Science diplomacy for stewardship: Advancing science-based policy for biodiversity beyond national jurisdiction through the Deep Ocean Stewardship Initiative (DOSI)
Workshop, 5-6 April 2018, National Oceanography Centre, Southampton, UK
Report

A workshop convened by the Deep Ocean Stewardship Initiative (DOSI) brought together 23 participants to discuss the scientific and technological challenges and opportunities facing the development of a new international legally binding instrument for the conservation and sustainable use of biodiversity in areas beyond national jurisdiction (BBNJ) under the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Expert presentations and break-out group discussions (program and participant list at Appendix 1) identified:

i) the science needs for ecosystem-based management of BBNJ;
ii) issues for the facilitation and governance of marine genetic resources, capacity building, and the transfer of marine technology; and
iii) opportunities to strengthen international collaboration and technological innovation in support of the BBNJ instrument, considering links to other initiatives such as the UN Decade of Ocean Science for Sustainable Development.

The workshop participants examined the multifaceted role of science and technology for the BBNJ agreement. The discussions highlighted cross-cutting technology transfer and capacity-building issues for ecosystem-based management and marine genetic resources. Opportunities and challenges for science-policy engagement in the development of the BBNJ instrument were identified. The workshop provided an opportunity to share information among participants about issues and activities related to BBNJ. This document summarises the workshop discussions.[1]

Sub-group of workshop participants, National Oceanography Centre, UK, 5 April 2018. Left to right, top to bottom: Alex Rogers, Paul Snelgrove, Maria Baker, Harriet Harden-Davies, Torsten Thiele, Jeff Ardon, Jane Collins, David Johnson, Marcel Jaspars, Kristina Gjerde, James Luger, Paul Tyler, Diva Amon, Ana Hilario, Anna Heath. (On screen remote participants: Daniel Dunn, Guillermo Ortonu-Crespo, Karen Stocks, Jeff Marlow). See Appendix 1 for full participant list.

[1] This workshop report has been prepared by Harriet Harden-Davies with input from the workshop co-organisers and facilitators (Diva Amon, Maria Baker, Kristina Gjerde, Marcel Jaspars, and Paul Snelgrove).
This document does not necessarily reflect the views of all workshop participants, or the Deep Ocean Stewardship Initiative. It is intended to form the basis of further discussions, including within the DOSI BBNJ Working Group.

1. Ecosystem-based management: deep-ocean scientific knowledge needs

A discussion on the scientific knowledge needs for ecosystem-based management was informed by a presentation by Paul Snelgrove (Memorial University) and break-out group discussions. The conversations focused on basic scientific understanding for area-based management tools (ABMTs) and environmental impact assessments (EIAs).

The BBNJ drivers: why is there a need for science and technology?
Knowledge of deep-ocean ecosystems is crucial for informing the adoption of effective measures for the conservation and sustainable use of marine biodiversity and deep-sea resources in ABNJ. For example, deep-sea coral ecosystems are now known to be characterised by longevity, fragility, low growth rate, poorly understood or slow reproduction and hence may be slow to recover. Such knowledge is important in sustaining ocean health and understanding the various ecosystem services. The challenges for ecosystem-based management posed by scientific knowledge gaps relating to biodiversity in ABNJ were discussed (e.g. we may know as little as 9% of species and far less about the microbial realm). It was also noted that the potential value of biodiversity including marine genetic resources is impossible to predict (e.g. different environments support different species of different bio-discovery potential). The challenges facing *in situ* observations and remote monitoring of biodiversity, as well as human activities, in remote ABNJ environments far from land at appropriate spatial and temporal scales were also discussed; these gaps were identified as a potential bottleneck for ABMTs and EIAs.

What to measure?
Five key deep-ocean science questions were identified:

1. Species: who lives there and who passes through?
2. Connectivity: how are individual organisms and populations connected?
3. Prediction: how can we predict where species are (habitat mapping, modelling tools etc.)?
4. Ecosystem function: how do species impact each other and earth systems?
5. Response to perturbation: how do species respond to change?

Current global scientific capacity: different levels of technology readiness for different science questions
The science questions were subsequently rated according to current knowledge status and level of technology readiness to address the science questions. There are varying levels of technology readiness depending on the science questions. Issues discussed included:

1. Species: quantification can be a hurdle taxonomically for both pelagic and benthic; smaller size classes (microbial, meio, macro) less well-known, particularly within the seafloor; imaging challenges related to zooplankton.
2. Connectivity: presence/absence; molecular; different spatial scales (microbial, meio, macro, mega); evolutionary or ecological; multiple temporal scales.[2]
3. Prediction: habitat mapping as a tool; modelling tools are useful but there are limitations (e.g. trophic models and energy flows currently less well understood than others; differing levels of technology readiness – geochemical, biological and physical).
4. Ecosystem function: complex task, need a lot of information for cumulative evaluation, further work required.

[2] It was noted that the question of ecological connectivity had implications for the issue of adjacency in the BBNJ context, and work on migratory species is being undertaken in this regard (see Nereus policy brief).

5. Perturbation: tools available to investigate perturbations from individual factors – but measuring cumulative effects is at a much lower level of technological readiness.

For ABMTs and EIAs in ABNJ, several challenges were identified including: monitoring temporal and spatial changes, additive and multiplicative issues, and determining the drivers of change. Although many of these measurements are currently feasible, their costs are often extremely high. Without further developments of cost-effective solutions this constraint will limit opportunities, spanning from effective development of ABMTs to capacity development. The need for technological innovation to address these challenges was then discussed. It was suggested that an assessment of key science questions and the current status of technology readiness could help shape future technology transfer and scientific and technological capacity building initiatives for BBNJ.

2. Advancing scientific knowledge: cooperation, collaboration and innovation

The break-out group discussions were informed by presentations by Alex Rogers (University of Oxford), Ana Hilario (University of Aveiro), Henry Ruhl (MBARI), Jeff Marlow (Harvard University), Daniel Dunn and Guillermo Ortonu-Crespo (Duke University) and Katya Popova (University of Southampton).

How to measure? Filling scientific knowledge gaps requires cooperation, collaboration and technological innovation. The need to scale-up science to obtain the information required for ecosystem-based management was highlighted. The need for new, emerging and existing technologies to be harnessed to monitor biodiversity (and human activities that could impact on biodiversity) to enable ecosystem-based management under a future BBNJ agreement was discussed. Participants explored the role of international scientific cooperation and collaboration, and the development and deployment of new technologies, in filling scientific knowledge gaps for BBNJ.

International cooperation is critical to advance scientific knowledge – especially for deep-ocean research. Cooperation across a range of countries and stakeholder groups, at global and regional levels, is crucial to enable deep-ocean science, accelerate discovery and combine data sources to provide information for management. Participants discussed:

- Census of Marine Life 2000-2010 offers an example of what can be achieved through international cooperation;
- The UN Decade of Ocean Science for Sustainable Development (2021-2030) offers an opportunity to mobilise international science cooperation to advance knowledge and build capacity, (highlights importance of designing research programs with measurable targets, identified science questions, technology options, and funds);
- The Essential Ocean Variables of the Global Ocean Observing System and the Deep Ocean Observing Strategy (DOOS) are important initiatives to guide global research efforts; and
- Repeatable protocols and standardised data formats support value-add by enabling data collected by individual missions to be combined to support pattern identification on scales that are useful to management (e.g. Global ocean survey and sampling iterative protocol, GOSSIP, Woodall et al 2018).

New technologies and tools offer great promise. The Deep Ocean Observing Strategy (DOOS) offers a catalogue of instruments and technologies across a wide range of platforms

(e.g. fixed point ocean observations, ROVs and AUVs). Examples of promising areas for new technologies include:

- Satellite technology - to monitor ocean ecosystems and human activities;
- Sensors - including genomic tools and eDNA;
- Underwater vehicles - (e.g. autonomous vehicles capable of travelling long-distance and gathering information for weeks or months at a time) could reduce dependence on research vessels;
- Robotics; and
- Models (e.g. models showing horizontal connectivity and ocean circulation highlight importance of healthy ocean ecosystems in ABNJ for areas within national jurisdiction – possible to show deep ocean).

However, barriers remain (e.g. high cost at early stages of development and deployment).

3. Towards a roadmap for technology transfer and capacity building: key elements for the BBNJ agreement

The break-out group discussions were informed by presentations from Harriet Harden-Davies (University of Wollongong) and the individuals referred to above. Technology transfer under UNCLOS can be considered to include a range of elements associated with the conduct and utilisation of scientific research and knowledge - from equipment to information. Technology transfer, while distinct from capacity development, can support capacity development. Capacity building could be considered to include a number of different activities. The need for a global aim for capacity building was discussed, such as: to develop an international enabling environment for ecosystem-based management of BBNJ through:

i. Producing science for informed decision making;
ii. Enabling access to information; and
iii. Empowering institutions to apply knowledge for BBNJ.

i) Building scientific and technological capacity to produce science needed for informed decision making and ecosystem-based management

A global vision for scientific capacity development could be to promote universal accessibility of scientific knowledge and expertise relating to the deep ocean. This could include capacity building at the following levels:

- *Individual*
  - Training scientists: should be an integral part of programs; can be facilitated by giving grants to attend expeditions and provision of training materials; the desirability of building capacity in underrepresented groups in science (e.g. women, ethnic minorities) was also suggested;
  - Research vessels can serve as a 'floating capacity building platform', enabling training and building international links. Examples provided include: IOC Training Through Research program; and Nekton;
  - Areas for capacity building include (but not limited to): Data and samples – training and awareness on data sharing (and best practice), rules on access and benefit sharing;
  - Funding (overcoming barriers to training and capacity building in research, support for multilateral/ regional capacity building initiatives); and
- *Institutional*
  - Examples include: mentoring scheme, mobility programme, training networks (ITNs), twinning arrangements;
  - Data and samples – training and access to infrastructure on data sharing; MGR repositories.

- *National*
  - Rights and responsibilities for marine scientific research and technology transfer;
  - Obligations and options for ABMTs and EIAs and MGR;
  - Support/ access to data;
  - Technology transfer mechanisms at global level, e.g. UNFCCC.
- *Regional/ Global*
  - Information sharing and mechanisms for enhanced research, mobility and capacity building;
  - Networks of national and regional science and technology centres, including data and sample nodes;
  - Knowledge intermediary/ agents/ brokers.

ii) **Access to data and information**

Information about activities and opportunities for capacity building:

The current lack of clarity about what activities are being undertaken, where and when (e.g. although existing tools such as Eurofleets enable the sharing of information about research vessels in Europe, these need to be expanded globally) was identified as a key challenge. It was suggested that there is an opportunity for enhanced information sharing (about capacity building opportunities from individual scientific researchers up to institutions) to enable access to scientific information and to identify priority areas in support of capacity development. Examples of existing global and regional institutions were provided (including CBD, IOC, Helcom, EBSAs, OSPAR), some of which have clearinghouse mechanisms, were discussed.

Data and information relating to ocean ecosystems including the conservation and sustainable use of BBNJ:

Translating scientific data into usable information for policymakers and managers requires quantitative models and frameworks to synthesise data from different processes and frameworks, to make information available in a user-friendly format via online platforms. Enabling access to multiple sources of data in a user-friendly format. The emerging example of OCTOPUS, a large marine database of more than 98million data points to be launched at Ocean Risk Summit in May was discussed (every hit on OCTOPUS counts as a hit on OBIS). Implementing institutions need access to assessments and reports on BBNJ – this requires data and information to be drawn from a range of different sources.

Key areas for further discussions were identified, including:[3]

- To meet obligations to share data or collect publicly funded data – how should data be shared and who pays?;
- Understanding the commissioning cycle of information – the role of national, regional and global bodies; and
- Role of intermediary groups - example of ICES.

iii) Applying scientific knowledge for ecosystem-based management

Implementation of BBNJ agreement will fall – to some extent – to existing institutions. Institutional challenges include: allocation of resources, adaptive governance needs adaptive evidence and information from a variety of sources. Questions remain about how institutions will respond to expansion of mandate and coverage under a BBNJ agreement, and how institutional interplay will work in practice the importance of informal arrangements for pragmatic cooperation was discussed, however, it was also suggested that there is no guarantee of delivery without specified commitments, timetable and funding.

[3] It was noted that some of these issues will be examined by the DOOS Data Task Team.

- *Linking science and policy:* Examples of the application of scientific knowledge to conserve and sustainably use biodiversity through designation of ABMTs (e.g. discovery of deep-water corals at risk from bottom trawling - emergency closure and monitoring) and the conduct and monitoring of EIAs (e.g. baseline study to determine what is there, monitor change over time) were discussed.
- The importance of capacity building for policymakers regarding accessing, interpreting and acting upon scientific information was discussed.

iv) Cross-cutting issues

- *Funding:*
    - Technology transfer: the potential to examine links between BBNJ and climate change in terms of science, technology and capacity, and to explore if the UNFCCC technology transfer mechanism (or similar) could fund and implement capacity development (e.g. co-benefits of building ecological resilience through BBNJ and CB/TT - value proposition) was discussed.
    - Ocean science: Deep-ocean explorations can be funded from public and private sectors and philanthropic sources (e.g. Nekton); the need for a range of funding sources was discussed, including in the context of the Decade of Ocean Science.
    - The need to link BBNJ to national interests was discussed.

4. Sharing benefits from marine genetic resources: issues for the facilitation and governance of marine scientific research.

This discussion was informed by a presentation from Marcel Jaspars (University of Aberdeen). Key issues for scientific and technological considerations for BBNJ were discussed as follows:

- Uncertainty surrounding the value of marine genetic resources, persisting need to reality check financial expectations and highlight significance of 'basic' scientific research and discovery, and the link to conservation and sustainable use of biodiversity – absence of definitions.
- Challenges for regulation: products such as cosmeceuticals are quicker to market – can be difficult to trace, if there is a reporting system – where would it be housed?
- Need for future-proofing a BBNJ agreement to cope with scientific progress and future technological advancements
- Unclear where 'commercial' research begins.
- Need for further discussions on how to facilitate and not hinder marine scientific research under a future BBNJ agreement.
- Opportunity for scientific community to provide information on good practice in accessing and sharing samples.
- Capacity building - potential to piggyback biodiversity research activities with 'pure' biological research activities but much will depend on future developments to the regulatory framework for marine genetic resources and the implications of that for scientific research.
- Policy issues include: standardised collection of information, best-practice approaches to collecting, sharing and using samples. Access to samples and long-term archiving.
- DOSI Deep Sea Genetic Resources Working Group (co-leads Jane Collins, Marcel Jaspars and Elva Escobar) is exploring a number of these issues.

5. Science-policy engagement

The break-out group discussions were informed by presentations from Paul Berkman (Tufts University), David Johnson (GOBI) and James Luger (University of St Andrews).

Science plays multiple roles in policy, including identifying new or emerging issues to be placed on the agenda; or respond to requests from policymakers. Science can help in:

- *Stimulating global dialogue and action:* Meaningful international dialogue can start with science questions of common concern;
- *Informed decision making:* Insights from scientific research contribute to the process of informed decision making - data compels decision makers to act - decision makers drive informed decision making (it is necessary to align different types of interests). Addressing science questions leads to the production of data, data builds evidence, evidence generates options, options contribute to informed decision making; and
- *Long-term, big-picture thinking*: Short-term political time-scales and immediate national security risks pose a challenge to intergenerational, planetary, long-term thinking (there is a continuum of policy urgencies – SDGs and food security provide a framework). Science can help build continuity.

Avenues for science-policy engagement include: personal contacts, meetings/workshops/events, policy briefs/reports/information documents. The following guiding approaches for science-policy engagement to contribute to informed decision making were highlighted:

- Clear messages in a format that can be easily understood by busy policymakers;
- Awareness of key players, motivations, groupings/alliances, existing legal/policy landscape; and
- Introduce options without advocacy – to be used or ignored – in order to remove politics of discussion and avoid politicisation of science. Because handing information to decision makers could be seen as an agenda – transparency is important.

The capacity of the scientific community to promote engagement in policy and decision-making processes was discussed. The role of sponsors, and international networks to promote a platform for global community dialogues and enabling active and inclusive engagement between scientists and policymakers was highlighted.
The following tools were suggested:

- Training opportunities
- Slide packs on key issues for scientific use.

6. Next steps

The Deep Ocean Stewardship Initiative (DOSI), with support from Arcadia, offers a multinational, interdisciplinary collaboration platform for the scientific community to contribute to the BBNJ negotiations and can facilitate the provision of expert information on scientific and technical aspects in all four aspects of the BBNJ agreement, especially in relation to technology transfer and capacity building, in collaboration with key organisations. The workshop marks the beginning of DOSI's work to facilitate collaboration and expert scientific input to the development of the BBNJ agreement, and will inform the work to be undertaken by the DOSI BBNJ Working Group.

The workshop outcomes will contribute to:

- The development of a BBNJ science-policy engagement plan via the DOSI BBNJ Working Group; provide BBNJ specific input to the DOSI Decade of Ocean Science Working Group. This could include capacity building tools e.g:
    - Slide pack on BBNJ policy – for scientists
    - Slide pack on BBNJ science and technology – for policymakers
    - List of experts on particular issues (note BBNJ Working Group is a step towards this)
- Identifying key issues for BBNJ that can be addressed through the development of academic papers and one-page policy briefs, suggestions included:
    - Importance of sustaining resilient deep-ocean ecosystems, including horizontal and vertical ecological connectivity, and changing ocean environments
    - Marine genetic resources as part of BBNJ ('MGR 101')
    - The microbial realm – new frontiers to advance scientific understanding, for technology development and potential
    - Access to data and information
    - Technology development and scientific collaboration aspects of capacity building (Developing scientific and technological capacity – at global, regional and national levels: how to enhance research and innovation – so that all can benefit?)
    - Satellite monitoring for BBNJ governance: (e.g. a 10+yr roadmap to low-cost efficient satellite monitoring, such as influencing satellite programmes to include fish stock and fishing fleet elements in observation, coordination and standards)
- Key highlights from the workshop were presented by Paul Snelgrove at a side-event at the United Nations, New York, 16 April 2018, entitled: *"The possible interlinkages between the UN Ocean Science Decade and the scientific aspects in the context of the BBNJ*" organised by the Government of Belgium, Government of Barbados, UNESCO-IOC, during the organisational meeting for BBNJ intergovernmental conference.

APPENDIX 1: Program and Participant List
Thursday 5 April

Session 1: Setting the scene		
09.30-09.40	The BBNJ instrument: state of play	Kristina Gjerde
09.40-09.50	Deep ocean science and technology: what is needed for BBNJ and what role could DOSI play?	Harriet Harden-Davies
09.50-10.30	Introductions (3 minute introductory remarks from all participants: *What is your interest in BBNJ? What role could DOSI play?)*	
10.30-11.00	Morning break	
Session 2: Science and technology for BBNJ		
11.00-12.30	*7minute introductory presentation from moderators, then break-out group discussions* • Group A: Enabling ecosystem-based management *What are the science questions to be addressed to enable ecosystem-based management in ABNJ? (Designating ABMTs? Conducting EIAs?)* • Group B: Sharing benefits from marine genetic resources *What are the key issues for the facilitation and governance of scientific research relating to marine genetic resources, capacity building and technology transfer?*	*Moderators* Paul Snelgrove Marcel Jaspars
12.30-1.30	Lunch	
1.30-1.45	Navigating the science-policy interface	Paul Berkman
Session 3: Developing scientific and technological capacity at global, regional and national levels		
1.45-3.15	Break-out groups report back How could the BBNJ instrument enhance scientific research and technological innovation so that all can benefit? (7min presentations followed by facilitated discussion) • Harriet Harden-Davies: introducing "capacity building and technology transfer" • Alex Rogers: future opportunities for scientific capacity development • Ana Hilario: the UN Decade of Ocean Science for Sustainable Development	*Moderator:* Diva Amon
3.15-3.45	Afternoon break	
Session 4: Overcoming obstacles through collaboration and innovation		

3.45-5.15pm	3minute introductory remarks from overseas participants Break-out group discussions Group A: Enabling ecosystem-based management How can knowledge gaps be filled through science collaboration and technological innovation? • *Henry Ruhl* • *Jeff Marlow* • *Daniel Dunn/Guillermo Ortono-Crespo* Group B: Sharing benefits from marine genetic resources • *Jane Collins* • *Kim Juniper*	*Moderators:* Paul Snelgrove Marcel Jaspars
5.15-5.30pm	Day 1 Summary & close	Harriet Harden-Davies, Kristina Gjerde, Paul Snelgrove
7.00pm	Dinner	

Friday 6 April

09.00-09.10	Welcome: Re-cap from Day 1 and plan for the day	Harriet, Kristina, Paul
09.10-10.00	Break-out group discussions Group A: Enabling ecosystem-based management Group B: Sharing benefits from marine genetic resources	Moderators: Paul Snelgrove Marcel Jaspars
10-10.30	Morning break	
Session 5: Putting science into practice		
10.30-12.00	(5-7minute presentations followed by facilitated discussion) • *Kristina Gjerde* • *James Luger*	Moderator: David Johnson
12.00-1.00pm	Lunch	
1.00-2.45	Break-out groups continued	
2.45-3.15	Afternoon break	
3.15-4.00pm	Reports back, Summary & next steps	Harriet Harden-Davies & Paul Snelgrove
4.00 pm	Close	Kristina Gjerde

Participants

Attended in person		
Diva	Amon	NHM
Jeff	Ardon	Commonwealth Secretariat
Maria	Baker	DOSI
Jane	Collins	eCoast
Kristina	Gjerde	IUCN
Harriet	Harden-Davies	University of Wollongong
Anna	Heath	Synchronicity Earth
Ana	Hilario	University of Aveiro
Marcel	Jaspars	University of Aberdeen
David	Johnson	GOBI
James	Luger	University of St Andrews
Alex	Rogers	University of Oxford
Paul	Snelgrove	Memorial University
Torsten	Thiele	IASS
Paul	Tyler	NOC
Katya	Popovo	NOC
Attended via zoom		
Daniel	Dunn	Duke University
Guillermo	Ortonu Crespo	Duke University
Henry	Ruhl	MBARI
Karen	Stocks	UCSD
Robert	Blasiak	Stockholm University
Jeff	Marlow	Harvard University
Paul	Berkman	Tufts University

Workshop Organisers: Harriet Harden-Davies, Maria Baker, Kristina Gjerde, Paul Snelgrove

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