Arctic Ocean Decade Workshop: Policy-Business-Science-Dialogue

Full report from Tromsø, Norway, 29 January 2020

Inputs to the planning of UN Decade of Ocean Science for Sustainable Development (2021-2030)

Innhold

Introduction

This report summarises inputs given by participants at the Arctic Ocean Decade Workshop. The inputs are meant to feed into the planning of the UN Ocean Decade for Sustainable Development.

This was a one-day workshop covering four of the Decades six societal outcomes: a clean ocean, a healthy and resilient ocean, a predicted ocean and a sustainably harvested and productive ocean. For each topic a keynote introduced the topic, followed by break out group discussions giving input on the topic. All together there was five break out groups, all discussing the same topics. In this report, inputs from the groups are summarised "together".

100 participants from 15 countries attended. Approximately 60 % Norwegians. About 70 % from the research community and 30 % from business, policy and non-governmental organisations.

The report first sums up the opening remarks. Then the inputs given by the workshop groups are listed under each topic together with a short summary of the keynote talks introducing each topic. Many inputs are relevant to more than one topic and were discussed at various times and in various contexts during the workshop. At the end inputs concerning other topics than the four societal outcomes are listed.

The workshop provided a dialogue and discussions between representatives from policy, business and science. This report reflects the viewpoints of the participants, sometimes without concluding remarks.

Opening and introduction remarks

The Executive Director of the Division of Oceans, Energy and Sustainability, The Research Council of Norway, Fridtjof Unander, underlined the importance of ocean science and the special features of the Arctic Ocean in these times of rapid change. He noted that the huge interest to participate in the workshop with more than 100 participants from 15 countries showed that the Arctic Ocean issues engage many more than the Arctic states.

Ole Øvretveit, director of Arctic Frontiers underlined the importance of Arctic Ocean issues and international collaboration.

Ivet Petkova, representing Arctic Frontiers Young, told the participants how important the Decade of Ocean Science is to the young generation. The Arctic Frontiers Young program gather and connect the next generations of upcoming scientists, to create opportunities for young people, to develop their inner curiosity, knowledge and skills. She reminded the audience that ocean science needs to be interdisciplinary and that a stable Arctic is essential for a stable world.

Peter Thomson, UN Secretary-General's special Envoy for the Ocean, greeted participants via video. The Decade is an opportunity to raise awareness of the ocean health and how important it is for food security and human wellbeing.

Vladimir Ryabinin, Executive Secretary Intergovernmental Oceanographic Commission of UNESCO, gave a presentation of the Decade of Ocean Science. He reminded the participants about the six societal outcomes of the Decade and that the Decade is not simply about ocean science, but ocean science for sustainable development. He noted also that predictions say ocean economy will develop faster than economy on land. The ongoing preparatory phase is to engage stakeholders to give IOC input. So far there are no detailed plans about allocation of resources for the Decade, but good plans open the door for resources.

Topic 1 – A clean, healthy and resilient Arctic Ocean

A clean Ocean: whereby sources of pollution are identified, quantified and reduced and pollutants removed from the ocean

A healthy and resilient Arctic Ocean: whereby marine ecosystems are mapped and protected, multiple impacts, including climate change, are measured and reduced, and provision of ocean ecosystem services is maintained

Keynote speaker Anne-Christine Brusendorff, International Council for the Exploration of the Sea (ICES), introduced the topic.

Brusendorff informed that ICES is an international governmental organisation giving scientific advice on marine issues. One of their science priorities is advice on fish stocks in the Arctic ocean and adjacent seas where they give advice about many of the commercial important fish stocks.

The changing environment of the northern seas has a huge influence on species and habitats. She said it's a need to quantify the impacts on human activities in the Arctic Ocean. This includes also the impacts of pollution like harmful substances, nutrients run off and ocean acidification.

Her advice to the workshop was that for a clean ocean the discussion should focus on key pollution issues, which sectors are involved and if there are increasing or decreasing trends. For a healthy and resilient ocean, she said key issues are ecosystem science and Arctic Ocean resilience. Different kind of knowledge should be considered and how western science and indigenous knowledge can complement each other.

Knowledge gaps and input

We do know quite much about the Arctic Ocean and we often know enough to act. Often, we need to change the mind set of humans and especially the decision makers to act based on existing knowledge. Some of the ongoing changes in the Arctic can be limited or reversed (e.g. mitigation of emission of pollutants and greenhouse gases, regulation of the pace of industrial exploration). Other changes are inevitable and require plans for adaptation. But there is still much we do not know about the Arctic Ocean, the ongoing rapid changes and predictions for the future. Arctic is the geographical area on earth with highest temperature increase. The most profound is the loss of sea-ice.

Ecosystems

Vital for the Arctic Ocean is to understand ongoing changes and predicted future changes to the ecosystems. To know what has happened in the past is vital to understand the ongoing changes. There is a need to close knowledge gaps and understand the differences in the Arctic Ocean, because the Arctic Ocean is not uniform.

There is a need to know how commercial exploration of the Arctic Ocean could impact specific parts of ecosystems.

Research and monitoring of the seabed and subsurface seabed life should be prioritised and can tell what has happened in the past and thereby we can we learn from the past. Sediment core samples with analyses of a variety of substances, including contaminants, is important.

We need to improve our knowledge about the ecosystems of the Arctic Ocean. We have many different ecosystems and we need to establish a baseline for the different ecosystems. This will help in understanding the changes and the resilience of the ecosystems. Very little is known about the

ecosystems in the Central Arctic Ocean basin, along the slopes and the effect of changes in sea ice. But changes are more intense, and biological productivity higher, along the margins of the Arctic ocean than in the Central Arctic Ocean and therefore there should be focus on both areas. While there is a range of ecosystem types in the Arctic Ocean, these systems are monitored in different degrees. We have good knowledge about some Arctic Ocean ecosystems and very little knowledge about others. If projecting knowledge from well-studied regions to poorly studied ones, we can learn what can be transferred from region to region and what knowledge is really missing. If we establish in depth knowledge about the Arctic Ocean ecosystems, we can predict much better how human activities in the Arctic (ship traffic, sea-bed activity, fisheries, etc) will affect the ecosystems. Also, environmental stressors may have different effects on different sub-populations (including of commercially harvested species); there is therefore a need for detailed studies. While modelling is extremely useful, it also has limitations. We need to be aware that while ongoing trends are likely to continue, there will also be surprises. Therefore, prediction is not extrapolation. This principle also applies more broadly for Arctic Ocean research, extrapolation from research from lower latitudes, or from local Arctic studies, cannot give the correct answer for other parts of the Arctic Ocean. The concept of connecting scales is important; for example, regional studies can often be combined with larger-scale modelling in order to consider the Arctic as a whole.

Focus on Arctic Ocean ecosystem understanding should be on the 18 Large Marine Ecosystems (LME) of the Arctic. Cooperation between ICES, PICES and the Arctic Council working groups on Integrated Ecosystem Assessment of the LMEs will identify knowledge gaps of each LME and be a basis for ecosystem-based management (EBM) of the Arctic Ocean. Ecology as a science is still a bit fragmented, and understanding of ecosystem functioning is still limited, e.g. the mechanism behind decline of sea bird species is not well understood. It is important during the Decade to improve interdisciplinary ecosystem approach which can help us understand the ongoing changes.

Pollution

A specific feature with the Arctic Ocean is that there are few local pollution sources, but global wind and ocean currents, and animal migration, transport pollutants from lower latitudes to the Arctic. There is a knowledge gap about impacts of possible increase in local pollution sources as anthropogenic activity in the north increases.

The understanding of the combined effects of climate change and other stressors caused by human activities is the key research priority for the Arctic Ocean, along with the spatial and temporal distribution of pollutants.

Distribution, accumulation and possible adverse effects of micro- and macroplastics in the Arctic needs to be further investigated.

There are high concentrations of some contaminants, e.g. mercury and PCBs, in higher trophic levels with consequences for wildlife, a food safety aspect and for those indigenous people who depend on hunting and fishing for subsistence. We need more knowledge about how contaminants, and especially a cocktail of contaminants, impact Arctic organisms which is often rich in fat. Further how contaminants are affected by climate change, e.g. remobilisation from melting sea ice and thawing of permafrost. Seasonal variations in fat content of the animals and susceptibility of contaminants are notunderstood. Time trends of contaminants are very important for science and management. Some legacy persistent organic pollutants show decreasing trends, but some emerging contaminants show

increasing trends. The network of Arctic contaminant monitoring needs to be improved. There is often lack of data from Russia. Further development and systematisation of the Arctic Environmental Specimen Banks (ESBs) can, in the future, help detect time series of emerging contaminants. Boreal species migrate northwards, but we do not know trophic interaction, how contaminants affect fish, shrimps, and how trophic pathways change within ecosystem structure. Chemicals used in the industry are often tested, but not in terms of their influence on cold and dark environment. There is an urge to improve how to regulate waste management chemicals, which go into the Arctic Ocean, regulate new products on the market and test them before use.

Climate and physical/chemical issues

Small organisms are very strongly controlled by their physical environment (advection etc.) and physical-biological coupling should be a focus area.

There are large gaps in our knowledge of the circulation of the Arctic Ocean, including in the inflow of Atlantic Water. 3D-modelling of the interior Arctic Ocean is crucial.

The impacts of increased anthropogenic noise are a knowledge gap.

Adaptations vary greatly between species. There should be more research on specific Arctic species in order to understand their resilience and adaptation. E.g., what the effects are of ocean acidification on lower trophic levels as well as commercially harvested species. Some studies indicate that Arctic ocean acidification can have a huge financial impact on e.g. commercial fisheries.

Geophysical understanding in an earth system view is also important to understanding the Arctic Ocean.

Reducing uncertainties in regional climate models should be prioritised as well as putting emphasis on communication of model uncertainties.

Land-Ocean interactions

The Arctic Ocean is surrounded by land masses, and as rapid changes are happening both in the ocean and on land. We need to increase the knowledge about land-ocean interactions. Freshwater fluxes have large impacts on many aspects relating to the Arctic Ocean, including carbon fluxes, coastal erosion, primary production, and ocean circulation. Riverine inputs and land runoff to the Arctic Ocean has increased, but there are major knowledge gaps about impacts and consequences of freshwater input to the Arctic Ocean. We still know too little about the cryosphere in general. How is the melting ice sheets (glaciers) affecting physical and chemical properties of the Arctic Ocean?

Coastal erosion is a major issue along parts of the Arctic coastline. There are many engineering challenges related to this and industrial research could help us find solutions. Scientific research also needs to focus on coastal erosion and help determine what areas will be affected. Scientific challenges relating to coastal erosion are multidisciplinary and include land-ocean interaction, freshwater, and sea ice decline.

Topic 2 – A predicted Arctic Ocean

A predicted ocean: whereby society has the capacity to understand current and future ocean conditions, forecast their change and impact on human wellbeing and livelihoods.

Keynote speaker Heidar Gudjonsson, Arctic Economic Council, introduced the topic.

Arctic Economic Council is an independent organisation that facilitates Arctic business-to-business activities and responsible economic development. Three issues are as of today the main business activities in the Arctic Ocean; transport, energy, and fisheries.

In his talk, Gudjonsson put emphasise on doing more with less.

Transport is the foundation of business. The container evolution made transport costs drop 90 %. New icebreakers can break ice sideways which means more ice is broken with smaller icebreakers.

Fuel is changing from heavy fuel oil to lighter petroleum components and liquid natural gas. Arctic is estimated to hold ca. 30 % of world's undiscovered gas and 13 % of undiscovered oil. Ice class commercial ships can break ice themselves, reducing the need for icebreakers and thereby reduce fuel consumption.

Nowadays 97 % of the fish is utilised, compared to 40 % some decades ago which means many more products are made from the fish now than before. It is important for businesses to utilise the existing resources as much as possible.

Knowledge gaps and input

There are huge geographical differences related to knowledge of the Arctic Ocean. We know a lot about the Barents Sea and the Fram Strait, but there is much less knowledge about the Siberian seas and the Central Arctic Ocean.

There should be developed a management control system for ships (like air control), e.g. warning signs when ships cross into Marine Protected Areas (MPA) or areas of ecological heightened concern and which features the ship crew especially needs to be aware of in these areas. Similarly, it should be developed a detection system for ships to avoid whales. Improved understanding of ice dynamics is important to predict the movement of ice in shipping routes.

Further develop models for predictions of impacts after major emergencies due to human activity in the Arctic Ocean. Better predictions will help authorities to deal with oil spill effects.

Data collection, storage and sharing

A key point to increase the understanding of the Arctic Ocean is to establish a good, international system for data collection, storage and sharing.

During the Decade it should be established programs and combined networks to collect data in a systematic way and prioritising the Central Arctic Ocean.

The industry can play a major part in developing a system for data collection, storage and sharing from the Arctic Ocean. Such a system should be one of the top priorities of the Decade in the Arctic Ocean. It is vital that by the end of the Decade there is an operating system for data handling and sharing. Data is collected both from research projects and trend monitoring programmes. Data from

spatial and trend monitoring programmes are important information for research projects and is also crucial to understand Arctic Ocean changes.

Currently, there is a huge lack of in-situ observations from the Arctic Ocean, particularly long-term ocean observations. This is a major obstacle to the understanding of the Arctic Ocean. Observations are currently funded through (time-limited) research projects and some trend monitoring programmes – there is a need for a publicly financed, secure source of research funds and monitoring programmes.

Data collection could be through a pan-Arctic network of autonomous samplers/instruments for data collection. In general, there is a need for better network to collect data across the Arctic Ocean because environmental status and changes are not uniform circum-Arctic.

Underwater robotics can be further developed with commercial actors. More cruise ships and other commercial vessels (ships of opportunity) can install monitoring devices.

As part of the systems with sharing data an Arctic regionally coordinated platform to discuss and share research plans, infrastructure and data should be established.

Monitoring for some parameters are good in some parts of the Arctic while there are some geographical areas without monitoring data. This makes it difficult to do e.g. pan-Arctic assessments. Monitoring surveys should integrate data on human activities and their effects. Monitoring should include not only instrumental observations, but also different sorts of other knowledge, including indigenous knowledge in places where it is relevant. Industrial activities are an important data source in addition to research, and should be available to all, as well as citizen science data (community monitoring). There exists much data, but those are so far mainly from accessible/ice-free areas and there is lack of data from the ice-covered Central Arctic Ocean. It is not possible to do assessments based on data from ice-free areas projecting it on the entire Arctic Ocean.

One of the challenges with Arctic Ocean data collection is that funding is national and therefore the monitoring is national. Monitoring of the Arctic Ocean should be harmonised between the nations because what happens in the Arctic Ocean affects all Arctic nations. The Decade could be the platform for the Arctic nations, and others who perform monitoring in the Arctic, to join forces and find a common approach to monitoring surveys of the Arctic Ocean.

There is need for an infrastructure to streamline the data sharing process and develop an Arctic data portal. Data and observations from ocean, atmosphere, sea ice, extreme events, interaction between terrestrial and ocean environments (nutrients, sediments etc.) should be included. Major obstacles to effective data sharing include methodological differences between researchers, and varying degrees of willingness to share. It is important to identify successful examples of data management/sharing from elsewhere, and to learn from their experience.

FAIR data (Findability, Accessibility, Interoperability, Reusability) is also about best available informed decision making. There is a huge need for access to data to be used in models, assessments, time trends, financing and many other issues. Someone needs to take the initiative to establish and maintain a data portal and add resources. Then it is easier for others to follow and add human and financial resources. One suggestion is that SAON (Sustaining Arctic Observing Network) should be the top outcome of the Decade. While there are problems with centralised archiving of actual data, one

could instead aim for a catalogue or metadata archive which would make it easier to find out what data exists and where is can be obtained. Commercial actors could pay a tax and get access to all data.

Data use and end products

There should be improved integration between researchers, monitoring observations and various stakeholders and knowledge holders both in the planning process and in the use of results. Also, knowledge built by Arctic people, indigenous communities and other local communities, should be integrated.

Stakeholders should be included in order to produce useful end products to predict the future Arctic Ocean. Their input is crucial in order to ensure that the products from e.g. modelling are useful. Successful examples from meteorological forecasting are often a result of a clear picture of what need to be delivered, and to whom. The outcome of such processes will then be more useful and valuable.

Topic 3 – A sustainable harvested and productive Arctic ocean

A sustainably harvested and productive ocean: ensuring the provision of food supply and alternative livelihoods.

Keynote speaker David Balton, Wilson Center, introduced the topic.

Balton talked about existing and possibly new management regimes for the Arctic Ocean.

Nine nations and EU have signed the arctic fishery agreement. The agreement covers an area the size of the Mediterranean Sea. The agreement bans commercial fishing in the Central Arctic Ocean until we have the appropriate science and management in place, not likely in the next 16 years. Seven countries have ratified the agreement.

He challenged the workshop participants that the existing agreements are not enough, and governance framework should be strengthened. These unmet needs could be met if Arctic Council changed their way of working. At the latest Arctic Council Ministerial there was no signed Ministerial Declaration for the first time. Arctic Ocean governance needs improvement. Effective Arctic governance is a combination of science function and management function.

Balton suggested that the ICES/PICES/PAME (Protection of the Arctic Marine Environment) Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean should finalise their work. He suggested to create a standalone science body and a management body for the Central Arctic Ocean. He also asked the workshop what more to do in the shipping space in addition to the polar code.

Knowledge gaps and input

One obvious challenge in the Arctic is the warming of the ocean, ocean acidification and migration of commercial fish stocks. A higher expected increase in food production in the Arctic Ocean as compared to other oceans, is expected, both in fisheries and possibly also aquaculture. Patterns of productivity and species distributions are changing. FAO estimates that high latitude areas have increased potential for food production. We need an efficient use of the resources harvested or produced, in the sea. One key word is circular economy, no waste, should be the goal.

Food supply is not only fish stocks but also harvesting of other species at lower trophic levels has been discussed, and marine bioprospecting for many purposes is increasing.

We need knowledge about how harvesting and production might impact the ecosystems. Food supply also includes marine mammals and seabirds, which are critical for indigenous communities. Technology development for energy effectiveness of harvesting is needed and will play an important role in the future.

Human activity in the Arctic is increasing (ship traffic, seabed activity, fisheries, etc). Key questions are: What are the impacts from these activities, and how will they affect the ecosystems. This requires a deep and thorough understanding of how the ecosystems function. Arctic food webs are short, and different links have great impact on each other. We therefore need to understand the entire systems not just e.g. single fish stocks. If human activity also includes oil, gas and mineral

exploration, science must evaluate the consequences and ask if food production would be damaged and such industries are wanted.

The key issue to deliver a sustainably harvested and productive ocean will be to make all citizens take ownership of/and responsibility for the importance of science in a changing world. In the context of a changing Arctic we need more knowledge about human behaviour and reaction to these changes like for example reaction to fish stocks migrating out of an area. We want discussions about the trade-offs of the emerging industrial activities (e.g. shipping and fishing) and the interests of local populations whose livelihood depends on local resources. A possibility is to develop scenarios for the Arctic Ocean that include not only economical values, but also cultural, historical, values of different generations, even family values. We need to develop methods to measure these "other" values. Is right to maximise or optimise all activities, do we need to go into all areas? Do we need alternative models/theories compared to the usual economic growth models with less use of natural resources are?

Management tools

The key to delivering a sustainably harvested ocean is the creation of mutually supportive mechanisms by and amongst science, industry, and governance. Ensure the expansion of existing regional observation and management initiatives to cover Arctic region, coupled to a widespread ocean literacy activity to link science, policy and general public awareness. We need more knowledge on how the rapid changes will impact the function of the management mechanisms and agreements and to support appropriate area-based management tools (e.g. static or dynamic Marine Protected Areas). To inform management we need models to include climate science in stock assessment

We need research on how to manage trade-offs (and conflicting benefits) between the pillars of sustainable development for the Arctic Ocean. With boreal species moving north there is a need to coordinate science and evidence for decision-makers to avoid conflict. A possibility is to build on existing national regulations, identify best practice (integrated management plans) and work towards international agreement.

Management mechanisms and bodies

The global legal framework applies to the Arctic Ocean as it does for other oceans. There are 70-80 international treaties that are applicable to the Arctic. There are several management bodies for the Arctic Ocean and different agreements include different countries. There are eight Arctic Council member states with 13 non-Arctic states as observers, there are five Arctic Ocean states and nine states and EU agreed on the fishery agreement.

In general there was agreement among the participants that management of the Arctic Ocean should build on established organisations (and possibly put more efforts into the existing ones) to coordinate integrated ecosystem based management of activities, communicate the importance of the ocean, and act now: show the power of knowledge. Although, it was also discussed the possibility to establish a new convention type organisation management body for the Central Arctic Ocean.

Even if the Arctic Council is not legally binding, it has initiated a number of Arctic specific agreements and has the potential role as the Central Arctic Ocean management body or a body to initiate Central Arctic Ocean issues agreed under other management bodies.

Knowledge about how the rapid Arctic changes will impact the function of the management mechanisms and agreements is important. There are concerns that the reaction time of existing mechanisms to ensure sustainability is too slow. The need for adaptive management was emphasised including strengthening of area-based management tools such as Marine Protected Areas. The creation of mobile Marine Protected Areas, requiring a creative process, was also proposed.

Arctic Council should work in close connection with ICES and PICES about Central Arctic Ocean issues because science should be the foundation for Central Arctic Ocean management.

The Arctic Ocean seabed should not be forgotten in future management because there will be increased interest for the arctic seabed in the coming decades.

Other international issues

Geopolitical tensions are increasing in the Arctic. The Decade could help foster international cooperation and limit tensions. Since there are so many different, and potentially conflicting, interests in the Arctic Ocean, it is important to get all actors to talk together at an equal level, not as member states and observers. Science diplomacy is critical, and Arctic science naturally lends itself to international cooperation due to the geography as well as the high costs of doing research.

International agreements take long time to develop, so we need other actions in addition.

Crosscutting topics

The public and especially young people are a driving force for policy change. The Decade need to be attractive to scientists and should be project driven. The Decade processes need to be transparent. The Decade needs to have calls to apply for project support to be attractive to scientists and coordinated calls between different countries on bilateral or multilateral basis. We need to foster a culture to focus on solutions and positive vision, not the environmental and mental grieve about catastrophic and apocalyptic scenarios.

Education

It is important to develop interdisciplinary Arctic Ocean research projects. The interdisciplinarity should be covered already in the education. We need education that translate expertise, so that different expertise can communicate and understand one another. We need to learn and educate collaboration and increase trust among different disciplines and science institutions/educational organisations. By collaborating, we strengthen cross-countries communication and translate our knowledge to future people.

Young scientists

The Decade should be a platform for more fellowships for young scientists. The future generation will work cross sectors with cross competences to achieve common goals. Young scientists should be more engaged and included in discussions at conferences and meetings (Arctic Frontiers Young programme as an example).

Communication

Communication should be directed to specific audiences. Communication of science to policy makers is different than communication to the general public or schoolchildren. Communication from e.g. ICES to decision makers are good. Bringing ocean science to the classroom will have a long-term effect on children's knowledge and awareness of ocean issues. The Decade should be spread among lecturers, professors, educators, local communities, so that everyone could be involved in different ways.

Science should be communicated through various channels that reach the young generation; social media (Instagram, twitter), YouTube. Young people collect information from different sources than older people. For good communication professionals should be involved helping us to communicate knowledge, e.g. video makers, artists, actors, etc. Young people themselves know much about how to communicate to their own generation.

Narratives are important in communication. Scientists need to think how they communicate their work and need to improve their communication in general. The concept of value is of importance, science can provide information that influence the perception of value among the public and among decision makers.

Civil society is key to create a concrete plan of action that involves people across the segments of society, and in particular involve the younger generation through education and outreach and build on its enthusiasm. Citizen science could one way of including communities in ocean literacy.

Funding

The different Arctic regions are limited by national funding. There is a missing international funding mechanism. One positive funding mechanism is the Belmont funding. A joint strategy, action plan and funding, which is building on and contributing to national initiatives, should be developed.

Annex

Programme

09.00	**Welcome Statements and Opening Remarks** • **Fridtjof Unander**, Executive Director of the Division of Oceans, Energy and Sustainability, The Research Council of Norway • **Ole Øvretveit**, Director of Arctic Frontiers • **Ivet Petkova**, Arctic Frontiers Young • **Peter Thomson**, UN Secretary-General's Special Envoy for the Ocean (video) Moderator: Christina Abildgaard, Director of Department for Ocean and Polar Research, the Research Council of Norway
09.30	**Introduction to UN Decade of Ocean Science for Sustainable Development** *By **Vladimir Ryabinin**, Executive Secretary Intergovernmental Oceanographic Commission of UNESCO*
	Introduction to group work *By Christina Abildgaard*
09.45	**Topic 1: A clean, healthy and resilient Arctic ocean** *Keynote talk by **Anne Christine Brusendorff**, General Secretary, International Council for the Exploration of the Sea (ICES)*
10.00	**Topic 2: A predicted ocean** *Keynote talk by **Heidar Gudjonsson**, Chair, Arctic Economic Council*

10.15	**Break Out Groups: Topic 1** Addressing the Decades Societal Outcome *A clean ocean* and *A healthy and resilient ocean*
11.30	**Break Out Groups: Topic 2** Addressing the Decades Societal Outcome *A predictable ocean*
13.00	**Lunch**
13.45	**Topic 3: A sustainably harvested and productive ocean** *Keynote talk by Senior Fellow **David Balton**, the Woodrow Wilson Center's Polar Institute*
14.00	**Break Out Groups: Topic 3** Addressing the Decades Societal Outcome *A sustainably harvested and productive ocean*
15.30	**Summing up and way forward** Summing up the group discussions with the working group chairs: • **Marianne Kroglund**, Norwegian Environment Agency • **Colin Moffat**, Scottish Government • **Tore Furevik**, Bjerknes Centre of Climate Research • **Elizabeth McLanahan**, National Oceanic and Atmospheric Administration • **Jose Moutinho**, Atlantic International Research Centre in Portugal Way forward • **Colin Stedmon**, Technical university of Denmark / Danish Centre for Marine Research • **Vladimir Ryabinin,** Executive Secretary Intergovernmental Oceanographic Commission of UNESCO
16.15	End of Workshop
18.15- 19.15	**Bringing the Arctic Ocean into United Nations Decade of Ocean Science** *Arctic Frontiers Side Event at Clarion Hotel the Edge, room: Arbeidskontoret* 1 Introduction by **Vladimir Ryabinin**, Executive Secretary IOC of UNESCO Panel discussion with: • **Anne Christine Brusendorff**, General Secretary, International Council for the Exploration of the Sea (ICES) • **Colin Moffat**, Chief Scientific Advisor Marine, Scottish Government • **Hanna Kauko**, Association of Polar Early Career Scientists (APECS) • **Paul Arthur Berkman**, Professor, Tufts University Moderator: **Peter Haugan**, Programme Director at Institute of Marine Research

Group leaders and rapporteurs

- Group 1: Chair: Colin Moffat, Scottish Government. Rapporteur: Anna Silyakova, UiT The Arctic University of Norway
- Group 2: Chair: Tore Furevik, Bjerknes Centre. Rapporteur: Anne Katrine Normann, Centre for the Ocean and the Arctic
- Group 3: Chair: Marianne Kroglund, Norwegian Environment Agency. Rapporteur: Mario Acquarone, AMAP
- Group 4: Chair: Elizabeth McLanahan, NOAA. Rapporteur: Jon L. Fuglestad, Research Council of Norway
- Group 5: Chair: Jose Moutinho, Atlantic International Research Centre. Rapporteur: Øyvind Lundesgaard, Norwegian Polar Institute

Participating institutions and countries

Aarhus University	Denmark
Akvaplan-niva	Norway
Alfred Wegener Institute	Germany
AMAP	International
Arctic Economic Council	Iceland
Association of Arctic Expedition Cruise Operators	Norway
Atlantic International Research Centre	Portugal
Bjerknes Centre	Norway
Bren School, University of California	USA
Centre for the Ocean and the Arctic, Nofima	Norway
Equinor	Norway
EurOcean	International
EuroGOOS	International
European Commission, DG Maritime Affairs and Fisheries	International
European Polar Board	International
Finnish Environment Institute	Finland
Fisheries and Oceans Canada	Canada
French National Research Agency	France
GenØk - Center for biosafety	Norway
GRID-Arendal / UNEP	Norway/International
Hafenstrom	Norway
ICES	International
Indiana University / Lilly Family School of Philanthropy	USA/France
Institut Francais Norvege	France
Institute of Earth Sciences	France
Institute of Ecology and Environment - National Centre for Scientific Research	France
Institute of Marine Research	Norway
IOC of UNESCO	UN Agency
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan
Kola Science Centre of the Russian Academy of Sciences	Russia
Marine Research Centre at Lomonosov Moscow State University / The University of Edinburgh	United Kingdom
MET Norwegian Meteorological Institute	Norway
Ministry for Foreign Affairs	Iceland
Ministry of Foreign Affairs, Ocean Team	Norway
Ministry of Trade, Industry and Fisheries	Norway
Multiconsult	Norway
NAMMCO - North Atlantic Marine Mammal Commission	Norway
Nansen Environmental and Remote Sensing Center	Norway
National Institute of Aquatic Resources, Technical University of Denmark	Denmark
NILU - Norwegian Institute for Air Research	Norway
NMBU - Norwegian University of Life Sciences	Norway
NOAA, Office of International Affairs	USA
Norwegian Environment Agency	Norway
Norwegian Polar Institute	Norway
APECS	International
NTNU - Norwegian University of Science and Technology	Norway

Orca Research Ltd	Ireland
Plymouth Marine Laboratory	United Kingdom
Sabima	Norway
SAON	International
Scottish Government, Marine Scotland	United Kingdom
SINTEF Ocean	Norway
Swedish Meteorological and Hydrological Institute	Sweden
Swedish Polar Research Secretariat	Sweden
Technical university of Denmark / Danish Centre for Marine Research	Denmark
The Norwegian Coastal Administration	Norway
The Ocean Foundation	USA
Tomsk Polytechnic University	Russia
UiT The Arctic University of Norway	Norway
University of Bergen	Norway
University of Oslo	Norway
University of the Arctic - UArctic	International
Wilson Center	USA
Young friends of the earth Norway	Norway