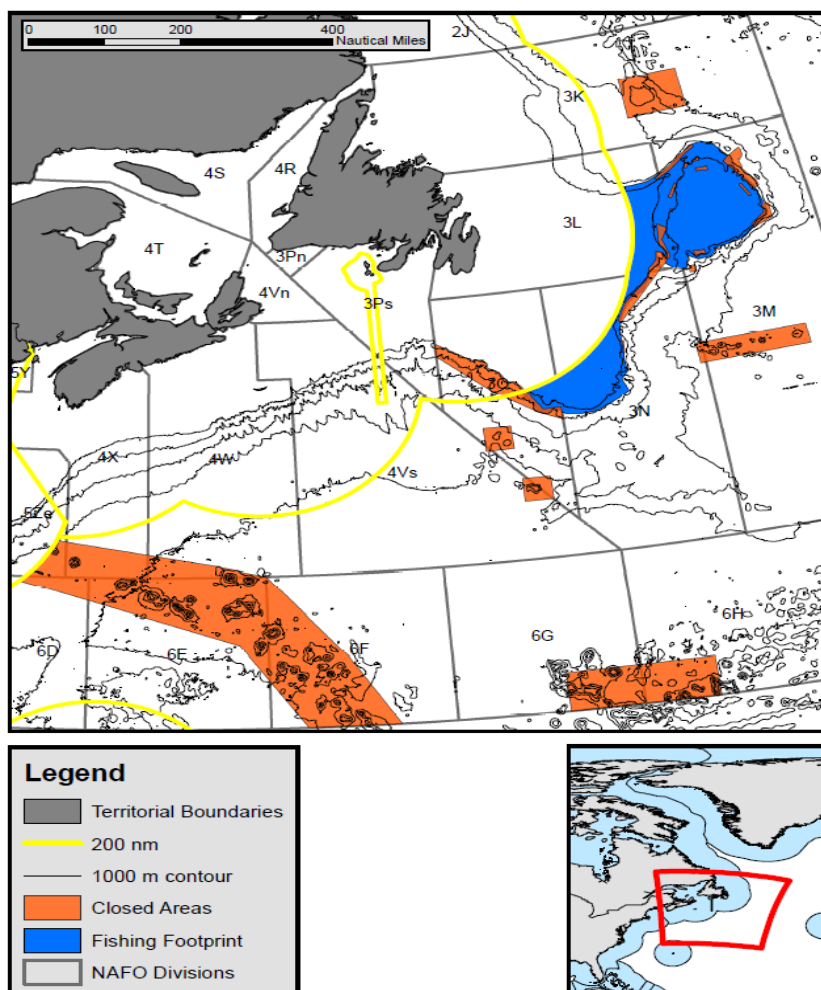


Figure 1. Map of VMEs in the NAFO regulatory area and fishing footprint.

Source: <https://www.nafo.int/>.

Map conforms to United Nations World Map No. 4170 Rev. 18.1, February 2020.

Specifically, advances have been made concerning: (i) the definition and identification of VMEs, (ii) understanding the functional importance of VMEs, (iii) quantifying the level of connectivity (both structural and functional) between VMEs, and (iv) development of methods for assessing significant adverse impacts (SAIs) on VMEs. By utilising the extensive fishery independent survey data in NAFO the significant concentration of species biomass has been determined for each VME indicator species. The identification of significant concentrations has enabled survey catch thresholds to be defined for sponge and coral VMEs in the NRA. In terms of the functional significance of VMEs, it has been shown that sponge grounds enhance significantly the biodiversity of habitat which in turn enhances food availability for fish in the area. It has been shown that the regional pattern of currents and the seabed topographic features are important drivers of larval connectivity between the VMEs, with the size and location of VME being especially important in sustaining and facilitating the recovery potential of networks of VME closures of the same type. Finally, with respect to assessing SAIs, the mapping of fishing effort (using VMS data) in combination with the known distribution of VMEs (not subject to protection by VME fishery closures) provides the basis for assessing the first three criteria of SAI as defined by the FAO guidelines (FAO, 2009). That is to assess the extent of overlap between fishing activities and VMEs to determine what proportion of the available VME is at risk of fishing, and what proportion of the VME has been impacted by fishing (Figure 2).

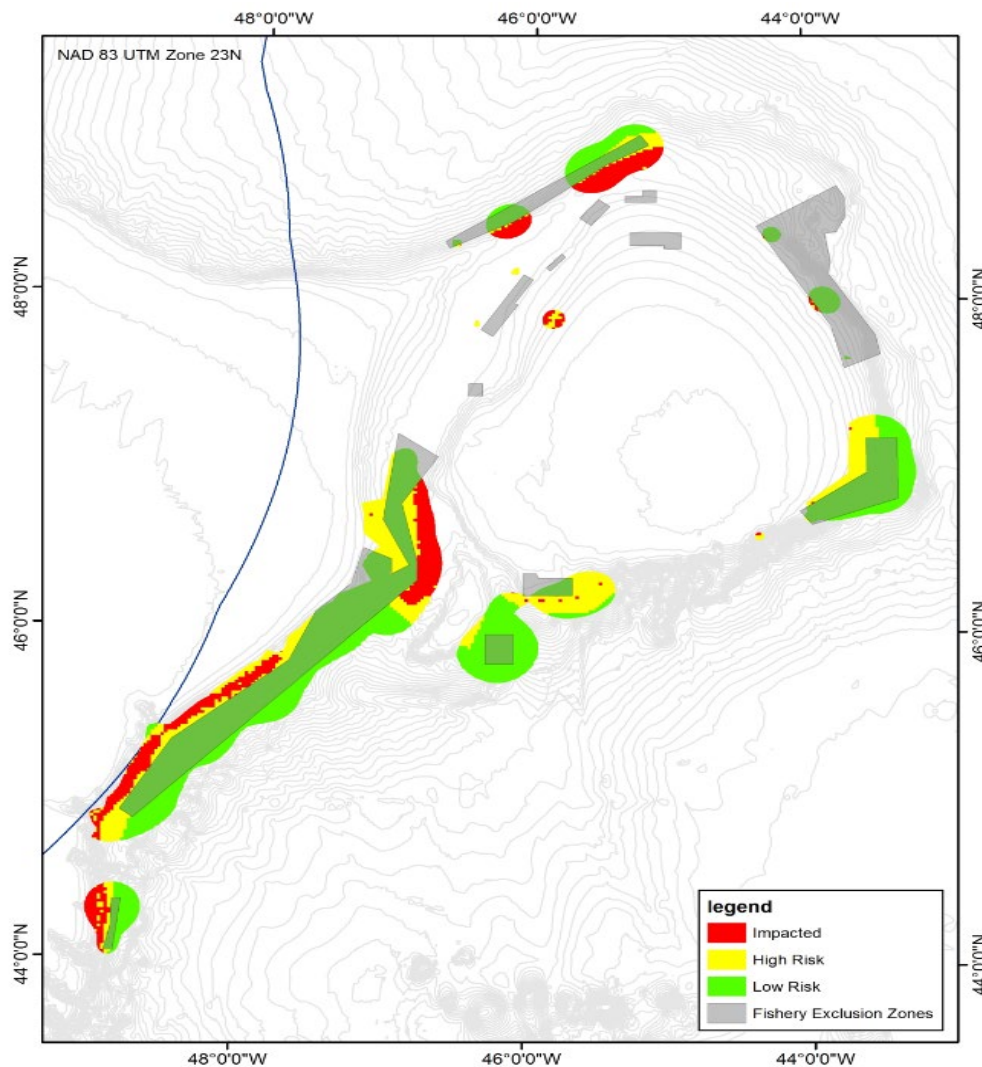


Figure 2. Assessed overlap between fishing and sponge VMEs in the NAFO footprint to identify impacted areas, areas at risk and areas of VME protected by fishery closures. Source: <https://www.nafo.int/>.

Map conforms to United Nations World Map No. 4170 Rev. 18.1, February 2020.

3.3.3 General Fisheries Commission for the Mediterranean management of vulnerable marine ecosystems and deep-sea fisheries

Miguel Bernal (GFCM) gave a presentation on GFCM management of VMEs and deep-sea fisheries. GFCM has specific fishery protocols in place to protect marine ecosystems and sustain the harvest of living aquatic resources, termed Fishery Restricted Areas (FRAs). FRAs are geographically-defined areas in which all or certain fishing activities are temporarily or permanently banned or restricted, and can be established to protect any kind of marine resource and ecosystem (including VMEs) from potentially harmful fishing activities. In 2005, the GFCM was a pioneer in establishing a deep-sea large FRA encompassing all sea areas below 1 000 m depth (thus prohibiting bottom trawling). Since then, another eight FRAs have been established, and three more are under consideration for 2019. In addition to the deepwater FRA, there are FRAs to conserve deep-sea sensitive habitats, and to conserve essential fish habitats.

The process for establishing a FRA is a multi-step review process that includes: the initial FRA proposal is submitted to GFCM (which can be done by any stakeholders, such as institutions, scientists, policy-makers, NGOs, or the private sector) and then undergoes technical consultations through the expert GFCM groups and the subregional committees before being considered by the Scientific Advisory Committee on Fisheries (SAC) and the Commission. If adopted by the Commission, a formal decision is then made establishing the FRA.

In addition to general measures for all fisheries, which also apply to deep-sea fisheries, GFCM has a number of specific measures concerning deep-sea fisheries, including: deep-sea FRA below 1 000 m where bottom trawling is prohibited, and multiannual management plans for European hake and deepwater rose shrimp in the Strait of Sicily, and a plan for trawl fisheries targeting giant red shrimp and blue and red shrimp in the Ionian and Levant Seas.

Upon the adoption of UNGA resolution 61/105 and the FAO Deep-sea Fisheries Guidelines, GFCM undertook steps to comply with the provisions held within, specifically the management of VMEs and deep-sea fisheries, including: the identification of regional VME indicators (features, habitats, taxa), VME encounter protocols (data collection and move-on rules), deep-sea fisheries definition and mapping of activities, and deep-sea exploratory fishing protocols. In response to this, the GFCM Working Group on MPAs at its meeting in 2015, requested the GFCM to begin addressing the management of deep-sea fisheries and VMEs in a comprehensive manner for the Mediterranean Sea.

As such, the first proposal for VME indicator species and an encounter protocol were presented to the SAC in 2016, which requested the formation of a VME Working Group to further discuss the management of VMEs and deep-sea fisheries. The first meeting of the VME Working Group was held in 2017 where VME indicator species were identified for the Mediterranean, deep-sea fisheries were defined (as those below 300 m depth) and mapped, and encounter and exploratory protocols were drafted. The 2017 SAC requested a second meeting of the VME Working Group for 2018, after which the SAC and Commission endorsed the technical elements for VMEs and deep-sea fisheries in 2018. As a result, the GFCM now has protocols in place for VME encounters (although at present there are no move-on rules attached) that will be tested during GFCM surveys from 2018-2020, definitions of deep-sea fisheries⁵ and mapping of existing deep-sea fishing areas in GFCM, and exploratory deep-sea bottom fishing reporting protocols for GFCM.

⁵ Bottom trawlers above 15 m (LOA) fishing for *Aristaeomorpha foliacea*, *Aristeus antennatus*, or *Plesionika martia*; and all fishing vessels above 15 m (LOA) operating with bottom contact gears (bottom trawls, longlines, gillnets, and pots and traps) at depths greater than 300 m and on all offshore seamounts.

3.3.4 Bottom fisheries in the high seas

Tony Thompson (FAO consultant) summarised recent trends in bottom fisheries occurring on the high seas in areas beyond national jurisdiction (ABNJ). Bottom fisheries are those fisheries where the gear contacts the sea floor during normal operation at depths of between 300-2 000 m depth, and includes bottom trawls and bottom-set longlines, gillnets and pots. In some regions, such as the south Pacific Ocean, bottom fishing includes species caught near the sea floor using deep mid-water trawls that fish close to the sea floor.

FAO published the *Worldwide Review of Bottom Fisheries in the High Seas* in 2009 (Bensch, et al., 2009) using information from 2003-2006. Considerable advances in the monitoring and control of high seas bottom fisheries, stimulated partially by the adoption of UNGA Resolution 61/105 that called for States and RFMO/As to sustainably manage bottom fisheries and protect vulnerable marine ecosystems from significant adverse impacts (paragraphs 80 and 83), has taken place since 2006. The ABNJ deep sea project agreed to expand and update the original review, including improved descriptions of historical aspects and information available up to 2018.

The management of high seas bottom fisheries is conducted by States, typically operating through RFMO/As⁶ (Figure 3). There are eight RFMO/As that manage bottom (and small pelagic) fish species according to multi-lateral agreements that are tailored to the particular regional circumstances. Some of these (GFCM, NEAFC, NAFO, and CCAMLR) were established between 1949 and 1982 and now operate under modernised conventions. Four others (SEAFO, SPRFMO, SIOFA and NPFC) were established recently between 2003 and 2015, and are in the process of developing and adopting their initial sustainable fisheries and biodiversity protection measures. In 2016, WECAFC launched a process to establish itself as an RFMO/A.

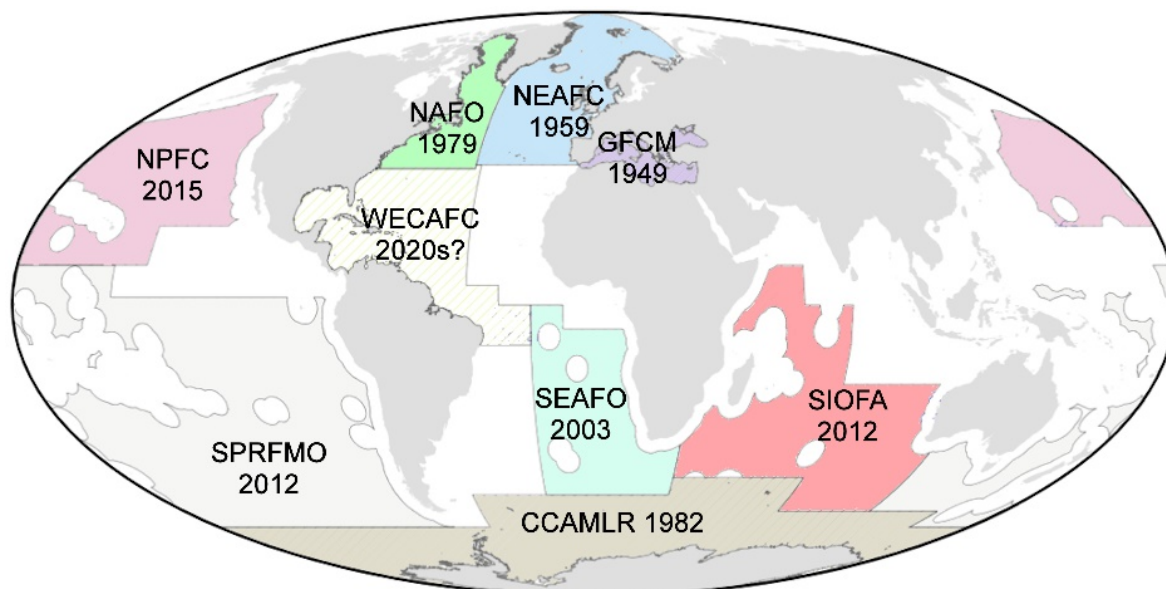


Figure 3. Establishment of R(F)MOs managing bottom fisheries. *Source:* FAO. *Map conforms to United Nations World Map No. 4170 Rev. 18.1, February 2020.*

⁶ **CCAMLR** Commission for the Conservation of Antarctic Marine Living Resources; **GFCM** General Fisheries Commission for the Mediterranean; **NAFO** Northwest Atlantic Fisheries Organization; **NEAFC** North East Atlantic Fisheries Commission; **NPFC** North Pacific Fisheries Commission; **SEAFO** South East Atlantic Fisheries Organisation; **SIOFA** Southern Indian Ocean Fisheries Agreement; **SPRFMO** South Pacific Regional Fisheries Management Organisation; **WECAFC** Western Central Atlantic Fishery Commission.

A variety of finfish and shellfish species are caught by bottom fisheries, mostly falling under the management regimes of the RFMOs, though the larger crab species are typically regarded as sedentary and managed by the coastal State. Some of these deep-sea species are considered moderately productive and relatively short lived, such as shrimp, cod and alfoncino, whereas others are very long lived with late ages at first maturity, such as orange roughy and Greenland shark. Though exact values vary greatly among regions, small pelagic catches in the high seas may be 10 times those of the demersal catches, and catches in the EEZs can be around 10 times those in the high seas. Nevertheless, the high seas demersal catches provide a diverse and valuable product for human consumption.

The assessment of high seas demersal fish stocks is only possible for those having higher catches and a longer time series. Even so, the actual status of the stock may still be poorly understood. A survey of 49 demersal stocks fished in the high seas with bottom fishing gear during 2014–2016 showed that 25 percent were fished sustainably, 26 percent were in an intermediate status, and 6 percent were overfished or at low levels. The status of the remaining 42 percent of the fished stocks was unknown. The analysis is further complicated when considering both biomass and fishing mortality, and a fuller analysis of stocks in the northwest Atlantic between 2007 and 2018 showed that the status of the stock and the fishing mortality can change quite quickly among years, and one or other could be at acceptable, intermediate or poor levels. The information used to assess stocks comes from a variety of sources and is continuously improving. It is difficult to estimate high seas catches, as it has only been in the last several years and in some regions where these catches have been recorded and reported. In 2014 and 2016, the high seas demersal catch is estimated at 224 798 tonnes and 215 772 tonnes, respectively (Table 1).

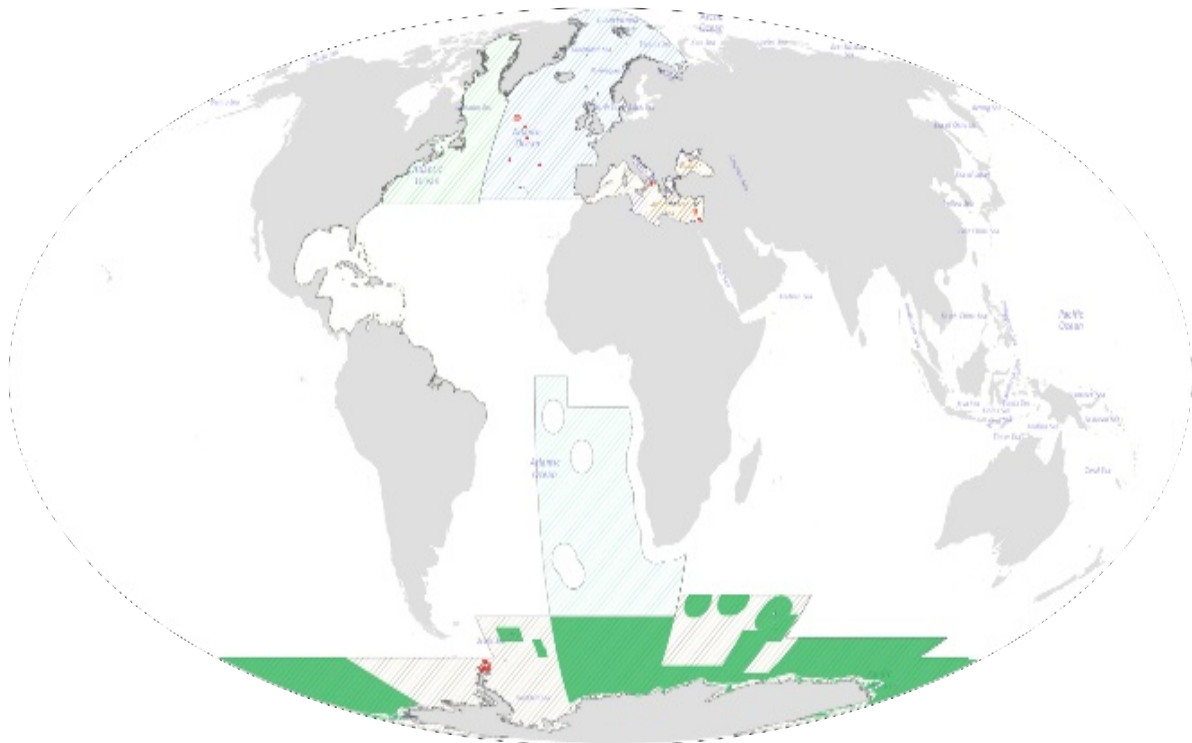
Table 1. Estimated demersal catches in the high seas.

Fish group	Catch (t)	
	2014	2016
Scallop	26	26†
Squid	15 023	15 023†
Crabs	9 489	5 477
Shrimps	37 710	31 950
Bony fish	156 823	156 391
Cartilagenous fish	5 727	6 905
Total	224 798	215 772

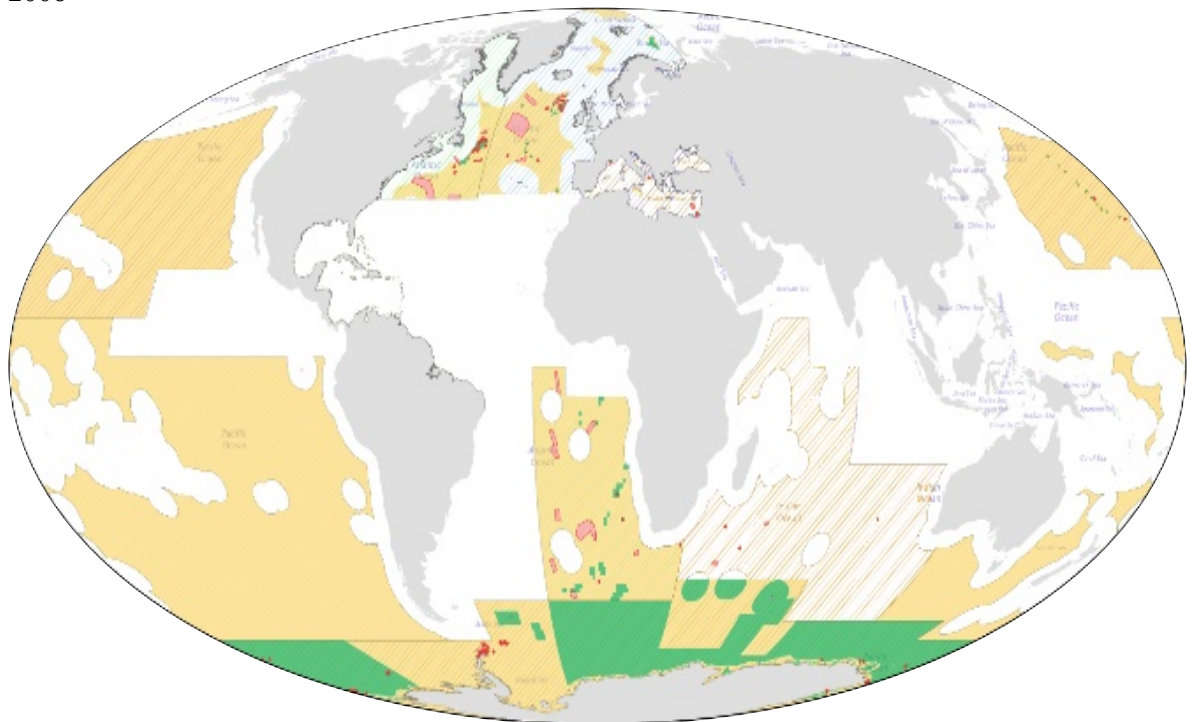
† 2014 catch used

High seas catches for particular stocks over a longer time series show declines, others show increases or steady catches. Other bottom fisheries can be sporadic in nature or new fisheries, both being very difficult to assess.

Changes have occurred in the management of bottom fishes in the high seas, particularly since 2006. The modern framework identifies where bottom fisheries are permitted (green), where they are not permitted to protect vulnerable marine ecosystems (red), and areas outside of these where exploratory fishing protocols and full impact assessments must be undertaken prior to allowing new bottom fisheries to develop (orange) (Figure 4).



2006



2019

Figure 4. Changes in the management of bottom fisheries between 2006 and 2019 showing where fishing is permitted (green), where areas are closed to protect VMEs (red), and areas closed until impact assessments have been undertaken (orange). *Source:* FAO VME DataBase.

Map conforms to United Nations World Map No. 4170 Rev. 18.1, February 2020.

3.3.5 *Assessing the impacts of anthropogenic activities on deep-sea sponges*

Christopher K. Pham (IMAR University of Azores) reported on the results of Work Package 6 of the SponGES project. Sponge aggregations are key component of the deep sea, playing an important role in the functioning of marine ecosystems. Today, the impacts of human activities have already reached the deep sea and will continue to expand since new deep-sea resources are intended to be exploited. The presentation showcased some results obtained within the framework of the SponGES project for assessing the impacts of anthropogenic activities on deep-sea sponge grounds.

The assessment was approached at the individual level through ex-situ experiments focused on the effects of individual and cumulative stressors (including climate change, fishing and mining- related stressors). At the community level, the recovery was investigated of a case-study sponge aggregation four years after physical disturbance by an experimental trawl. At a larger spatial scale, an analysis was presented quantifying the removal of sponge biomass during three years of trawling by the fishing fleet operating in the Flemish cap area (northwest Atlantic) along with the biomass protected by fisheries closures. Finally, data was presented that was collected onboard fishing vessels on the effect of longline design on sponge bycatch.

3.3.6 *Biodiversity, biotechnology and the blue economy*

Shirley Pomponi (Florida Atlantic University), co-lead of Work Package 5 of the SponGES project presented on biodiversity, biotechnology, and the blue economy. The ocean supports a great diversity of life and ecosystems. This biodiversity is also the source of chemical and molecular diversity, which is the basis for exploration and discovery of novel, marine-derived chemicals and other bioproducts. Sponges are the source of thousands of chemicals with potential pharmaceutical and industrial applications, and some sponge-derived drugs, e.g., Zovirax® and Halaven®, are clinically available. Although the majority of marine-derived drugs are from shallow water organisms, many novel chemicals and bioproducts have been reported from deep sea organisms. One example is the aphrocallistins from the deep-sea glass sponge, *Aphrocallistes beatrix*, active against triple negative breast cancer. A key sponge from North Atlantic sponge grounds, *Geodia barretti*, produces the barrettins, which have anticancer, antiviral, and antifouling activities. Why sponges produce these chemicals is not well known, especially for deep water sponges. It is hypothesized that because sponges are sessile for their adult life, the chemicals are involved in communication and signalling for a variety of functions, including reproduction, deterring predation, and preventing settlement of other organisms. These chemicals have pharmaceutical potential because they interact with molecules that have been conserved for hundreds of millions of years and are also involved in human disease processes, for example, cell division and cell death, immune and inflammatory responses, and calcium and sodium regulation.

New technologies are accelerating the pace of discovery of novel chemicals and bioproducts. Metabolic diversity of key sponge ground species is being assessed by “metabolic fingerprinting” to identify new chemicals with applications to human health and industrial use. An integrated “-omics” approach (metagenomics, metatranscriptomics, and metabolomics) is being used to search for pharmaceutically relevant genes. In addition, deep sea sponges produce intricate skeletons that inspire research on bone tissue engineering and regenerative medicine. Bioorganic silica produced by sponges attracts and stimulates stem cells to differentiate into bone forming cells. Silica-based composites, inspired by the composition of bioorganic silica and the unique 3-dimensional architecture of sponge skeletons, are being developed as implants for bone tissue regeneration.

There are key knowledge gaps and challenges in unlocking the biotechnological potential of deep-sea sponges. Sponge grounds are poorly explored; threats from industrial use of the deep sea, as well as changes in ocean chemistry and temperature as a result of global change, will have adverse effects on deep-sea sponge ground biodiversity, and as a result, on our ability to discover new chemical and

molecular diversity. There are additional challenges. Access to deep-sea sponge grounds requires ships and technologies to explore and sample the deep-sea benthos; this is expensive. Ensuring an adequate supply of the bioproducts requires the development of sustainable production methods; wild harvest of the source sponges is neither economically nor ecologically sustainable.

The timeline from identification of a bioproduct until it is clinically available can take as much as two decades. And expectations regarding benefit sharing of commercialized products need to be realistic. Discoveries must be patented and licensed for development. Pharmaceutical and biotech companies will spend millions to develop a drug, and royalties are typically less than 5 percent of the net revenues from commercialization. Frameworks have been proposed to manage genetic resources from the ABNJ and ensure benefit sharing and capacity building, but there are still many details to resolve. Who administers, maintains, and ensures compliance with agreed upon procedures? Who is required to share and what is required to be shared? When are benefits shared, who are the beneficiaries, and how is capacity building implemented? These questions remain challenging for benefit sharing of revenues from commercialization of bioproducts developed from sponges collected in territorial waters. Whether they will be simpler or more complex to resolve in the ABNJ is not known. They may be simpler because the areas are not under the jurisdiction of any state, but they may be more complex if benefit sharing with a variety of governing bodies is mandated. Regardless, mechanisms to identify and implement protection of the BBNJ should include valuation of deep-sea sponge grounds for discovery of bioproducts with pharmaceutical and industrial applications, and exploration and discovery of the ABNJ and the services they provide must continue.

3.3.7 Areas beyond national jurisdiction deep-sea ecosystem services valuation

Daniela Ottaviani (FAO consultant) presented on the ABNJ Deep Sea Project results from Component 2 where an approach for an economic valuation of deep-sea ecosystem services was developed and tested for the ABNJ deep-seas.

Ecosystem valuation is a process that assigns a monetary value to the benefits that are provided by an ecosystem and its ecosystem services. Deep-sea economic valuation considers ecosystem services delivered by marine waters and seafloor areas below a depth of 200 m, where light is so dim that no photosynthesis occurs.

Economic valuation in the ABNJ is challenging given: (i) its remoteness and location in areas largely inaccessible except through the use of specialized and costly equipment and technologies; (ii) a limited number of economic activities (fishing, navigation, laying marine cables and pipelines, constructing artificial islands and other installations, and conducting scientific research) allowed under United Nations Convention on the Law of the Sea (UNCLOS); and (iii) connectivity between the deep-sea lying in the ABNJ and the deep-sea lying in the EEZs and further connectivity with coastal areas.

The ecosystem valuation was undertaken at a global scale considering: (i) deep-sea ecosystems (including areas below 200 m found in both the EEZs and the ABNJ); and (ii) deep-seas of the ABNJ (including areas below 200 m only found in the ABNJ).

A total economic value (TEV) framework was used to assess a wide range of goods and services delivered by the deep-sea, including: (i) deep-water fish, (ii) precious corals, (iii) deep-water and ultra-deep-water oil, (iv) pharmaceutical of marine origin, (v) deep-sea mineral ores, (vi) carbon sequestration, (vii) scientific research and education, and (viii) recreation and leisure.

Each ecosystem service is assessed as the flow conveyed over a time frame of one year, and the reference was the year 2014. The computed TEV, expressed in United States dollar (USD) currency, is the overall sum of economic values estimated for the analysed ecosystem services. The economic valuation was carried out through a price-based valuation approach.

Every economic estimate calculated by this study is data based. A big data-mining effort was carried out in order to compile information for a valuation of deep-sea ecosystem services at a global scale. Major sources of information included a large number of international databases and data sources as well as nearly 250 published papers. One major achievement was to pull such diversified large amount of information, related to the deep sea, within a single document, which can represent an important baseline for future studies.

Comprehensively, the TEV assessed for the deep-sea ecosystem as a whole is estimated at 266 billion/year USD, which is constituted of 92 percent by the economic value of abiotic resources (oil and minerals), 5 percent by biotic resources (fish and coral), 2 percent by cultural services (scientific research and tourism/recreation), and 1 percent by carbon sequestration.

As a comparison, the TEV associated to the ABNJ is 30 billion/year USD, which comprises of only four ecosystem services and represents slightly more than 10 percent of the total deep sea TEV. Among provisioning services, the valuation framework included resources that are currently extracted from ecosystems (such as fish, precious corals, oil) and resources that are likely to be used in future (such as minerals and deep-sea biological materials for pharmaceuticals).

The great difference between deep-sea and ABNJ deep-sea TEVs is due to oil from deep and ultra-deep oil reserves, which is extracted mainly from a geographic area known as the “Deep-water Golden Triangle”, having its vertices pointing to the Gulf of Mexico, Western Africa and Brazil. The fact that the economic valuation is carried out at two levels (deep-sea ecosystems as a whole and deep-seas of ABNJ) provides interesting results. For example, the comparison between the fish resources in the deep-sea and in the deep-sea of the ABNJ shows how fish harvested in the ABNJ represent only 4 percent of the fish extracted from the deep-sea ecosystem and further constitutes a very minor fraction (0.2 percent) of global capture fishery production (81.5 million tonnes in 2014) for all marine fish species.

The assessment of resources that are likely to be used in future was based on what we are able to assess from current available information. Marine organisms represent an important source of biological materials that can lead to the discovery of new drugs. The testing pipeline and the time line from the initial identification of a molecule with bioactivity and interesting therapeutic application to the final drug commercialization is very long. For several cases of pharmaceutical of marine origin, it took more than 20 years for such odyssey to be completed. Currently, there are seven pharmaceutical drugs that are derived from marine heterotrophic organisms. Among these, only Halaven® can be considered to be partially derived from the deep sea as the chemical lead was identified in both shallow and deepwater sponge (*Lissodendoryx*). Bioprospecting studies on deep-sea organisms and many compounds have entered the pipeline, but to date, no one has made it to the end. By searching into financial statements of pharmaceutical companies and other documents, this study estimated the overall commercial value of these drugs of about 2.3 billion/year USD. This estimate can be considered a proxy until current bioprospecting on the deep-sea will become evident.

More challenging to estimate was the economic valuation of deep-sea mineral ores. Mining activities in the deep-sea are still in an exploratory phase. In the ABNJ, mineral extraction is controlled and regulated by the International Seabed authority (ISA). A major target area is the Clarion-Clipperton Zone, located in the ABNJ of the Pacific Ocean, between Mexico and Hawaii. In this area, the seabed is covered by polymetallic nodules at about 5 000 m depth, mainly composed of manganese and iron as nickel, copper, cobalt, and other precious and rare elements.

In 2014, the ISA released 12 exploratory contracts. Several technical studies have investigated the economic viability of mining operations considering scenarios of an annual recovery between 1.5 and 3 million tonnes of dry nodules/year. A fictitious scenario was built to assess the economic value of polymetallic nodule extraction in the hypothesis that exploratory deep-sea mining contracts in place in 2014 would have moved in that year to an exploitation phase. This allowed the valuation of deep-sea mineral extraction to be approximately 25.5 billion/year USD, using the metal market price from 2014 and comparing it with other assessed ecosystem services.

Another interesting finding was related to the service carried out by the deep-sea in carbon sequestration, which ensures that CO₂ absorbed by the ocean at the air-sea interface (through CO₂ solubility in seawater and photosynthesis) is transported at depth and stored in different deep-sea compartments.

The market price of 1 tonne of sequestered carbon in the European Union Emission Trading System is rather low. If the average unit price in 2014 (of about 8.5 USD/year) is applied, the economic value of carbon sequestration is very minor. However, if the social cost related to the economic damage of having one additional tonne of carbon released in the atmosphere is considered, the economic valuation significantly changes. In fact, if the social cost of 417 USD/tonne is used, the economic importance of carbon sequestration becomes comparable with that of deep and ultra-deep oil resources.

Therefore, the major findings of this study highlight how abiotic resources are currently the major economic driver for deep-sea, and particularly ABNJ deep-sea, exploration and exploitation. Bioprospecting activities using biological material from deep-sea organisms are still on-going and will be fully accountable in future. The investment made for scientific research in the deep-sea accounted to nearly 5 billion USD and is still underestimated due to large data gaps in retrieving information on investments at the national level. The economic relevance of deep-sea fisheries represents 11 percent of global capture fishery production, but activities of ABNJ deep-sea fisheries has a relatively lower economic value.

This study also points out the fact that the service ensured by the ocean in carbon sequestration is poorly accounted by international carbon markets. If this service is accounted with social cost, its importance in economic terms stands out. This implies that full accounting of large scale regulating and supporting services of the deep-sea concurring to the maintenance of the deep-sea ecosystem can significantly increase the current total estimated economic value of the deep-sea and likely dwarfing the economic value of current use of deep-sea resources.

3.3.7. Monitoring change and ecosystem risk assessments

There is growing agreement that assessment of risk in the marine environment needs to take an ecosystem approach to account for the single and cumulative impacts from multiple sectors that operate within the world's oceans. The number and breadth of human activities in oceans and coastal zones are increasing. There is a long history of assessing risk of significant impacts from single sources of disturbance and pressure but the assessment of risk at ecosystem scales and across multiple sectors remains a substantial challenge.

An effective, flexible and resource appropriate approach to risk assessment can be found in Ecological Risk Assessments for the Effects of Fishing (ERAEF) and the FAO Ecosystem Approach to Fisheries. The ERAEF approach was developed to provide a framework and set of tools to assess the ecological impacts of fishing on species (including target, bycatch and protected species), habitats and communities. In this presentation, Piers Dunstan (CSIRO) focuses on the technical challenge of developing a level 2 product susceptibility analysis (PSA) for assessing the risks to biodiversity from deep-sea fishing gear. The approach of CSIRO expands upon the existing semi-quantitative approach by combining statistical models with the mechanistic understanding provided by qualitative ecosystem models. The approach used can be extended as a cumulative assessment, assessing the potential risks of both deep-sea fishing gears and climate change.

A risk assessment to biodiversity requires three components, a quantification of the "biodiversity" present at any location, a functional model for how the different components of biodiversity will relate to the pressures acting at that location and an understanding of the distribution, and ideally intensity, of the pressures at that location. CSIRO used joint multiple species statistical models to predict biodiversity spatially-based on observed species occurrence. We use effort and location of fishing gears

from RFMO/As in the Indian and Pacific, along with predictions on Sea surface temperature and chlorophyll A climatologies to map the distribution and intensity of a subset of pressures. Finally, we use qualitative models to characterise the links between biodiversity and the pressures that are acting on the system.

We developed and implemented inhomogeneous Poisson point process Regions of Common Profile (RCP) models to generate biologically data driven bioregions for the Southwest Pacific and the Southwestern Pacific Ocean regions. We extend the RCP model to be a spatial point process.

Qualitative models represent a working hypothesis about how an ecosystem works. Conceptual models need to portray the ecological system at a level of resolution that is useful to the purposes of the risk assessment, striking a balance between simplicity and complexity.

The results presented here demonstrate the capability to perform a detailed risk assessment on biodiversity. The RCP models provide a prediction of different ecosystem types and the species that are associated with each ecosystem. This approach provides a significant advance on previous approaches that allow for the simultaneous prediction and grouping of species into different ecosystem types or communities.

The qualitative models allow us to describe the ecosystem that operates within each statistically defined region. The qualitative models describe the interaction between the different components of the ecosystem and how and where the different pressures (i.e. climate change and fisheries) will interact with the ecosystem.

The combination of RCP multispecies models and qualitative models is unique to this project. It allows the best elements of each approach to be combined to provide a qualitative assessment of the change in species and ecosystems at specific locations. The assessment does not quantitatively measure the change in biodiversity with the pressures and is the equivalent of a hazard-based ERA level 2 risk assessment where potential pressures are identified and the potential impacts identified.

3.3.8. OSPAR, climate change and ecosystems: ecological and biological impacts

Susana Salvador, Executive Secretary of the OSPAR Commission, presented on the work undertaken by OSPAR in response to the ecological and biological impacts of climate change on marine ecosystems. The OSPAR Convention which entered into force on 25 March 1998 established the OSPAR Commission which counts with 16 Contracting Parties. General obligations under the OSPAR Convention are set out in Article 2 of the Convention. They include the adoption of all possible steps to prevent and eliminate pollution, the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems, and, when practicable, to restore marine areas which have been adversely affected. Overall, the work of the OSPAR Commission is guided by the ecosystem approach to an integrated management of human activities in the maritime area. This approach is supported by the general obligation of the Contracting Parties to apply the precautionary principle, the polluter pays principle, as well as best available techniques (BAT) and best environmental practices (BEP), including clean technology.

The structure of OSPAR deals with a huge scope of work and human activities. It started by focusing on the management of environmental impacts of offshore activities, in particular by and monitoring, assessing the impact and regulating the polluting substances. In 1998 enlarged its remit of work by adopting Annex V on the protection of biodiversity and ecosystems. OSPAR Convention allows for the regulation of all relevant activities under the authority of its Contracting Parties. There are a number of human uses of the ocean, including in the ABNJ, which may be subject to OSPAR regulations.

Climate change and ocean acidification

The OSPAR North-East Atlantic Strategy 2010-2020 states that the “first effects of climate change and ocean acidification are apparent throughout the OSPAR Maritime Area and pressures on the marine environment from climate change and ocean acidification are set to grow”. So, OSPAR is to monitor and assess the nature, rate and extent of the effects of climate change and ocean acidification on the marine environment and consider appropriate ways of responding to those developments. A chapter of the last assessment of the marine environment published in 2017 - Intermediate Assessment - addressed marine climate change and looked at trends in sea water temperature, sea ice, sea level, salinity, storms and waves, and ocean pH, as well as changes on land, including glaciers and snow-covered areas.

Marine ecosystems are subject to a variety of concurrent pressures such as warming, eutrophication, hypoxia, and pollution, which may act in concert to produce responses that may be additive, synergistic or antagonistic. The assessment of cumulative effects is thus part of the OSPAR guiding principle - the Ecosystem approach - and it aims at addressing the causes, pathways of exposure and consequences of these effects from multiple human activities, on the ecosystem components. A specific expert group - ICG-EcoC – studies the systematic procedure for identifying and evaluating their significance so to estimate the overall expected impact.

OSPAR recently established another expert group - ICG-OA - to work on the subject of ocean acidification, in particular towards the development of a new assessment indicator to be used for the next overall marine assessment of the North-East Atlantic to be produced and launched by OSPAR in 2023 – the Quality Status Report.

Protection of biodiversity

OSPAR has a wide mandate when it comes to identifying and assessing specific species, habitats and features in need of protection within the OSPAR maritime area. The role of OSPAR is based on the ecosystem approach and its mandate for setting in place an integrated process for the protection of marine areas in ABNJ having regard to human activities and their cumulative impacts. This includes the assessment of the status of the environment, the identification of features in need for protection, as well as the establishment of conservation objectives and monitoring measures.

The definition of Marine Protected Area (MPA) is provided by OSPAR Recommendation 2003/3 implementing Annex V of OSPAR Convention as “an area within the maritime area for which protective, conservation, restorative or precautionary measures, consistent with international law have been instituted for the purpose of protecting and conserving species, habitats, ecosystems or ecological processes of the marine environment”.

This Recommendation defines the OSPAR marine protected area network as including sites within national jurisdiction and “any area in the maritime area outside the jurisdiction of the Contracting Parties which has been included as a component of the network by the OSPAR Commission”, expressly envisaging that these marine protected areas can be designated in areas beyond national jurisdiction, which is considered particularly important for the protection and conservation of highly mobile species, such as certain birds, marine mammals and fish, and to safeguard the critical stages and areas of their life cycle (such as breeding, nursery and feeding areas).

3.3.9. Deep-ocean climate change impacts on habitat, fish and fisheries

Lisa Levin (Scripps Oceanographic Institute) presented on a recent workshop held with support from the ABNJ Deep Seas project on the projected impacts of climate change on deep-ocean ecosystems. Climate change is pervasive and is now exposing deep-ocean ecosystems to altered environmental conditions. We face considerable challenge in understanding how this will affect deep-sea habitats, fish and fisheries, and what management actions can be taken in response. This presentation highlights

outcomes from a collaboration between the FAO/UNEP ABNJ Deep-seas and Biodiversity project and the Deep Ocean Stewardship Initiative, undertaken in response to UNGA Res. 71/123 (article 185) which calls upon states and RFMO/As to ‘take into account the potential impacts of climate change and ocean acidification in taking measures to manage deep-sea fisheries and protect vulnerable marine ecosystems’. The study was initiated with a workshop at Woods Hole Oceanographic Institution in Summer 2017 and subsequently completed and summarized in a meeting report (FAO, 2018).

The principal cause of climate change is rising greenhouse gases and other compounds in the atmosphere that trap heat causing global warming, leading also to deoxygenation and acidification in the oceans. Three-dimensional, fully coupled earth system models were used to predict the extent of these changes at the bathyal ocean floor (200–2 500 m depth) for individual ocean basins, slopes, seamounts, canyons, and VME closed areas for six RFMO/As plus CCAMLR. Trends in changes are identified in temperature, pH, oxygen and supply of particulate organic carbon (POC) to the seabed. Model predictions indicate that most of the deep seafloor is likely to experience warming and declines in pH by 2041–2060 and 2081–2100, especially at higher latitudes, with greatest warming effects at bathyal depths of the northwest Atlantic, western Greenland Sea and Barents Sea, Red Sea and Sea of Okhotsk. The most severe reductions in pH values are projected to occur at bathyal depths of the north Atlantic, Arctic and Southern Ocean. Deoxygenation (oxygen loss) is predicted to be greatest in the north Atlantic and part of the Arctic and Southern Oceans, while a significant decline in export POC flux at 200–2,500 m is expected in the north and south Atlantic, north Indian and south Pacific Oceans, with the greatest declines on the Atlantic slope. Cumulative impact assessment and time of climate signal emergence (from background variability) can help identify areas that will be subject to the most change most rapidly. The northeast Atlantic will probably be exposed to the highest cumulative negative impact of warming, and declines in pH, O₂ and POC flux among all regions under the RCP8.5 climate change scenario. At the bathyal seafloor, change in all variables except POC flux is projected to exceed historic variability by 2050; temperature and pH are projected to emerge in the 2030s in the Atlantic and Arctic Oceans.

The response of various fish and invertebrate species to these changes in the physical environment are considered based on published literature and analyzed using hazard and habitat suitability modelling. Features that make fish vulnerable to strong environmental influence include changes that affect the attached egg phase, pelagic egg phases and larval phases which may be related to ocean currents, temperatures and dependent on food availability. Fish distributional change in response to warming, especially near the poles is likely to be the first detectable response (e.g. Greenland cod).

Key elements in assessing risk of impact to VMEs and fish were exposure to climate hazard (amount of change relative to natural variability), and climate vulnerability (underpinned by species’ intrinsic sensitivity and adaptive capacity). Of 41 commercial species examined, all are predicted to experience a high level of climate hazards, with risk of impacts by 2100 being on average 13 percent higher than the risk by 2050. The most vulnerable taxa were Antarctic toothfish, yellowtail flounder and golden redfish, a result of larger body size and narrow thermal tolerance. Vulnerable species were most concentrated in the northern Atlantic Ocean and the Indo-Pacific region, but also in offshore West Africa and in the south Pacific. High vulnerability in the Antarctic region results from the high vulnerability of Antarctic toothfish.

Invertebrate/VME sensitivities are linked to physiological tolerances including those for reef formation, level of habitat specialization, dependence on environmental triggers for reproduction, development of mutualistic interactions, as well as on adaptive capacity and longevity. Of six VME indicator taxa examined for projected habitat change, all but one was predicted to have their suitable habitat reduced inside the fisheries management areas by 2100.

Key challenges identified in assessing deep-sea climate impacts include: (a) mismatch in spatial scales of global and regional climate modelling and scales of VME designation; (b) failure of climate models to account for the non-linear response of ecosystems resulting from the combination of stressors and species interactions; (c) scarcity of long-term climate observations on the deep seafloor needed to verify

models, capture periodicity and short-term events, and to further mechanistic understanding; and (d) limited availability of oxygen and other biogeochemical sensors on observing platforms.

Science needs include increased deep-ocean observing, particularly around existing and exploratory RFMO/A fishing areas and VME closures, and on the vulnerability and adaptability of key habitat-forming species and fisheries species to changing deep-ocean conditions. Collaboration among scientific networks with industry are needed to achieve these goals.

Bearing the above in mind, and the uncertainty in the specific details of the predictions, we know that climate change will bring change in the deep-ocean, and therefore the status quo of today will not apply to tomorrow. Therefore, we must ensure monitoring programs are in place that will identify these changes, and that management can adapt in a timely fashion to promote sustainable fisheries and minimize undesirable impacts. Specific management adaptations could include: (i) more rigorous impact assessments of new fisheries that incorporate climate as a cumulative impact; (ii) a more thorough review process prior to allowing new fisheries to develop; (iii) strengthened monitoring and mapping of bottom-fishing areas and species associated with VMEs vulnerable to climate change; (iv) identification of areas to be more intensely monitored for fishing impacts on the environment; and (v) preventing further significant impacts and monitoring the effects of climate change by broadening of VME indicator species reporting to include all encounters, and with bycatch species reporting.

3.3.10. Deep-sea industry contributions to science

This presentation described the preparatory activities undertaken by Association members prior to the start of their fisheries in the Southern Indian Ocean. The historical development of the Association is described and the issues that prompted the development of the Association. An account is given of the management conservation actions that were taken. Overall details are provided of the Benthic Protected Areas along with a detailed description of the criteria that were used in the creation of the conservation areas.

Ross Shotton, Executive Secretary of SIODFA, presented on some of the initiatives taken by the deep-sea fishing industry with regards to scientific data collection. Deep-sea fishing companies with interests in the southern Indian Ocean began exploring the options of scientific data collection in the mid-1990s, starting with the Sealord Group Ltd. (based in Nelson, New Zealand) funding habitat mapping efforts by the University of Hawaii for the southern Indian Ocean. This work paved the way for the formation of SIODFA and the strategies discussed for closing the fishery to new entrants, including the determination of circumstances under which new members might join SIODFA: participate in data collection, including acoustic stock assessment programmes, unsubsidized operations, one-year probation before full membership, agreement on a company-wide freeze of fishing effort, and participate in the SIODFA Benthic Protected Area (BPA) programme. Other industry-led activities included the identification of management zones and a catch reporting system, developments in coral bycatch reporting, introduction of an elasmobranch bycatch reporting system, and the development of a data collection plan for alfonso.

As such, SIODFA undertook a number of scientific activities, including: BPAs in the southern Indian Ocean; a bycatch data collection programme for sedentary and fragile invertebrate animals and deepwater sharks; intensive data collection on alfonso and orange roughy (for length, weight, sex, gonad condition, and otolith collection); a commercial vessel aggregation-based acoustic fish stock assessment programme; and an ongoing industry consultation process relating to management issues in the southern Indian Ocean.

3.3.11. Mapping and characterizing deep-sea habitats in the United States exclusive economic zone and how this science data have influenced management decisions

Alan Leonardi, Director of the NOAA Office of Ocean Exploration and Research, presented on United States (USA) efforts to explore, map, and characterize the deep-ocean and shared examples of how these efforts have influenced management decisions. Recognizing the collective future of humanity depends on understanding and sustainably managing ocean uses, the USA National Oceanic and Atmospheric Administration (NOAA) has undertaken systematic exploration of the deepwater habitats to better understand what exists in ocean areas under USA jurisdiction and which may be subject to ecosystem-based management and protection. NOAA's Office of Ocean Exploration and Research (OER) works with partners and stakeholders to explore the ocean to fill gaps in the basic understanding of the USA deep waters and seafloor to sustain and accelerate the economy, health, and security of the nation. OER and its partners—government and nongovernment, domestic and international—work collaboratively to establish exploration priorities and jointly undertake the expeditions. All OER data are in the public domain and available through relevant archives and national repositories. Several examples demonstrated how resource managers have been an active part of the effort and how the data have been used to revise fisheries management plans and regulations, extend the boundaries of existing marine protected areas, and establish new marine protected areas.

3.3.12. Theme 2 discussion

The meeting highlighted the importance of environmental impact assessments before new or exploratory fisheries are undertaken to avoid irreversible damage to the marine environment. It was noted that RFMO/As have strict exploratory fisheries protocols. These include pre-assessments that must be submitted to Scientific Committees. These include information on the fishery, its timing, number of vessels, gear, and by-catch, among others. Approved fisheries are closely monitored, usually with a requirement to carry fisheries observers.

The meeting noted the importance of mapping benthic habitats to understand VME distributions and inform management decisions. The potential to use DNA to understand fish stock distributions was also noted.

In terms of valuation, it was noted that abiotic resources, such as oil and minerals, are the major economic drivers for deep-sea resources. The value of the oceans as a carbon sink is undervalued in monetary terms. The oceans currently take up approximately one third of the carbon produced by humans and play an important role in mitigating climate change.

The meeting noted the importance of marine biodiversity to chemical diversity and the development of pharmaceuticals. The importance of marine-based pharmaceuticals is likely to increase in the future, however introducing new marine-based products on the market remains a challenge and is time consuming due to regulatory requirements.

The meeting recognized the opportunities to use commercial fishing vessels to collect scientific information, however also noted the high costs of operating these vessels.

3.4. Theme 3: deep-sea management

Darius Campbell (NEAFC) and Steve Fletcher (University of Plymouth) co-chaired the third themed session on deep-sea management, which aimed to highlight how the policies and research showcased under the previous two themes are used for the management of ABNJ resources and the implementation of ABNJ governance and policy. In doing so, the session aimed to answer questions on: How does science support fisheries management and biodiversity conservation? How does the fisheries sector manage their impact on biodiversity?

3.4.1 *The Commission for the Conservation of Antarctic Marine Living Resources and fisheries measures*

David Agnew, Executive Secretary of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) presented on the organization and its mandate for fisheries within its convention area.

Early history

The early history of the toothfish fishery, and the development of IUU fishing, has been described in detail by multiple authors (Agnew, 2000) (Miller, et al., 2010) (Österblom & Sumaila, 2011). To summarise, toothfish (*Dissostichus eleginoides* in the sub-antarctic and *D. mawsoni* in the high Antarctic) had been known from the late 1970s in research and trawl fisheries conducted principally by the Soviet Union, and was recorded from the Atlantic (Subareas 48.2 and 48.3) and Indian (Subareas 58.5 and 58.6) sectors. However, whilst the species uses shelf areas in its juvenile phases it is primarily pelagic in these phases, and only develops a significant demerso-pelagic lifestyle when it moves offshore onto the shelf slope (500-2000 m). Therefore, it was not detected in significant quantities until the Soviet Union started longlining in 1989 and by the mid 1990s, 3 000 tonnes/year was being taken in Subarea 48.3 (South Georgia) by a fleet comprising Argentine, Bulgarian, Chilean, Korean, Russian and Ukrainian vessels and up to 5 000 tonnes/year from Subarea 58.5.1 (Kerguelen Is). This immediately attracted a fleet of unregistered vessels, mostly flagged to and operating from South America. Increased surveillance in this area, and several high-profile arrests, together with a growing knowledge of toothfish distribution, forced the IUU fleet to move, apparently in only a few months at the end of 1995, to the Indian ocean sector. Here they met much lower levels of surveillance and are estimated to have taken a record 33 000 tonnes in one year, principally from Subarea 58.7 (Prince Edward Island).

In the early 1990s, CCAMLR had implemented very few of the elements of an effective compliance regime, although the international inspection system was agreed in 1988. CCAMLR actions against IUU included actions by individual states having jurisdiction over sub-Antarctic waters, the NCP IUU conservation measure (prohibiting contracting parties from allowing access to port for Non-Contracting Party vessels which had been sighted fishing in the Convention Area) and the measure requiring all CP vessels to be licenced (noting that a significant number of CP vessels were engaged in the early IUU fishery). The Catch Document Scheme (CDS) was agreed in 1999 and, together with several other compliance tools (including IUU list of CP vessels and actions against nationals) started to restrict availability of IUU fishing opportunities, and access to markets, for a number of the IUU vessels. These national and international governmental actions were complemented by NGO and legal industry activities. For instance, the Tasmanian Conservation Trust set up a monitoring operation with financial assistance from licensed toothfish fishers and the Australian Government (ISOFISH, the 'International Southern Oceans Longline Fisheries Information Clearing House).

Recent developments

These actions were sufficient to remove most of the “low hanging fruit” IUU operators, and forced the others to seek new markets and trade routes. But in 1999/2000 the estimates of IUU fishing started to rise again. This time the activity was focussed on the northern Indian Ocean areas, principally around Kerguelen Island, Heard Island and the banks to the south of them.

A new measure requiring CPs to take action against nationals involved in IUU fishing was necessary, since surveillance efforts at this time detected several persistent individuals and companies operating numbers of vessels with an expectation in the business model that they would be arrested and removed from the fleet. National actions, particularly by France, Australia and South Africa were stepped up, using international surveillance networks and, around Kerguelen, the installation of a SAR receiving base station allowing real time detection of IUU vessels in that area. NGO and industry activity continued, and most recently has resulted some high-profile activity by Sea Shepherd in the Antarctic. Again, the most significant actions up to about the mid-2000s were to address the bulk of IUU activity occurring in the productive waters under national jurisdiction in the Indian Ocean.

At an international level, throughout the 2000s and to the present, CCAMLR has identified States either involved in the toothfish fishery or the toothfish trade, and written to them asking them to desist or to cooperate with the CDS. These actions were codified for implementation through a Policy to Enhance Cooperation between CCAMLR and NCPs (1999). It has had some success in raising the profile of IUU activities by states who might otherwise not know that their flag was being used for such activities, but had limited success in bringing more NCPs to engage with the CDS (so far only Seychelles, Singapore and Ecuador).

Finally, the CDS, previously only available in paper form and subject to fraud, was converted to an electronic format in 2004. In addition to tightening up the operation of the CDS, this has also allowed CCAMLR to track the destination of all toothfish and to identify those NCPs that are receiving or trading in toothfish. For instance, it has allowed CCAMLR to recognise Vietnam as a significant NCP importing toothfish, and to seek more specific cooperation from Vietnam in doing so.

Conclusion

Fishing is an economic activity, and all the actions that CCAMLR and other parties took to combat IUU in the Southern Ocean had the effect of making it more difficult, and costly, to operate. The high value of the resource (up to 25 USD/kg FOB), the low cost of fishing (toothfish longline/gillnetters are relatively small with low crew sizes) and the remoteness of the high seas areas of the Southern Ocean has contributed to its persistence. Nevertheless, the actions taken have resulted in a reduction in IUU fishing and a maintenance of all toothfish stocks at sustainable levels. The four largest fisheries (South Georgia, Heard and MacDonal Islands, Kerguelen Island, Ross Sea) all carry MSC certificates.

Osterblom and Bodin (2012) analysed the activities and contributions of 117 organisations over the 20 years of CCAMLR’s fight against IUU fishing and concluded that although there were hugely significant actions by a large number of agencies one key element was the presence of a central agency for coordinating responses and collating and compiling consistent data. This central role continues to be taken by CCAMLR, and in particular the Secretariat, and although fishing has now moved significantly further south – and away from waters in which there is any national jurisdiction – the level of IUU fishing has continued to decline over the last 10 years.

3.4.2 A review of Ecosystem Approach to Fisheries application in the areas beyond national jurisdiction

Rick Fletcher (FAO consultant) presented on an activity of the ABNJ Deep Seas Project that undertook a review of the application of the FAO ecosystem approach to fisheries (EAF) management within the ABNJ.

The United Nation's Food and Agriculture Organisation (FAO) Ecosystem Approach to Fisheries (EAF) management framework was adopted at COFI 25 in 2003 as the appropriate approach to implement in a practical manner, the principles of sustainable development, the Convention on Biological Diversity and the Code of Conduct for Responsible Fisheries. EAF therefore not only deals with all the ecological consequences of fishing, but it also explicitly deals with the social and economic implications (good and bad) generated by the management and institutional arrangements related to fisheries. While it is a tool to improve all fishery management processes by adopting risk management principles, many still think that EAF only deals with the ecological effects of fishing operations.

In 2017, the ABNJ Deep Sea Project Steering Committee agreed to undertake a regional overview and document the various approaches taken in the different ANBJ regions in relation to implementation of the EAF management framework. The project was to: (1) Undertake a desktop review of the application of the ecosystem approach within each ABNJ; (2) Based on the extent of EAF implementation, make recommendations on activities to strengthen EAF within deep-sea RFMO/As (CCAMLR, GFCM, NAFO, NEAFC, NPFC, SIOFA, SEAFO and SPRFMO) and/or their members. Importantly, this was not an assessment of whether the RFMO/A was meeting its convention/agreement. The audit involved assessing each of the 13 key EAF components using a number of standard questions that focused on the degree to which there has been consideration of each of the EAF principles of:

Ecological Wellbeing: Retained Species, Non-Retained (trash) Species, 'Special' Species; Direct Ecosystem Effects, Indirect Ecosystem Effects, Climate Drivers.

Human Wellbeing: Vessel/Industry Level, Community Level, National (Contracting Party) Level.

Ability to Achieve: Legal and Administration, Management Systems, Compliance, Reporting and Review, Non-Environmental External Drivers.

To simplify the audit process, an EAF background report covering each of the criteria was generated for each RFMO/A using material obtained from web-based sources. From this report, a gap analysis was undertaken that assessed the degree to which the overall systems of management within the ABNJ were compliant with EAF. The draft background reports and draft audits were sent to the relevant RFMO/A secretariats for their comments and suggestions.

The level of EAF implementation varied among RFMO/As and among different components of EAF. Many differences among RFMO/As were associated with the time since the formation of their management body/convention/agreement. In addition, a number of common themes were identified across the RFMO/As (Figure 5).

Most RFMO/As have strong legal and administrative structures plus relatively effective compliance systems. Depending upon time since formation, they have also addressed, or are addressing, the ecological impacts of fishing related to target species, benthic habitat (generally referred to as Vulnerable Marine Ecosystems [VMEs]) and bycatch issues to relatively high levels. The assessment and management of cumulative impacts of fishing and impacts of environmental external drivers (e.g. climate) are also now generally in progress. This is despite the inherent logistic difficulties studying within these remote areas.

The largest EAF gaps identified were the formal consideration of social and economic issues at both the vessel level and at the national/contracting party level, and the impact of non-environmental external

drivers. Importantly, there are no objectives for these EAF components within most RFMO/As and generally no formal processes for their consideration in decision-making.

These gaps are likely to be a consequence of the clear priority focus within most RFMO/As to deal with the ecological and compliance issues. Nonetheless, despite being fundamental to Sustainable Development and CCRF principles, the lack of formal consideration of social and economic risks is common for fisheries management within most jurisdictions.

By undertaking a full participatory EAF process for each RFMO/A, this would generate a clear basis for why each of the EAF issues associated with the fishing activities either do, or do not, require direct management, plus the level and type of actions that are required. Such assessments and their associated justifications ensure only the correct priorities are being addressed, and at an appropriate level. This assists with overall efficiency of governance but moreover provides robust justifications about the appropriateness of these management arrangements to external parties.

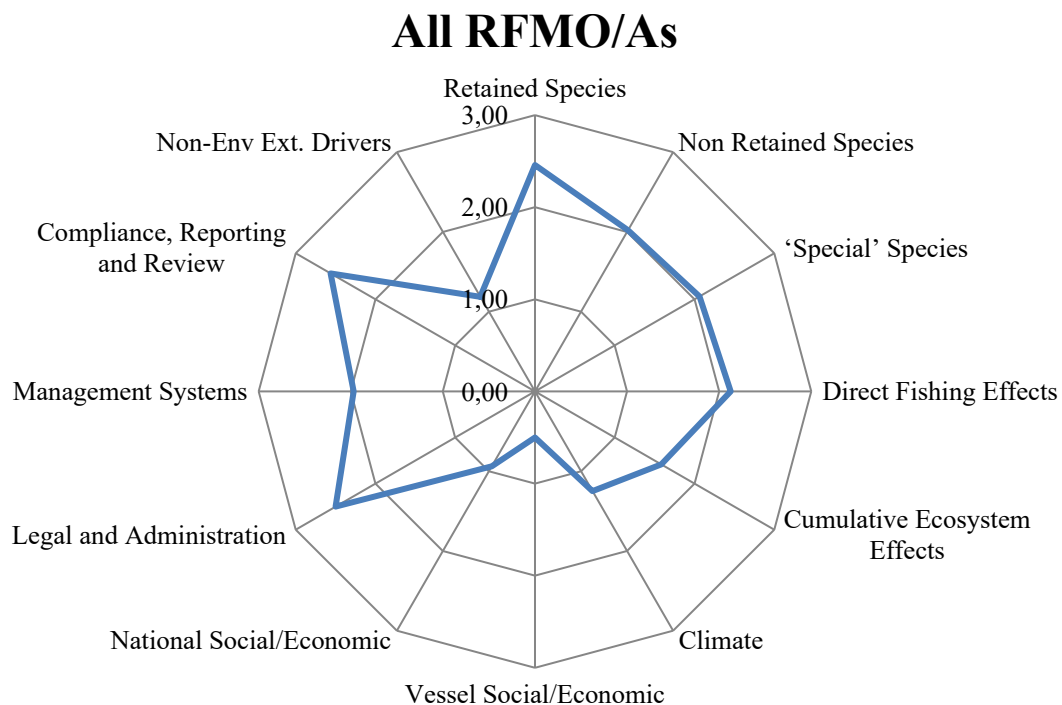


Figure 5. Average level of implementation for each EAF Category across the eight ABNJs. The scores for each EAF component are - nil (0), partly (1), mostly (2), mostly/fully (2.5), or fully addressed (3).

3.4.3 Science needed to support deep-sea fisheries management: the case of the Northwest Atlantic Fisheries Organization

Javier Murillo (Fisheries and Oceans, Canada) presented on what type of science is needed to support deep-sea fisheries management, providing the case of NAFO as an example. During last years, States and RFMO/As have engaged in a process to protect VMEs, conservation of biodiversity in Areas Beyond National Jurisdiction (BBNJ), and the implementation of precautionary and ecosystem approaches. This process has been motivated through international agreements and UNGA resolutions. The Northwest Atlantic Fisheries Organization (NAFO) is the RFMO responsible for the management

of fisheries resources within the NAFO Convention Area outside coastal states Economic Exclusive Zones (EEZs) in the Northwest Atlantic, that is, the NAFO Regulatory Area (NRA).

NAFO Contracting Parties, such as the European Union (in particular Spain and Portugal) and Canada have annual and seasonal surveys in the NRA. These surveys started decades ago with the main objective of obtaining biomass and abundance indices, population structure and biological data of main commercial fish species to provide advice on fish stock assessments. However, following the progress of fisheries management into ecosystem-based strategies, the general objective of the surveys changed to know the status of resources and changes in the ecosystem, including the study of benthic invertebrates caught from the bottom trawl. Results from these surveys were initially used to implement the UNGA Resolution 61/105, of 2006, and deep-sea coral and sponge catches were identified and their distribution in the NRA mapped (Wareham & Edinger, 2007) (Fuller, et al., 2008) (Fuller, 2011) (Murillo, et al., 2011) (Murillo, et al., 2012). These results allowed the first delineation of seven candidate VME areas and were the baseline information for the international and multidisciplinary NEREIDA (NAFO PotEntial VulneRable Marine Ecosystems. Impacts of Deep-seA fisheries) program (2009–2010), led by Spain and with active participation from Canada, the UK and the Russian Federation.

The NEREIDA program contributed substantially to increase the knowledge of the VMEs in the NRA and allowed the identification of 13 geological units (including canyons and steep flanks) along the ~68,900 km² prospected with multibeam echosounder. Research vessel trawl survey data on deep-sea corals and sponges recorded since 2006 were used to identify significant concentrations of biomass (Kenchington, et al., 2014) and, through the use of species distribution models, continuous surfaces of suitable habitat and the main environmental drivers affecting these distributions were identified (Knudby, et al., 2013) (Knudby, et al., 2013). The combination of all these results, added to the mapping of fishing effort from VMS (Vessel Monitoring System) and historic data, allowed NAFO to identify the VMEs in the NRA (NAFO, 2016) and the closure to bottom fishing activities of six seamount complexes and 14 areas in the NRA (NAFO, 2019). The process of identification and protection of VMEs in the NRA has been one of the most developed elements in the NAFO Roadmap for the development and implementation of an ecosystem approach to fisheries (EAF) in the NAFO Area (Koen-Alonso, et al., 2019). However, a key element of ensuring ecological sustainability and therefore needed to consider in EAF is protection of the functional processes associated with benthic habitat.

A growing number of legislative agreements, including the Convention on Biological Diversity, require management schemes to address the functioning of the ecosystems. EAF requires the integration of ecosystem components, and so requires a multivariate, and multifunction approach. Recent advances in data handling have made this possible and one approach that has been applied with some success is biological trait analysis (BTA). It uses the biological traits of taxa as indicators of key aspects of functioning. BTA can be applied to any taxonomic level and can incorporate indicators of several different aspects of functioning. BTA can also be used to explore the probable causes of observed changes and to investigate shifts in community structures and function. Spatial representation of the relative provision of benthic ecosystem services across a seascape is critical for incorporating ecosystem services into EAF. Through combination of BTA with seabed mapping has been possible to identify areas according to dominant ecological function and relate those to the physical oceanography and geology of the area. Additionally, large scale functional maps showing the distribution of organisms with particular biological traits (e.g. filter feeders, structure-forming, etc.) have been produced. These maps can be used to estimate significant adverse impacts of fishing activities on benthic habitats and be incorporated into the NAFO Roadmap as part of the assessment of ecosystem state and sustainability.

3.4.4 Economic incentives and rights-based management in deep-sea fisheries

Dale Squires (University of California – San Diego) presented on options for economic incentives and rights-based management in deep-sea fisheries in the ABNJ. Why are property rights and rights-based management important for management of deep-sea fisheries in Areas Beyond National Jurisdiction?

Property rights (secure entitlements) are important determinants of economic incentives, and in turn economic incentives are major determinants of the behaviour and decision-making of States and vessels in fisheries and fisheries management.

Rights-based management can realign State and vessel incentives toward self-interest consistent with collective interest at both the level of States and vessels in fishing operations and toward no longer competing for a share of the available resource before another party can take it. Vessels no longer face incentives for the “race-to-fish” and “race-to-invest” of open access in the absence of property rights. Without secure access to a resource, vessels compete wastefully with each other for a share of a common resource. Under rights-based management, economic efficiency should increase so that vessel profits increase and economic rent to the fishery, as a whole, increases. At the level of States, through their RFMOs, have the legal authority to develop and implement rights-based management. Individual States must enact enabling laws and legislation for their vessels.

History shows that adoption of rights-based institutions tends to come late in resource use when the costs of both open access and centralized direct regulation are high but uncertainty has been cleared away. However, even when fisheries or some species-stocks and ecosystems have not yet reached the overfished and overcapitalized “Tragedy of the Commons” state because of open access to the fishery, global experience shows that these conditions inevitably grow in importance and that planning ahead can pay valuable dividends. Developing a management regime that anticipates these issues is far easier than attempting to address them after they have arisen. Management solutions are more difficult to achieve in an overcapitalized, overexploited, and/or over-degraded fishery that may even require difficult-to-achieve rebuilding or extended time-area closures. Moreover, allocations of fishing opportunities, and entry into, the fishery are especially contentious during such conditions.

Two fundamental and interacting issues in establishing property rights in high seas deep-sea fisheries are exclusion from the RFMO-regulated fishery and allocation of rights among CPCs. The right to fish on the high seas is fundamental to the difficulty in establishing exclusion and hence strong property rights. Allocation entails distributing opportunities and wealth, and creates distributive gains and losses. Allocations may not be permanent due to changing conditions in markets and the environment and new entrants, requiring a periodic revision.

Rights-based management in international fisheries is more challenging than in domestic fisheries because of the requirement to achieve multilateral cooperation through voluntary and self-enforcing RFMO/As and the presence of two interacting and inter-dependent rights, the sovereign right held by States licensing fishing and the entitlement to catch/effort/capacity/habitat impact.

Rights-based management in deep-sea fisheries in the ABNJ can be especially important for sustainable resource use and minimizing adverse environmental impacts, especially benthic habitats with trawling, due to the slow-growing and low productivity resource, often episodic recruitment, vulnerable habitats, and “patchy” distribution of many ABNJ fishing grounds on seamounts.

Without secure rights and open-access “race-to-fish” incentives, economic incentives can incentivize vessels to harvest at unsustainable rates (“mine the resource”), especially since global pulse fishing is now longer feasible. Vessels can also be incentivized to bottom fish in ways that are not respectful and consistent with the vulnerable bottom habitat due to the open-access incentives. The net economic benefits to the individual vessel simply do not incentivize fully sustainable fishing. Rights-based management under these conditions, coupled with the limited number of homogenous vessels in many deep-sea fisheries in the ABNJ, also incentivizes more cooperative behaviour and decision-making among both vessels and CPCs. Such cooperative behaviour includes information sharing and even extending to applied Research and Development to gain scientific information and methods to reduce adverse environmental impacts. Such cooperative behaviour further spreads risk and uncertainty, lowers costs, and allows operators to enjoy the full benefits of conservation and sustainable harvesting, without free-riding by others.

Transferable credit systems form a potential alternative to rights-based management. Transferable credit systems, while similar to rights-based management as a cap-and-trade system, are simply direct regulation made flexible by allowing credits -- unused quotas or limits -- to be transferred from one party to another party without a need for additional quota or limits. Quotas, limits, and credits are established by direct regulation and are thus not a property right. They provide many of the advantages, but not the full advantages and economic efficiency, of property rights, but are easier to implement and are more compatible with freedom of entry.

A key distinction between rights-based management and a credit system is that the property right is both owned and tradable, whether actually used all or in part. A credit from a quota or limit only pertains to the unused portion of the quota/limit and does not entail a right to the credit or the residual catch/effort/capacity/habitat impact covered by the quota/limit. Transferable credits from quotas/limits are complementary to direct regulation and not a substitute, whereas rights-based management is a clear-cut substitute for direct regulation.

A rudimentary credit at the national level already exists in some deep-water RFMO/As through trading between CPCs of unused national allocations of Total Allowable Catch, which are simply aggregate or industry-level quotas established under direct regulation. Such aggregate credit systems can be extended to the individual company or vessel level. Because credit systems are not property rights but instead simply direct regulation made flexible, they create weaker economic incentives, but may be easier to implement in international fisheries.

Transferable habitat impact quotas provide an additional incentive-based conservation and management measure for addressing ecosystem impacts of fishing. These can be developed through either a property right or a credit system. A Total Allowable Habitat Impact (TAHI) is established, where habitat or ecosystem impact is measured by a proxy variable such as area fished. The TAHI is then allocated to Contracting Parties to the Convention (CPC)s and then to companies or vessels. These individual allocations, individual transferable impact rights or credits (unused quotas or limits under direct regulation) can be transferred among CPCs, companies, and vessels, much like the more familiar transferable catch or effort rights or quotas/limits. The experience of the British Columbia deep-sea trawl fishery shows that transferable habitat impact quotas not only works, but can even reduce the footprint below the TAHI.

The report concludes with a more speculative discussion of norms, allocations, and entry into the fishery. Economic and other barriers to entry, norms, the number and degree of homogeneity of the CPCs and vessels, , and relatively stable resource stocks and their locations may, under certain combinations of these elements, set the stage for some form of rights-based management or more extensive use of credit-based management even under the free entry into the fishery allowed by international law. Economic and other barriers to entry into a fishery and norms within and across RFMOs can reinforce credit- or rights-based management and may lessen free-riding on existing States' conservation efforts. Economic and other barriers to entry, which limit free entry into the fishery and allow for exclusive use of a credit or right, can also shape and reinforce norms that develop over time.

3.4.5 Existing spatial measures in fisheries: a South Pacific Regional Fisheries Management Organisation case study

Martin Cryer (Fisheries New Zealand) presented on existing spatial measures for fisheries in the ABNJ, and gave the case study of the South Pacific Regional Fisheries Management Organisation (SPRFMO). All regional bodies that manage fisheries in the ABNJ have spatial restrictions of one sort or another that constrain where fishing can and cannot occur. Many bottom fisheries in the ABNJ are now restricted to their historical spatial footprint, but, in addition, two distinct approaches to establishing additional spatial closures are in use. First, spatial measures to protect vulnerable marine ecosystems (VMEs) or biodiversity may be established using deliberative processes where a "case" for a closure is

presented to the organisation's scientific committee (or equivalent body) which then advises the decision-making body. The level of scientific support for such processes varies, but the process is largely planned and the closures are mostly quite large and relatively enduring. A second process relies on the VME encounter protocols that all regional bodies have implemented in response to UNGA resolution 61/105. If a vessel catches a weight of VME taxa higher than a given threshold (corals and sponges are the most commonly used in such protocols), then the encounter must be reported and fishing must cease in the area. These closures are generally small (often just 1 or 2 miles around the encounter location), occur sporadically, and may remain in place for only one or a few years.

SPRFMO was established in August 2012 to manage non-highly migratory fisheries in the South Pacific. Bottom fisheries are currently conducted only by New Zealand and Australia. Until March 2019, these bottom fisheries were subject to relatively non-prescriptive management measures that permitted each flag state to interpret the requirements and control their flagged vessels to deliver the required outcomes. This "interim" approach led to Australia and New Zealand having different approaches to catch limitation, different (but overlapping) areas open to trawl and line fishing methods, different approaches to spatial closures within historical footprints, and different VME encounter protocols and move-on rules. These different implementations of the measures were confusing and occasionally incompatible or antagonistic (e.g., some areas within the shared historical footprint were open to fishing by Australian vessels but closed to New Zealand vessels).

Since 2013, therefore, New Zealand and Australia have been working on a more integrated bottom fishing measure for SPRFMO that includes spatial management measures to prevent significant adverse impacts on VMEs. The measure was adopted by the SPRFMO Commission in January 2019 and will apply equally to all bottom fishing vessels. A formal spatial planning approach was selected to design the spatial measures and the decision support software tool Zonation (Lehtomäki & Moilanen, 2013) was used to integrate available information, provide a focus for stakeholder engagement and discussions, and to quantify the costs and benefits of candidate spatial measures.

Initial technical exploration of the utility of spatial decision-support tools for high seas fisheries and conservation problems (Rowden, et al., 2019) and development of models to predict the distribution of key VME indicator species (Georgian, et al., 2019) occurred between 2013 and 2017. There was periodic discussion and engagement with stakeholders from the New Zealand fishing industry, environmental organisations (eNGOs) and New Zealand high seas fisheries management agencies during this period, and updates to SPRFMO's Scientific Committee started in 2014, but most discussions at this time were technical.

In 2017 and 2018, seven full-day stakeholder workshops were convened in a more formal process to implement the spatial planning approach. Stakeholders included the New Zealand and Australian fishing industries, environmental organisations (eNGOs), and scientists and officials from both New Zealand and Australian high seas fisheries policy and management agencies. The process was somewhat iterative but the key steps are described below.

Bearing in mind the obligations inherent in the UNGA resolutions, the FAO Deep Sea Fisheries Guidelines, and the SPRFMO convention text, stakeholders were invited to identify explicit objectives for spatial management. This is an important step because it allows the calculation of relevant performance metrics for any candidate set of spatial measures. The summarised objectives were as follows:

- Access, in a practical way, to as much economically productive fishing ground as possible;
- Provides a management approach that industry can confidently promote as sustainable;
- UNGA resolutions and SPRFMO Convention implemented, including closing areas to trawling where VMEs are likely to occur (unless managed to avoid SAIs);
- Impacts on VMEs to be minimised; and
- Management measures that are easily-understood, practical, enforceable, and without unnecessary complexity and cost.

Stakeholders, including fisheries managers, were also engaged in processes to decide on some of the important settings in the analyses and reporting metrics, subject to the requirement inherent in the UNGA resolutions and other guiding documents to include all VME indicator species for which sufficient information was available to build habitat suitability models (Georgian, et al., 2019). In particular, stakeholders agreed that the analyses should be conducted at a fine scale (1 km² cells) so the design of management areas could be done with as much understanding as possible of the likely consequences for VMEs and fishing. Analyses could be done at a coarser scale or the software could have been configured to aggregate priority cells for conservation or fishing, but these options were not used. Input layers for the analyses included:

- ensemble habitat suitability models (incorporating boosted regression tree, maximum entropy, and random forest models) for ten VME taxa:
- four species of matrix-forming stony corals, two classes of sponges, and four other structure-forming VME indicator species as identified by Parker et al. (2009);
- estimated “naturalness” of VME taxa in each cell, based on previous fishing history; cells fished more frequently were estimated to be in a less natural state;
- estimated value of each cell for the fishing industry; after some iterations, the industry decided that the accumulated value of all catch since the start of the fishery in a cell was a reasonable index of the value of that cell, so long as the value layer was modified to take account of the need for “run ups” to trawl lines.

Zonation calculated the priority for protection (from 0 to 1) of each cell given the biological data layers, the likely cost to the industry of closing any given area to fishing, and the software settings, whether decided technically or by stakeholders/managers. The most important metrics calculated by Zonation and used by stakeholders to assess candidate spatial management areas were the proportion of the entire estimated distribution of each VME taxon not exposed to fishing and the cost to the industry in terms of loss of access to space they valued. These metrics were calculated at a range of spatial scales from the whole of the southwest Pacific Ocean to smaller ecological or fisheries management sub-areas.

Using maps of Zonation’s estimated priority for conservation, individual trawl tow lines, and value to the fishing industry, officials used an iterative process of automated GIS searches and manual boundary adjustments to design a candidate set of areas open to fishing that protected a high proportion of the distribution of all VME taxa at relatively low cost to the fishing industry and had simple orthogonal boundaries. This “first cut” was then discussed with stakeholders and fine-tuned over several meetings and rounds of written consultation. The main issues raised by stakeholders and addressed by changes to the boundaries, were the need for areas open to fishing be large enough for realistic “run ups” to trawl lines on seamounts and other features, and the eNGO’s desire for higher protection of VMEs, especially within the northern parts of the Louisville Seamount Chain (because this area has been designated as an Ecologically or Biologically Significant Area (EBSA) 17). The final spatial management areas agreed by the SPRFMO Commission in January 2019 constitute the only areas within the southwest Pacific Ocean where bottom fishing can occur, other than under exploratory fishing protocols which carry additional impact assessment steps.

The new spatial management regime codified in SPRFMO’s CMM-03-2019 protects a substantially higher proportion of the distribution of VME taxa than the interim regime (84 percent compared with 65 percent) at a slightly lower cost to the fishing industry in terms of lost access to space they value (7.9 percent lost compared with 8.7 percent). There are regional variations in these percentages, and variations between VME taxa, but at least 70 percent of the distribution of VME taxa is protected in all ecological bioregions (including EBSA 17) and fishery spatial units considered.

These gains were achieved through a long and resource-intensive process. The science underpinning the process took several years and was difficult and expensive; the data are sparse, and the species distribution modelling approaches are still developing. However, we found spatial decision-support tools like Zonation to be extremely useful for integrating that hard-won information and explicitly weighing up different objectives. The process is not robotic because the software provides multiple possible approaches and lots of calls need to be made, not all of which are technical. Multiple discussions, workshops, consultation as well as technical forums are required because it takes a long time to get the confidence and buy-in of stakeholders in the software and in the processes being used. In the end, complete agreement between stakeholders is unlikely, but engagement processes like those described here allow stakeholders to voice their objectives, be involved in and understand the analyses being done, and make trade-offs between different or opposing objectives explicit for decision-makers and stakeholders alike.

3.4.6 Using marine spatial planning in the areas beyond national jurisdiction

To support the conservation and sustainable use of deep-sea biodiversity and resources, the ABNJ Deep Seas Project developed a framework for cross-sectoral area-based planning in the ABNJ. To develop the framework, UNEP-WCMC conducted a number of studies to: (i) review the applicability of area-based planning tools in ABNJ; (ii) gather experiences and good practices from other regions; and (iii) review the relevant governance arrangements and sectoral mandates in the ABNJ. The key result from these studies suggest marine spatial planning as a plausible framework through which cross-sectoral area-based planning could be undertaken in ABNJ.

Increasing regional knowledge, awareness, and capacity related to the ABNJ in the Regional Seas Secretariats in the South East Pacific and the Western Indian Ocean was one of the key objectives of the ABNJ Deep Seas Project. To date, six regional workshops have been held to facilitate knowledge exchange and capacity building to undertake area-based planning in the ABNJ. The two Regions were closely involved in the development and testing of the framework through a series of regional, multi-stakeholder workshops. In addition, the framework went through a thorough review process with member States from the two Pilot Regions, regional stakeholders, sectoral representatives and area-based planning experts.

The Project has contributed towards improved understanding of the characteristics of ABNJ and activities occurring in the region; developed area-based planning knowledge to help member countries understand what area-based planning could mean in the context of their region, and in light of the ongoing potential future BBNJ negotiations under UNCLOS; and enhanced capacity for engagement in area-based planning processes and help to explore what area-based planning could look like in the region. The marine spatial planning framework that is being developed will help make the concept of cross-sectoral planning tangible and allow discussions on what it means.

3.4.7 Ecologically or Biologically Significant Marine Areas: an area-based planning tool to inform non-fisheries area-based management in the areas beyond national jurisdiction

David Johnson (Global Ocean Biodiversity Initiative) presented on Ecologically or Biologically Significant Marine Areas (EBSAs) and their role as an area-based planning tool to inform non-fisheries area-based management in the ABNJ. He emphasized that it was important to continue to build scientific credibility and transparency for this process. The decade-long Census of Marine Life made a significant contribution to gathering biodiversity data for the deep-sea: describing ocean life, its diversity, distribution and abundance. CBD Aichi Target 11 to protect 10 percent of marine areas by 2020 is likely achievable for national jurisdictions but not for the ABNJ. The OSPAR Commission, CCAMLR and the Mediterranean Action Plan efforts to designate High Seas MPAs are an exception:

the majority of the High Seas remain unprotected. Furthermore, a large number of ‘strongly protected’ areas in national jurisdiction’s deep-sea are not actively protected but are primarily protected by isolation.

EBSAs reflect a synthesis of best available scientific and technical information that has informed expert scientific judgment to describe areas that meet one or more of the EBSA criteria (agreed in 2008 at CBD COP9). To date there have been 14 regional EBSA workshops. Of the 321 EBSAs described by these workshops, 10.3 percent are solely in the ABNJ and 22.3 percent have some or all areas in the ABNJ. Emphasis has also been given to classifying types of EBSAs (static features, groups of features, ephemeral features, dynamic features) helping to add precision to boundary interpretation and to better understand tools and technologies needed to monitor and manage these areas.

Johnson et al. (2018) have reviewed the EBSA process. Overall it represents a very successful cooperative effort. However, gaps exist where data was not available or where for whatever reason likely significant areas have not (yet) been considered in the process. Future workshops might draw upon regional/global thematic taxa and feature analysis. The Global Ocean Biodiversity Initiative, funded by the German International Climate Initiative, has sought to add such data, for example, highlighting seabird tracking data, International Bird Areas and International Marine Mammal Areas, as well as possible nodes for migratory connectivity. Climate change and ocean acidification are also major drivers to consider when reviewing the EBSA portfolio. The EU-ATLAS Project has looked at impacts of climate change in the North Atlantic, including changing current circulation patterns, that will influence area-based planning. Johnson and Kenchington (2019) suggest climate change refugia should be mainstreamed into the criteria for describing EBSAs.

Extending marine spatial planning (MSP) to ABNJ is a challenge. MSP is a cross-sectoral tool, using best available data, ensuring co-existence of relevant activities and uses, and promoting transboundary cooperation. Several national studies (e.g. GPS Azores) have developed scenario methodologies that might be useful for ABNJ. However, in ABNJ there is no overall competent authority. Rather, area-based planning relies on different sectoral authorities. Stakeholder interests are also very different, including those of adjacent States, sectoral competencies, and civil society. Scale is also a key issue and it may be more pragmatic to envision a sea-basin scale plan.

Prof Johnson then presented a series of examples of where EBSAs had informed sectoral initiatives and selected applications of EBSAs in specific locations such as Sargasso Sea and the Costa Rica Thermal Dome. He suggested that the UN Decade of Ocean Science for Sustainable Development could help support the post 2020 Biodiversity Framework. The EBSA process has facilitated scientific collaboration and capacity building at a regional scale; contributed to existing regional and national marine conservation efforts; and provides an important starting point for future long-term systematic assessment in ABNJ, plus a potential focus for MSP.

3.4.8 Visualizing data from different sectors in the areas beyond national jurisdiction

Miles Macmillan-Lawler (GRID-Arendal) presented on future work under the ABNJ Deep Seas Project. The aim of this work is to create a prototype of a user-friendly web platform that brings together information (e.g. on regulations and management measures, human uses, plans/projects, and the environment) from across all sectors active in the ABNJ. It will serve to highlight the existing management measures in the ABNJ and to increase the visibility of potential interactions between sectors for managers active in sectoral management bodies. The platform will also include key biodiversity data to indicate which ecosystems exist in the ABNJ, and highlighting areas identified for biodiversity importance, such as EBSAs.

The development of the platform will be based on information provided by its intended users (ABNJ managers). Interviews at the start of the work will aim to establish what their practical information access and sharing needs are, and what kind of platform they would find genuinely helpful and practical. The prototype platform will be developed to address these needs. The platform is intended to be accessible and intuitive for managers and decision-makers, including those without a technical background. It will, therefore, not be a technical portal or web GIS that aims to visualize or provide for download spatial data used by GIS technicians, scientific advisors, and data experts. Where appropriate, it will link to existing relevant GIS portals, metadata catalogues and information repositories rather than duplicating them.

The platform will be a prototype, i.e. a ‘proof of concept’, rather than a fully developed tool at this stage, based on the short time frame of the Project. It will serve as an illustrative prototype that might address those needs, so that further development under GEF 7 (if appropriate) would be starting from a working baseline. Such future work would need to go through another iteration of end-user testing and feedback, and include efforts to build a critical mass of platform users, as well as a long-term mechanism for maintaining the platform both in terms of technical support and in terms of updating its content as relevant.

3.4.9 Theme 3 discussions

The participants discussed the Ecologically or Biologically Significant Marine Areas (EBSAs) process lead by the Convention on Biological Diversity (CBD) and the reasons for only covering biodiversity and not including fisheries. It was explained that it could be part of the exercise, but it is already identifying major features of the ocean, which attracts fisheries. The RFMO/As have been involved for example by sharing data. In the regional implementation of the EBSAs, there is an effort to combine the fisheries sector with the biodiversity concern.

4. HORIZON 2020 DEEP-SEA SPONGES PROJECT

The plenary was presented with scientific research on deep-sea sponges and introduced to an economic valuation methodology. Claus Hagebro (FAO) facilitated for the speakers Andy Davis (University of Rhode Island), Ana Riesgo (Natural History Museum), Ellen Kenchington (DFO), and Daniela Ottaviani (FAO).

It was noted that sponges are the most important organism to support pharmaceutical innovations. In addition, deep-sea sponges occur close to important commercial fishing grounds. The ecosystem services are interlinked so if sponge grounds are damaged there will be trade-offs.

The participants discussed whether there is a risk to put a value on sponges - it would be tempting for the markets - but it might imply that the sponges are not given their true value. On the other hand, if, for example, there is a value for a resource it can be added into an environmental economic system and it is more likely to be accounted for by managers.

4.1. The utility of species distribution modelling for data-poor regions and species: case study of deep-sea sponges

Andrew Davies (University of Rhode Island) presented on the utility of species distribution modelling for data-poor regions and species, the particular case of deep-sea sponges. For much of the global ocean,

and particularly the deep sea, the fundamental question of where are marine organisms, how abundant they are, and how many species there are in a given area is poorly resolved or entirely unanswered. This poses a substantial challenge for governments, managers and conservation agencies, who face an increased demand for access to marine resources. Given the logistical constraints of deep-sea exploration, marine species distribution modelling (MSDM) is becoming a widely used tool in many data-poor regions and for species around the world. Using existing data sources, these empirical approaches can predict species distributions in areas that are yet to be surveyed, and also provide a wealth of information about species niches and habitat specificity. Output data can contribute to spatial management planning, refine understanding of species responses to change and guide targeted surveys. In this paper, we present the current state of MSDMs in the deep ocean and discuss the challenges that MSDM practitioners face when developing models for specific purposes. We present potential solutions and highlight a community-driven web portal that aims to improve sharing of high-quality data amongst scientists, leading to improved transparency, reproducibility and confidence in the study of deep-sea species distributions.

4.2. Genetic diversity and connectivity in deep-sea sponges of the North Atlantic: connecting organisms with conservation strategies

Ana Riesgo (Natural History Museum of London) presented on genetic diversity and connectivity in deep-sea sponges of the North Atlantic. Fan-shaped sponges are conspicuous and diverse organisms of deep-sea sponge grounds in the North Atlantic with a wide range of ecosystem services. Their taxonomy is difficult given the great similarities of their morphological features even in distantly related species, hindering their identification and therefore monitoring in ecosystem surveys with conservation aims. Connectivity is a vital demographic process underpinning the persistence and productivity of populations, relying on recruitment and migration processes to maintain a pool of genetic diversity that sustains resilience and adaptation to environmental shifts. Deep-sea fauna exhibit broad geographic ranges with many species having a putative wide-range or even cosmopolitan distribution, suggesting that deep-sea populations may be ‘open’ and hence lacking in spatial genetic structuring. Here, we assess the phylogenetic relationships, microbiome composition, genetic diversity and connectivity of several Northeast Atlantic species of fan-shaped sponges of the deep-sea using traditional genetic markers (COI and 18S) and ddRADseq-derived single nucleotide polymorphisms (SNPs). Our results on the most abundant species from the deep Cantabrian Sea to the Norwegian fjords, actually indicate a more restricted distribution of three phylogenetically close species of *Phakellia* (*P. robusta*, *P. ventilabrum* and *P. hirondellei*) and two species of *Cymbastela*, with high levels of connectivity between distant areas such as the Rockall Bank and the Cantabrian Sea and species-specific patterns of microbiome composition. In addition, we found geographically restricted molecular oddities that point to specific adaptations of *P. robusta* populations in the Norwegian fjords. Our study will help design areas essential for the conservation of sponge grounds in the North Atlantic based on the connectivity patterns observed in their keystone species.

4.3. The importance of sponge grounds in enhancing diversity of associated epibenthic megafaunal communities in the deep-sea

Ellen Kenchington (Fisheries and Oceans Canada) presented on the importance of sponge grounds in enhancing diversity of associated epibenthic megafaunal communities in the deep-sea. The association between biodiversity and sponge grounds was highlighted in the 2006 United Nations General Assembly Resolution 61/105, which specifically lists sponge grounds as vulnerable to fishing activities and calls for their protection. Yet, despite biodiversity conservation being one of the rationales behind this call, only a few studies have examined the biodiversity associated with sponge grounds, and even fewer have reported on the influence of species composition and sponge morphology in the provision

of habitat. Through the analysis of benthic photographic transects, we examined the biodiversity of epibenthic megafauna associated with three different sponge ground ecosystems in the northwest Atlantic: the monospecific sponge grounds off Nova Scotia, Canada formed by the glass sponge *Vazella pourtalesi*, the tetractinellid sponge grounds of the Sackville Spur, Flemish Cap, and the mixed-species sponge grounds of the Flemish Pass. Using various modelling approaches we statistically examined the importance of these sponge grounds enhancing the diversity and abundance of associated epibenthic megafauna communities. Our results indicate that the megafaunal assemblages associated with these sponge ground ecosystems were significantly different in composition compared to areas outside the sponge grounds, with brittle stars, cnidarians, and other sponges typically being more common inside the sponge habitat. Across all three sponge ground ecosystems, species density and abundance of epibenthic megafauna was up to 3 and 4.2 times higher, respectively, in the presence of sponges when compared to areas absent of these sponges. The use of similar methodologies to survey each sponge ground ecosystem allowed for the first comparison of the diversity between multi- and monospecific sponge grounds, and between large/massive- and barrel/vase-shaped sponge morphologies. The higher diversity noted in the Flemish Cap mixed-species sponge grounds when compared to the Scotian Shelf monospecific sponge grounds was attributed to the wider range of sponge morphologies and the ability to act as settlement for other epifauna in the former. These results provide further evidence of the importance of sponge grounds in shaping community structure and biodiversity of associated deep-sea epibenthic communities.

4.4. Deep-sea sponge ecosystem services valuation

Daniela Ottaviani (FAO consultant) presented on the work done under Work Package 8 on deep-sea sponge ecosystem services valuation, which is a component of the ABNJ ecosystem services valuation work done for the ABNJ Deep Seas Project. The economic valuation of ecosystem services delivered by deep-sea sponges is challenging as deep-sea sponges are located in remote areas, difficult to access and study, far away from human settlements and from most of economic activities; scientific understanding on their biology and ecology is still advancing. Thus, overall the identification of benefits deep-sea sponge provided to human society (i.e. ecosystem services) is not straightforward, neither consequently their valuation in economic terms.

Despite the current challenges and data gaps faced, an economic valuation of ecosystem services allows to express the values associated to different types of ecosystem services in the same monetary currency and this, in turns, helps to understand the trade-offs involved across sectors and stakeholders. Trade-offs among ecosystem services occur mostly when provisioning services are maximized with a detrimental effect on regulating and supporting services. An economic valuation of ecosystem services helps to make these trade-offs explicit.

Future work will be address in an economic valuation of trade-offs occurring in the Flemish Cape area, in the Area Beyond Natural Jurisdiction (ABNJ), located at about 560 km from the coast of Newfoundland and Labrador (Canada). This area represents an important fishing grounds for bottom fisheries. To protect the existing important deep-sea sponge grounds, six fishing closures have been established by the Northwest Atlantic Fisheries Organization (NAFO). The estimated biomass of existing sponges has been estimated to filter 70 million m³ day⁻¹ with an evident role in nutrient cycling and carbon transport. This is an interesting case study in which we would like to compare the economic value associated to bottom fisheries in the Flemish Cape area with economic valuation of regulating services carried out by deep-sea sponges.

5. EAF-NANSEN PROGRAMME

Merete Tandstad, FAO, moderated the special session on the EAF-Nansen Programme, and gave a general overview of its activities in the deep-sea. The EAF-Nansen Programme is the longest running programme at FAO Fisheries Division and performs scientific research that is used for advice and management decision-making, with particular focus on sustainable fisheries and oil, gas and climate change impacts.

5.1. The EAF-Nansen Science Plan and Theme 7

Merete Tandstad, Coordinator of the EAF-Nansen Programme, introduced the Programme and its science plan for the period 2017-2021. It was explained that the Programme is designed around three main areas of work, a) strengthening the knowledge base for the sustainable management of fisheries in the face of increasing fishing pressure, climate variability and change, pollution and other anthropogenic stressors, b) supporting improved fisheries policy and management in line with EAF including taking into consideration the risks and opportunities related to climate and other environmental variability and change, and c) developing capacity at the institutional and human resources levels, including the promotion of gender equality and effective participation of women in all Programme activities. The science plan is embedded in the component related to “Strengthening the knowledge base” and it was designed in consultation with partners at different stages of its development. It consists of 11 main themes that were identified as being the main drivers of change of marine ecosystems. Although most of these themes are relevant to the work on the deep sea, Theme 7 has a particular relevance as focusing on providing scientific information on bottom habitats, and particularly on the presence of vulnerable habitats for which special care is required when planning and managing activities that may affect them. Two dedicated surveys with the R/V *Dr Fridtjof Nansen*, in the Indian and Atlantic oceans (2018 on the Mascarene Ridge and 2019 on the Discovery Seamounts, respectively) have allowed for the collection of data on bathymetry, geomorphology, presence of VME-indicator species, fisheries resources, evidence of human footprint, microplastics, and biological and chemical oceanography. Additional surveys are planned for 2020 in the CECAF and SEAFO areas, and in 2021 on the Mascarene Ridge.

5.2. Survey information supporting fisheries management decisions in the South East Atlantic Fisheries Organization area

Paulus Kainge, a Chief Scientist from the Ministry of Fisheries and Marine Resources in Namibia, based at NatMIRC in Swakopmund, was invited to attend and contribute to the FAO ABNJ Deep sea meeting in Rome, May 2019. He was specifically invited to give a presentation at the Lunchtime Special Session organised by the EAF-NANSEN Programme. His presentation was titled “Use of survey information in supporting fisheries management decisions in the SEAFO Convention Area”, and was aimed at highlighting the work conducted through the R/V *Dr Fridtjof Nansen* in the SEAFO Convention Area.

He began by giving a short history of SEAFO, the geographic area of its Convention, as well as its functional structure, which consists of the Contracting Parties making up the Commission. The Secretariat oversees the day-to-day activities of the Commission and is supported by three bodies, the Scientific Committee, the Compliance Committee and the Standing Committee on Administration and Finance, all of them reporting directly to the Commission. He then mentioned briefly the functions of the Scientific Committee, which are 1) to provide the Commission with scientific advice and recommendations for the formulation of conservation and management measures for fishery resources covered by this Convention, and 2) to encourage and promote cooperation in scientific research in order to improve knowledge of the living marine resources of the Convention Area. He also mentioned that

SEAFO, like many other RFMO/As, is faced with a challenge of a “data-poor” situation, which a main reason why the Scientific Committee requested the Commission to assist in requesting for funding in order to conduct scientific research survey. This resulted in the EAF-Nansen availing the R/V *Dr Fridtjof Nansen*, during January-February 2015, for a survey on five seamounts.

The 2015 survey was mainly focused on “analysing the occurrence and abundance of benthopelagic fish and sessile epibenthos, including indicators of VMEs, in selected ‘existing fishing areas’ and areas closed to fishing within the SEAFO Convention Area”. He then presented that the results from this survey were considered by the Scientific Committee at its meeting in October of the same year, and the Scientific Committee recommendations were also presented to the Commission during the same year, in November 2015. In its recommendations to the Commission, the Scientific Committee advised the following:

- Schmitt-Ott (Closure no. 9), Wüst (Closure no. 7), and Vema (Closure no. 6) seamounts remained closed;
- Valdivia Seamount Complex and Ewing Seamount on the Walvis ridge remains open; and
- Area South and southeast of the Valdivia Bank be closed for all fishing gears except pods and longlines.

The Commission adopted the recommendations and the third one became Closure 12, enforced by CM 30/15. He highlighted that the most satisfying thing was that these decisions were adopted within 9 months of the R/V *Dr Fridtjof Nansen* cruise. He also indicated that results of the 2015 cruise have now been published in two scientific papers in Issue 41(1) of the African Journal of Marine Science of 2019. He also mentioned that one of the activities of the Scientific Committee is to evaluate application for exploratory fishing by member states. And it was one of the applications where the Scientific Committee advised the Commission that in two unmapped areas proposed to be explored, VME species have occurred in previous longline catches, and that as a mitigation measure, the areas known or likely to have VME indicators should be avoided. What followed was that the Commission decided to close the two areas for exploratory fishing, and this caused a lot of protests from the applicant the following year, and the issue was sent back to the Scientific Committee for further advice. The Scientific Committee then requested further research funding in the form of a research vessel in order to go to the specific seamount and conduct an investigation. This was granted by the Commission, by requesting assistance from the FAO and the R/V *Dr Fridtjof Nansen* was made available again and conducted this survey during January-February 2019. The results will again be considered by the Scientific Committee during November 2019, whereby recommendations will be forwarded to the Commission during the same year.

5.3. Characterizing the marine ecosystem and morphology of the Saya de Malha Bank: EAF-Nansen survey of the Mauritius-Seychelles Joint Management Area

Dass Bissessur, Department for Continental Shelf, Maritime Zones Administration and Exploration of the Ministry of Defence and Rodrigues, presented the results of the R/V *Dr Fridtjof Nansen* survey aimed at characterizing the marine ecosystem and morphology of the Saya de Malha Bank. The specific objectives of the survey were to optimise the seafloor mapping, identify appropriate stations to validate the marine landscape map, sample benthic organisms for habitat assessment at depths higher than 10 m, conduct pelagic trawls for zooplankton at depths higher than 50 m, and “replicate” survey stations of the 2008 ASCLME cruise, for comparison. The main outcomes of the survey were presented. The bathymetry survey resulted in a detailed multibeam echosounder map of the seamount, highlighting the presence of a “sinkhole” and flat summit. As for the physical oceanographic data, a surface temperature of 28°C and salinity varying from 34.1 to 34.6 PSU were observed at all stations. Below 50 m, the salinity increased reaching a peak (35.4 PSU) at 150 m depth. Finally, a relatively high concentration

of dissolved oxygen was observed at 500 m depth, with a peak at 400 m depth. The sediment sampling provided data on the granulometry, Total Organic Content and Total Carbonate Content of the substrate, and allowed for the collection of specimens belonging to the infauna and epifauna. Habitat mapping with a Video-Assisted Multi Sampler (VAMS) was also conducted. In terms of nutrients, water samples were collected at pre-defined depths and Phosphate, Nitrate, Nitrite, Ammonia, Silicate concentrations were measured. Main findings show an increase with depth of the concentrations of phosphate and silicate. Data on microplastics and marine litter were collected, showing only a low number of stations containing microplastics, and rare sightings of marine litter. Finally, results of the zooplankton sampling are pending, while the pelagic trawls for fish resources provided limited data, which is therefore inadequate for further analysis on distribution, size composition and biomass estimates of the main species.

6. ABNJ DEEP SEA MEETING 2019 CONCLUSIONS

Policy perspective – Stefán Ásmundsson

At the time when the ABNJ Programme was designed, the high seas were generally presented as open access. It has changed now. However, FAO with partners must continue to address fundamental activities. There is already a governmental structure in the ABNJ, but there is a need to strengthen those organizations that exist and cooperate and coordinate between them is very important. All states need to improve their domestic coordination.

There are three main themes to act upon:

1. Fisheries management of the catching of the fisheries resources;
2. area-based management tools and other tools e.g. there are effects from the fisheries on the marine environment without considering that the RFMO/As are already working on that; and
3. other human activities are also affecting the fisheries e.g. sea bed mining and-based pollution, although the RFMO/As are not monitoring or accountable for those activities.

There are also three points to take into account: 1) Scientific basis (social and economic factors are also important and can vary between countries, but the scientific basis should not be forgotten); 2) management framework has to be in place (it exists in some areas, but not in all); and 3) implementation (e.g. national legislation and administration).

Industry perspective – Ross Shotton

The fisheries sector in the SIODFA ABNJ is worried when short-term interests from individual nations give unsuitable quotas. In addition, they are very preoccupied when international policies are being implemented that they have disregarded decades ago.

Biodiversity perspective – David Johnson

ABNJ Governance and policy: Biodiversity conservation should be part of the evolving governance framework; BBNJ negotiations provide an opportunity to fill the legal lacuna whilst not undermining existing mandates; we need to follow a precautionary approach and generate political support for biodiversity conservation using the EBSA process (including recognising climate change refugia) and build on existing area-based measures.

Deep-sea science and monitoring: There is limited knowledge of biodiversity in ABNJ; furthermore the system is undergoing unprecedented rapid change and is subject to cumulative stressors; UN Decade

of Ocean Science for Sustainable Development is an opportunity to address this – topics to consider include bioregionalization; connectivity; data sharing and transparency; harnessing new technologies (remote sensing, AI, big data); and monitoring cumulative impacts.

Deep-sea management: Biodiversity loss in ABNJ is taking place due to lack of integrated management. We should enable better sectoral integration and co-ordinated regional implementation. Opportunities include recognising Blue Growth potential supported by SEA and MSP and implementing systems to accommodate management at appropriate spatial and temporal scales (a sea basin approach).

Science perspective – Joana Xavier

In this meeting there have been some presentations showing that there is an initial understanding of evolutionary drivers. It would be feasible to allocate resources to study a subset of species and ecosystems and to translate the gained knowledge to managers.

The technology allows us to starting to understand the links in the ecosystems. There are larger research vessels and improved laboratories to achieve more with less. In addition, the communication is enhanced. However, there are still challenges e.g. in investment and inclusiveness within science. Experiments are very expensive in the deep-sea and some of the least developed countries cannot afford this research. Fundamental science is not sufficiently funded.

There is a disconnection between what the managers need and what the scientists are focused on. Improved communication and cooperation between sectors, academia, policy-making and managers are necessary. Bridging those interfaces requires further efforts and meetings like this is useful.

Environment perspective – Takehiro Nakamura

Management of human activities requires communication between the environmental sector and the society. The environmental organizations such as FAO, the Regional Seas Programme and RFMO/As do not include human activities enough. It is important to discuss their roles. At national level a common agenda on the environment should be considered at different ministries, not only at the ministry of environment. There is a gap between environmental scientists and socio-economic scientists. In addition, there is a need to level the knowledge so all nations can participate in the BBNJ process in order to provide for a good base for negotiations.

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APPENDIX 2 MEETING AGENDA

ABNJ DEEP SEA Meeting 2019

DAY 1: Tuesday, 7 May – Iran room	
08:00–09:00	Participant registration
09:00–09:20	Official opening Manuel Barange , FAO (moderator) Árni M. Mathiesen , FAO Takehiro Nakamura , UN Environment
09:20–10:30	Setting the scene Fred Kingston , NAFO (moderator) Merete Tandstad , FAO (FAO and deep-seas) Darius Campbell , NEAFC (RFMO roles and responsibilities – the particular case of NEAFC and OSPAR) Ellen Kenchington , DFO (The importance of deep-sea ecosystem science and research) Miriam Balgos , Global Oceans Forum (Capacity building in the ABNJ) Fred Kingston , NAFO (moderator)
10:30–11:00	<i>Coffee break</i>
11:00–12:30	THEME 1: ABNJ governance and policy William Emerson , FAO (moderator) Blaise Kuemlangan , FAO (Review of legal instruments and DEEP-FLIP Training) Stefan Asmundsson (Review of ABNJ governance structures) Tim Costelloe , SIOFA (Challenges faced by new RFMOs – case of SIOFA) Abdellah Srour/Miguel Bernal , GFCM (Introducing the concept of policy for semi-closed areas)
12:30–14:00	<i>Lunch</i>
14:00–15:30	THEME 1 continued William Emerson , FAO (moderator) Ross Shotton , SIODFA (Global processes and the fisheries sector: industry initiatives)

Takehiro Nakamura , UN Environment (Opportunities and challenges for cross-sectoral planning in ABNJ)	
Theme 1 plenary discussion and summary	
William Emerson , FAO (facilitator)	
<i>15:30–16:00</i>	<i>Coffee break</i>
<i>16:00–17:00</i>	THEME 2: Deep-sea science and monitoring
Ellen Kenchington , DFO (moderator)	
Manuel Maldonado , CSIC (SponGES WP4: Deep-sea sponge aggregations under a Gaia’s perspective: functional connABNJections)	
Andy Kenny , CEFAS (VME science and SAIs in NAFO)	
Miguel Bernal , GFCM (VME science and regional bodies)	
<i>17:15–19:00</i>	Reception

DAY 2: Wednesday, 8 May – King Faisal room

<i>09:00–10:30</i>	THEME 2 cont.
Rick Fletcher (moderator)	
Tony Thompson , FAO (Bottom fisheries in the high seas)	
Christopher K. Pham , IMAR (Assessing the impacts of anthropogenic activities on deep-sea sponges)	
Shirley Pomponi , Florida Atlantic University (SponGES WP5 – Biodiversity, biotechnology, and the Blue Economy)	
Daniela Ottaviani , FAO (ABNJ deep-sea ecosystem services valuation)	
<i>10:30–11:00</i>	<i>Coffee break</i>
<i>11:00–12:00</i>	THEME 2 cont.
Manuel Barange , FAO (moderator)	
Piers Dunstan , CSIRO (Monitoring change and ecosystem risk assessments)	
Susana Salvador , OSPAR (Climate change and ecosystems, ecological and biological impacts)	
Lisa Levin , University of California San Diego (Deep-ocean climate change impacts on habitat, fish and fisheries)	
<i>12:00–14:00</i>	<i>Lunchtime SPECIAL SESSION: EAF-NANSEN PROGRAMME</i>

	<p><i>Snacks</i></p> <p>Merete Tandstad, EAF-Nansen Programme (moderator)- introduction to the EAF-Nansen Programme and the side event</p> <p>Gabriella Bianchi, EAF-Nansen Programme (The EAF-Nansen Science Plan, Theme 7)</p> <p>Paulus Kainge, NatMIRC (Survey information supporting fisheries management decisions in the SEAFO area)</p> <p>Dass Bissessur, Mauritius (Characterizing the marine ecosystem and morphology of the Saya de Malha Bank – Nansen survey of the Mauritius-Seychelles joint management area)</p> <p>Q&A</p> <p>Closure, (Merete)</p>
14:00–15:30	<p>THEME 2 cont.</p> <p>Shirley Pomponi, Florida Atlantic University (moderator)</p> <p>Ross Shotton, SIODFA (Deep-sea industry contributions to science: how the industry manages their impact on biodiversity)</p> <p>Alan Leonardi, NOAA (Mapping and characterizing deep-sea habitats in US EEZ and how this science data have influenced management decisions)</p> <p>Theme 2 plenary discussion and summary</p> <p>Hans Tore Rapp, Rick Fletcher, Ellen Kenchington (co-moderators)</p>
15:30–16:00	<i>Coffee break</i>
16:00–17:30	<p>SponGES session</p> <p>Claus Hagebro, FAO (moderator)</p> <p>Andy Davies, University of Rhode Island (WP 7: the utility of species distribution modelling for data-poor regions and species: case study of deep-sea sponges)</p> <p>Ana Riesgo, Natural History Museum (WP 3: Genetic diversity and connectivity in deep-sea sponges of the North Atlantic: connecting organisms with conservation strategies)</p> <p>Ellen Kenchington, DFO (WP 2/8: Conserving deep-sea sponge biodiversity)</p> <p>Daniela Ottaviani, FAO (WP 8: Deep-sea sponges valuation methodology and future work)</p> <p>Claus Hagebro, FAO (moderator)</p>

DAY 3: Thursday, 9 May – King Faisal room

09:00–10:50 THEME 3: Deep-sea management

Darius Campbell, NEAFC (moderator)**David Agnew**, CCAMLR (CCAMLR measures for catch documentation schemes)**Rick Fletcher** (EAF approach and RFMOs)**Javier Murillo**, DFO (What science is needed to support deep-sea fisheries management? – the case of NAFO)**Dale Squires** (Rights-based management in deep-sea fisheries)**Tom Blasdale**, NAFO (Deep-sea fish stock assessments: advances and challenges)10:50–11:20 *Coffee break*

11:20–13:10 THEME 3 cont.

Steve Fletcher, UNEP-WCMC (moderator)**Martin Cryer**, New Zealand (Existing spatial measures in fisheries: SPRFMO case study)**Nina Bhola**, UNEP-WCMC (Using marine spatial planning in the ABNJ)**David Johnson**, Seascope Consultants (Case studies for area-based management tools: western Indian Ocean and Southeast Pacific)**Miles Macmillan-Lawler**, GRID-Arendal (Visualizing data from different sectors in the ABNJ)**Steve Fletcher**, FAO (moderator)13:10–14:30 *Lunch*

14:30–16:00 Theme 3 plenary discussion and summary

Darius Campbell, Steve Fletcher (co-moderators)16:00–16:30 *Coffee break*

16:30–17:15 Wrapping Up and Moving Forward panel session

William Emerson, FAO (moderator)**Stefan Asmundsson** (Policy perspective)**Ross Shotton** (Industry perspective)**David Johnson** (Biodiversity perspective)**Joana Xavier** (Science perspective)

Takehiro Nakamura (Environment perspective)

Abdellah Srour (RFMO perspective)

Plenary conclusions and closing remarks

William Emerson, FAO (moderator)

17:15

Conference closure

The *Sustainable Fisheries Management and Biodiversity Conservation of Deep Sea Living Resources in Areas Beyond National Jurisdiction* Project (ABNJ Deep Seas Project for short) is a five-year project supported by the Global Environment Facility, and implemented jointly by the Food and Agriculture Organization of the United Nations, and the United Nations Environment Programme. The UNEP project component is executed through the UNEP World Conservation and Monitoring Centre.

The Project is designed to enhance sustainability in the use of deep-sea living resources and biodiversity conservation in the ABNJ through the systematic application of an ecosystem approach. It brings together over 20 partners who work on deep-sea fisheries and conservation issues in the ABNJ globally. The partnership includes regional organizations responsible for the management of deep-sea fisheries, Regional Seas Programmes, the fishing industry and international organizations. The Project aims to:

- strengthen policy and legal frameworks for sustainable fisheries and biodiversity conservation in the ABNJ deep seas;
- reduce adverse impacts on VMEs and enhanced conservation and management of components of EBSAs;
- improve planning and adaptive management for deep sea fisheries in ABNJ; and
- develop and test methods for area-based planning.

The ABNJ Deep Seas Project started in September 2015 and is one of four projects under the GEF Common Oceans Programme. More information is available from www.commonoceans.org

