

JOINT ICES/ NMTT WORKSHOP LAUNCHING THE NORDIC CLIMATE CHANGE FORUM FOR FISHERIES AND AQUACULTURE (WKNCCFFA)

VOLUME 4 | ISSUE 7

ICES SCIENTIFIC REPORTS

RAPPORTS
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ISSN number: 2618-1371

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ICES Scientific Reports

Volume 4 | Issue 7

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Recommended format for purpose of citation:

ICES. 2022. Joint ICES/ NMTT Workshop launching the Nordic Climate Change Forum for Fisheries and Aquaculture (WKNCCFFA).

ICES Scientific Reports. 4:7. 16 pp. <http://doi.org/10.17895/ices.pub.10036>

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i Executive summary

The Nordic Marine Think Tank (NMTT) and International Council for the Exploration of the Sea (ICES) Workshop launching the Nordic Climate Change Forum for Fisheries and Aquaculture (WKNCCFFA) reviewed and considered recent research and other initiatives relevant to challenges posed by climate change for fisheries and aquaculture in the Nordic region. It also aimed to synthesize expertise, practical experiences and lessons learned of stakeholders in meeting challenges of climate change and to develop a collaborative platform to facilitate exchange among stakeholders, science, civil society and policy makers. The scoping workshop met these objectives. Scientists set the context and scene for the impact and measures for climate change. Participants considered the challenges facing industry and policy makers. The workshop concluded that future seafood availability will mostly be from aquaculture, that there is a need to establish a common protocol and standards for measuring CO₂ emissions. More research on value chain is needed, including establishing open-source platforms for data sharing and on enabling consumer acceptance of new species. Policy frameworks are important and dedicated climate change policies in the fisheries and aquacultures sector needs to be established through dialogue across stakeholders. Climate change considerations need to be part and parcel of fisheries management considerations and quota allocations and a review of present-day governance structure for fisheries management is needed. Gear and vessel innovations are needed to reduce CO₂ emissions of fishing activities and industry and policy makers should start by focussing on the low hanging fruits.

ii Expert group information

Expert group name	Joint NMTT-ICES Workshop launching the Nordic Climate Change Forum for Fisheries and Aquaculture (WKNCCFFA)
Expert group cycle	workshop
Chairs	Carl-Christian Schmidt
	Arni M. Mathiesen
Meeting venue and dates	9–10 December 2021, Elsinore, Denmark (56 participants)

1 Introduction

The Nordic Marine Think Tank (NMTT) and International Council for the Exploration of the Sea (ICES) hosted the Workshop launching the Nordic Climate Change Forum for Fisheries and Aquaculture (WKNCCFFA) on 9–10 December 2021. The workshop took place in Helsingør, Denmark, and was attended by 50 participants representing all Nordic countries: Denmark, Sweden, Norway, Finland, Faroe Islands, Iceland and Greenland. In addition, some colleagues attended via online connection. The program for the event is available in Annex 3. Presentations given by the speakers at the conference can be found on www.nmtt.org/forum.

The workshop was moderated by Arni M. Mathiesen, former Minister, Iceland, and the Round Table by Carl-Christian Schmidt, Chair of the NMTT and Mark Dickey-Collas, Chair of the ICES Advisory Committee (who were also the formal chairs).

In his opening remarks, the Danish Minister of Fisheries, Rasmus Prehn, underscored the importance of working on climate change challenges in fisheries and aquaculture. These sectors are directly affected by the changing climate. Changing climate are changing distribution and appearance of fish stocks in our oceans. Most important is to better understand how we adapt the industry to these changes. Also, we need to reduce the sectors own emission that affect the climate.

2 Setting the Scene

In the first keynote address, professor Michaela Aschan provided an overview of the latest Intergovernmental Panel on Climate Change (IPCC) report (ER6 Climate Change 2021). Over the past years, the climate change scientists have observed more extreme weather events based on a robust science. She underscored that a temperature increases of 1.5 per cent would affect both fisheries and aquaculture in several ways. For the aquaculture sector such temperature increase will affect growth rates of the farmed fish, increase the number of jelly fish blooms, and change the water quality. Aquaculture needs better monitoring, and this implies investment by the fish farmers in more technical equipment. For the fisheries sector the temperature increase combined with increasing CO₂ uptake have made oceans more acid while also changed the ocean circulation. Both these observations influence larvae developments and changes the nutritional availability and quality with direct consequence for the harvesting potential. Consequently, the spatial distribution of the fish will change, and this has implications for quota allocations, which choke species that will be relevant and also complicates the shared stocks negotiations.

Against increasing ocean temperatures fish grow faster and mature earlier which means that fisheries regulations need to change, e.g., increasing mesh sizes. Also, increasing temperatures drive ecosystem changes in terms of the functional diversity and food web connectivity of the ocean biomass. Such changes call for an ecosystem approach to fisheries management.

Professor Aschen underlined the need to develop climate adaptation plans (CAP) and in this regard referred to the Climefish project (www.climefish.eu) financed by the European Union as well as the standard CWA 17518: 2020 entitled “Good practice recommendations for making Climate Adaptation Plans for fisheries and aquaculture”.

The second keynote was given by Sara Hornborg and dealt with life cycle assessments (LCA). LCA is a method to measure the climate footprint of products through the value chain. She highlighted, however, that the methodological assumptions differ across studies of LCA which makes it difficult to compare results of LCAs. Combined with lack of appropriate data for the LCAs leads to assumptions that are central to the understanding of the results.

With respect to the LCA in the capture fisheries, Sara Hornborg detailed the various factors influencing the LCA results. These include stock size, management system, fish stock abundance, fleet structure and local management actions as well as the fishing gear used. In aquaculture, it is the feed structure that influences the LCA outcome.

Finally, Sara Hornborg underlined that the uncertainties in GHG emissions estimates are mainly due to data problems, system boundaries and certain knowledge gaps. Nevertheless, in conclusion it was clear that the fuel used in fishing and feed used in aquaculture are two key areas to further explore as these are the principal emitters of GHG.

The third keynote speech was given by Max Nielsen and provided an economic perspective to climate change in fisheries and aquaculture. He highlighted that GHG emissions is an externality which is not paid for and that it is therefore important to get prices right. It is also important to take action now with a view to reduce costs of future action i.e., action now is cheaper.

Max Nielsen then underscored that market-based reforms of the fisheries management systems across the Nordics have reduced the CO₂ emissions but that once consolidation of fleets towards larger vessels start those CO₂ emissions tend to increase. Nevertheless, the net result of the reforms is a lowering of CO₂ emissions. Looking at fuel use across fleet segments larger vessels are more fuel efficient per kilo caught fish and this is also influenced by how the quota system functions. Recent research has revealed that bottom trawling may release CO₂ stored in the sea floor which could render bottom trawling an unsustainable practice.

In aquaculture, it is the feed element in production that is the largest CO₂ emitter and use of feed based on fish and agriculture protein should be limited. In this respect it would be beneficial if aquaculture would be part of the European Emissions Trading System for CO₂ (see https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets_en for additional information).

3 Industry Challenges

The Workshop then turned to looking at the fisheries and aquaculture industry's challenges in addressing climate change.

The first speaker, Hildur Hauksdóttir from Fisheries Iceland, recalled the importance of fisheries in the Icelandic economy. About half of Iceland's export is seafood and 20 per cent of all CO₂ emissions is from the fisheries sector. The Iceland objective is to reduce the emissions by 50 per cent by 2030 and with a view to becoming fossil fuel free by 2040/50.

Hildur Hauksdóttir mentioned that Fisheries Iceland had organised four public meetings to discuss corporate social responsibility (CSR) of the Icelandic fisheries sector. These meetings had been well attended by stakeholders and been used to identify an agenda for the CSR actions that would make the sector more sustainable and reduce its climate change impact. The main themes of these meetings had been transparency, environment, innovation, and the sector's contribution to society.

In concluding her remarks, she underlined the importance of efficient fisheries management which lower the fuel consumption of the fleet and the importance of better utilisation of the raw material once landed with a view to reduce waste.

Anne Mette Bæk, president of IFFO and director of EFFOP and Marine Ingredients Denmark talked about the marine ingredients industry's work on climate change. Mostly, fishmeal and oil are sourced from small pelagic fish with fishing fleets with very low CO₂ emissions. She highlighted that in today's market costumers of fishmeal and oil are asking for traceability and also information about CO₂ emissions.

The marine ingredients industry is affected by water temperatures, pH changes in sea water, sea level rise as well as El Nino and La Nina phenomena. Changes in these factors have led to changes in the species composition of landings in the Danish factories and has also meant lower yields of fish oil. The industry is therefore looking for new sources of raw material, for example mesopelagic fish and trials are underway to determine their catchability, yields, and use as input to marine ingredients.

She finished her presentation by underscoring the need for certification and multistakeholder initiatives both seen as instrumental to the future of the marine ingredient industry complex. The importance of "blue food" in the global food system is important for health and the marine ingredients industry help the aquaculture sector to become more innovative and more flexible in their use of marine ingredients.

To provide a more detailed look at the future of aquafeed, Vidar Gundersen, Global Sustainability Director of BioMar, started by presenting BioMar a Danish global leader of aquaculture feeds. 1600 persons work for the company producing annually 1,5 million tons of aquaculture feeds of which about 60 per cent is for salmon aquaculture. Salmon aquaculture is also a driver of innovation. He highlighted that since about 2012 the focus of BioMar has been on climate change impacts and how the company can help responding noting that 80 per cent of the environmental footprint in aquaculture is due to the feed used.

One outcome of working on lowering the environmental footprint has been, over time, a reduction in the use of fish in feed compounds which, today, is limited to just 20 per cent. Soy meal has been the biggest replacement of fishmeal. In doing this, the Omega 3 content in feeds has been reduced considerably but has lately been restored somewhat by using marine based microalgae.

As for future developments, Vidar Gundersen highlighted BioMar's work on single cell raw materials from industrial waste streams and by-products from existing industry. More use of by-products and trimmings, single cell raw material and the use of lower trophic levels fish are important avenues for the aquaculture feed manufacturers. Meanwhile most of the diet in aquaculture will still be plant based. Concurrently, BioMar seeks to reduce the GHG footprint of the feed compounds by one third by 2030, by 50 per cent by 2050 through circular and restorative approaches while enabling 100 000 people by 2030 to be part of capacity building on climate actions.

Jesper Heldbo of Aquacircle then talked about the technical challenges in reducing CO₂ emissions in aquaculture.

For fish farmers innovation and the inclusion of artificial intelligence (IA) is seen as central to further expansion. AI is the means to ensure a better use of raw material, lower feed use and surveillance of the stock of fish in aquaculture production systems. In this regard degassing, i.e., removal of CO₂, in aquaculture using AI is central to ensure proper process management. Overall, AI will create efficiencies in future aquaculture production systems. Further possibilities to reduce the sector's overall climate footprint lies in the placement of recirculating systems closer to the consumers, stopping flying the fish all over the world and in the introduction and trading of carbon quotas across food production systems.

He concluded by presenting a model aquaculture production system, AquaPort, where fish farms are an integrated part of an industrial-energy cluster which can result in zero discharge and carbon neutral fish production. He highlighted that often "red tape" is a problem in moving towards integrated approaches and that thinking outside the box is needed in both industry and in the regulatory area.

Alex Olsen, former Sustainability Director with Espersen A/S provided an overview of the climate change challenges faced by the processing industry. He underscored that while the processing industry could still do better it was a case of self-interest in that reducing energy use was part of an ongoing call for increasing profitability. Key areas for further reduction include energy, CO₂ emission, water use and food waste.

As an example, Alex Olsen referred to the carbon footprint of cod fillets which includes 47,8 per cent for fishing/harvesting, 29,1 per cent for transport, 19,6 per cent is the processing of fillets and the rest of 3,5 per cent is sea transport. Most major fisheries processor source raw material from all over the world and hence transport is important. As far as possible, transport should be done by sea as the carbon footprint is low.

In concluding his presentation, he underscored the need for further cooperation across the value chain to ensure good behaviour of fishing companies. He also highlighted that certain fishing practices e.g., bottom trawling may have particular negative effects that needs to be addressed. Finally, he underlined the need for further international cooperation on innovation to reduce the environmental effects of fishing gear, getting stakeholders together and ensure transparency.

4 Policy Challenges and Responses

The second day of the workshop focussed on Policy Challenges and Responses thus turning to the political and administration of the fisheries and aquaculture sectors. Several countries provided an overview of policy initiatives taken or planned in dealing with climate change in fisheries and aquaculture. The purpose of this discussion was to cross-fertilise and ensure that countries were up to date with activities elsewhere. The workshop finished with a Roundtable, comprising of industry representatives, who provided their personal insights into what a possible future agenda to address climate change might look like.

The second day of the workshop was opened by Angus Garret, Head of Horizon Scanning and Long-Term Issues at Seafish. He provided an overview of the UK seafood industry's adaptation to changing climate conditions. He underlined that there are opportunities for smart food solutions in that fish and seafood have a very low climate footprint compared to other foods. Seafish has focussed on the adaptation side of climate change seeking solutions and ways that industry participants may respond to the climate challenge. Now in its sixth year the climate change work of Seafish is a continuing conversation among fisheries stakeholders, scientists and industry to build up a knowledge system, which is both practical and based on local knowledge.

He recalled the major publications on climate change in both fisheries and in aquaculture produced by Seafish (see <https://www.seafish.org/insight-and-research/current-and-future-trends/climate-change-impacts-and-adaptation/> for further details). He recalled that the key drivers of climate change relevant to the industry are severity of storms and waves, temperature change of the sea and air, rainfall, sea level rise and ocean acidification. Such challenges have implications for fisheries management regimes due to dynamics of fish stocks and the appearance of new fish stocks, operational safety of fishing operations, aquaculture installations, but also ports and land-based infrastructure used in fisheries and aquaculture sector. Despite uncertainties and knowledge gaps it is important to prioritise areas for action.

In conclusion, Angus Garret underscored the need to enhance fisheries science, to allow for a more flexible fisheries management approach, building resilience into fisheries operations at sea and in ports and in doing so consider and engage the whole industry, and with stakeholders. In moving forwards, it is important to have a flexible approach to be able to respond to new science.

Mark Dickey-Collas of ICES and Chair of ACFM gave an overview of the work of ICES related to climate change. He highlighted that ICES work on climate change goes back several decades and has involved work with several international organisations. Since 1985, 16 out of 21 fish stocks have changed their distribution across the North Atlantic. Such changes are observed in distribution of stocks and in stock productivity with implications for fisheries management and negotiations as to who can catch the fish.

The existing governance system for fisheries is rigid, lacks flexibility and hence have difficulties in adapting to the changing climate conditions. For example, ICES have no framework for incorporating climate change in its advice on fisheries management. We therefore need to consider a new framework that is more resilient to climate changes. This involves a closer look at the way we build and use our organisations, our learning system, how we incorporate flexibility, and a review of agencies and assets.

Jon Stefansson of the Iceland Ministry of Industries and Innovation talked about Climate Change and the Effects on Fisheries Management. He highlighted that, in Iceland, climate challenges are not directly addressed in the fisheries management but that the fisheries management settings indirectly deal with climate through the use of fishing gear, open/closed fishing areas, types of

vessels allowed to fish and the requirements for these vessels, through the allocation of TAC and via the resource rent taxation. The recently elected coalition government in Iceland has called for an acceleration of the energy conversion of the fleet based on proposals from the working group on green steps in the fisheries sector.

He referred to the ongoing mackerel dispute and called for a speedy negotiation with all parties involved to find a decent solution and thus avoid that the mackerel stock become overfished. The coastal states fishing the mackerel carry a joint responsibility for ensuring that the stock remains sustainably managed.

In conclusion, he referred to the recent White Paper on Adaptation to Climate Change. The fisheries management related issues in the White Paper calls for sufficient monitoring and assessment of the effects of climate change on fish stocks and their distribution, for more funding and research, and for assessment of the adaptation needs of the seafood and aquaculture industry.

Andreas Stokseth of the Norwegian Ministry of Trade, Industry and Fisheries told participants that Norway will hold the presidency of Nordic Council of Ministers in 2022 and is fully committed to the vision of the Nordics as the most sustainable and integrated region of the world. This vision also applies to the Nordic seas. Ocean climate and sustainability issues has a firm and central place in the programme during the Norwegian presidency. Norway is keen to bring the big issues of the international ocean agenda into the context of Nordic cooperation.

Norway has a climate goal of reducing the CO₂ emissions by 55 per cent by 2030 as compared to the level in 1990 including for the seafood industry. The seafood industry increasingly must document sustainability and carbon footprint for authorities, traders and consumers. The Norwegian government is therefore committed to contribute to innovation and supports new ways to organize production and new technology in the seafood industry. Considerable funding will be allocated to three areas of marine research that can have high positive effects on reducing greenhouse gas emissions in the future i.e., research into alternative and more sustainably produced ingredients for aquaculture fish feed, R&D in green shipping and technology, and research into cooling and frozen fish technology as an alternative to the fresh fish/air freight strategy which has been a major culprit in driving the size of the carbon footprint of the salmon industry.

Henry Damsgaard Lanng of the Danish Ministry for Food, Agriculture and Fisheries gave an overview of the Danish responses to climate change. The Danish approach has been increasing research activities on fisheries and aquaculture climate change challenges through the Danish Technical University (DTU). In capture fisheries priorities include vessel fuel efficiency, life cycle analysis for fish products, the use of marine protein as an alternative to meat, strengthening the ocean's ability to store and absorb CO₂ and holistic climate change solutions accounting for wider landscape issues. For aquaculture, priorities include energy efficiency, LCA, alternative feed sources, and genetic improvements of fish breeds to improve resource efficiency.

He also highlighted the Green Development and Demonstration Program (GUDP) established in 2010 and which since then has funded projects to the tune of 185 million DKr per year in both fisheries and agriculture. Fisheries projects, inter alia, have included improved trawl doors that reduce impacts on the sea floor while improving fuel efficiency and technologies to improve water quality in recirculating aquaculture.

Mats Svensson of the Swedish Agency for Marine and Water Management gave the workshop a short overview of the Swedish climate change challenges. He highlighted that the pressure on the marine environment comes from environmental pollutants, climate change, over-fertilization but also from fisheries activities itself. A new Marine Plan will be implemented in 2022 and deal with ecosystem-based management approach, more protected areas, and more areas for marine wind energy parks.

He highlighted the problems faced in the Baltic Sea with water quality as bottom water has become increasingly hypoxic and anoxic. Consequently, the plankton communities have undergone major shifts and has influenced fishing possibilities. As for North Sea and West coast fisheries he observed that major change to cod and herring stocks are underway. Coastal fisheries in Sweden have already been reduced considerably.

5 Round Table

With a view to garner the industry representatives experience of the workshop and point to relevant future agenda for the Forum a Round Table took place. Participating at the Round Table were Unn Lakså of Sjøkovin, Faroe Islands, Jennie Montell of Espersen a/s, and Brian Thomsen of Danish Aquaculture Organisation. The Round Table was moderated by Mark Dickey-Collas, ICES, and Carl-Christian Schmidt, NMTT.

The key points that emerged from the Round Table discussion and the ensuing discussion with all participants were as follows:

- Future seafood availability will mostly be from aquaculture.
- There is a need to establish a common protocol and standards for measuring CO₂ emissions.
- To fill our knowledge gaps on climate change impacts in the fisheries value chain more research is needed, including economic research.
- Regulations for aquaculture and fisheries, needs to be simplified and transparent to augment social acceptance of these activities and their environmental impacts.
- Work is needed on improving consumer acceptance of new species.
- To reduce food waste the whole value chain should focus on how to use all the fish.
- The fish processors need to team up with land-based vegetable producers to reduce overall CO₂ emissions.
- Improve collaboration across the value chain and establish open-source data platforms through which data sharing can take place.
- Policy frameworks are important and dedicated climate change policies in the fisheries and aquacultures sector needs to be established through dialogue across stakeholders. This will improve acceptance and willingness to invest in CO₂ reducing technologies.
- Climate change considerations need to be part and parcel of fisheries management considerations and quota allocations.
- A review of present-day governance structure for fisheries management is needed to ensure that climate change considerations are accounted for. Legal texts should be sufficiently flexible to consider climate change impacts focusing on processes rather than prescribed outcomes. One outcome would be adaptive management.
- Gear and vessel innovations are needed to reduce CO₂ emissions of fishing activities and industry and policy makers should start by focussing on the low hanging fruits. The fishing industry will learn from the maritime transport sector as this sector moves to be carbon neutral.

Annex 1: List of participants

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Annex 2: WKNCCFFA resolution

Joint ICES/ NMTT Workshop exploring the establishment of a Nordic Climate Change Forum for Fisheries and Aquaculture (WKNCCFFA), chaired by Carl-Christian Schmidt, Denmark; and Arni M. Mathiesen, Iceland, will meet in Elsinore, Denmark, 9–10 December 2021 to:

- a) Review and consider recent research and other initiatives relevant to challenges posed by climate change for fisheries and aquaculture in the Nordic region ([Science Plan codes](#): 1.1; 2.1; 3.6; 7.3);
- b) Synthesize expertise, practical experiences and lessons learned of stakeholders in meeting challenges of climate change ([Science Plan codes](#): 4.1; 5.2; 7.3; 7.7);
- c) Develop a collaborative platform to facilitate exchange among the Nordic fisheries and aquaculture stakeholders, science, civil society and policy makers ([Science Plan codes](#): 2.1; 3.6; 7.3; 7.5).

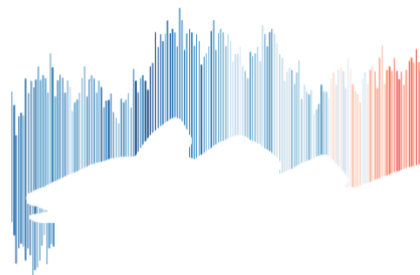
WKNCCFFA will report by 15 March 2022 (via HAPISG) for the attention of SCICOM and ACOM.

Supporting information

Priority	<p>Rising sea temperatures, changing salinity, acidification, pH and oxygenation are some of the effects that increasingly will be felt by the fisheries and aquaculture sectors. Some changes have already taken place. However, little has been done in terms of supporting the preparedness of the fisheries and aquaculture sectors to reduce their own climate impacts while adapting to the anticipated changing conditions. The Workshop, organized jointly by the Nordic Marine Think Tank (NMTT), ICES and with support from the Nordic Council of Ministers, will bring together fisheries and aquaculture stakeholders and scientists from the Nordic countries to advance collaboration on addressing challenges imposed by climate change.</p> <p>Consequently, the workshop is considered to have a very high priority in establishing a climate change forum for fisheries and aquaculture stakeholders which will act as a knowledge exchange platform with mutual benefits for industry, science and fisheries policy makers.</p>
Scientific justification	<p>Term of Reference a)</p> <p>The IPCC report (2019) notes that “ <i>A.5. Since about 1950 many marine species across various groups have undergone shifts in geographical range and seasonal activities in response to ocean warming, sea ice change and biogeochemical changes, such as oxygen loss, to their habitats (high confidence). This has resulted in shifts in species composition, abundance and biomass production of ecosystems from the equator to the poles.</i>”</p> <p>It is important to synthesize the science on a regional scale and reflect on it with science, industry, NGOs and policy makers to identify relevant knowledge for decision making, specifically considering social and economic impacts and the future role of seafood production in the overall food producing sector.</p> <p>Term of Reference b)</p> <p>Industry is already challenged by climate change affecting the marine environment and the dynamics of the resources. In addition the sector needs to adapt to increasing regulations on emissions while reducing the environmental impact of their activities. Besides the scientific knowledge, sharing the lessons learned and knowledge within the sector will help to facilitate adaptation.</p>

	<p>Term of Reference c)</p> <p>The fisheries and aquaculture sectors urgently need to identify pathways to adjust to a changing climate (adaptation) while concurrently take up measures and techniques in both fisheries and aquaculture that will reduce the sectors' impacts on the climate (mitigation). To facilitate the exchange among stakeholders, industry, civil society science and policy makers need a safe and trusted forum for discussion. The proposed Nordic Climate Change Forum for Fisheries and Aquaculture aims to provide this.</p>
Resource requirements	The resource required in the framework of this workshop is marginal and is mainly organisational support for establishing a workshop programme and assistance for broadening participation from stakeholders.
Participants	The Workshop will be attended by 100-120 participants from across the Nordic countries. Participation will be broad and include industry, scientific community, fisheries policy makers and managers, and NGOs working in the field of fisheries and aquaculture.
Secretariat facilities	Standard EG support.
Financial	No financial implications.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	SICCME, SIHD, EPDSG, HAPISG, EOSG, FRSG, DSTSG, ASG, WGREIA, WGS2D, WGGRAFY, WGOOFE.
Linkages to other organizations	The work of this Workshop is aligned with other international fora considering climate change in fisheries and aquaculture such as the FAO, IUCN, OECD, UN.

Annex 3: WKNCCFFA programme



Funded by the Nordic Council of Ministers

**Joint NMTT-ICES Workshop
launching the
Nordic Climate Change Forum for Fisheries and Aquaculture**

Konventum, Elsinore, Denmark

9-10 December, 2021

AGENDA

As adjusted during the event

9 December 2021, Chair: Árni M. Mathiesen, former Minister, Iceland

08:00 Registration and coffee

09:00 Welcome and Introductions by NMTT and ICES

09:15 Opening of the Workshop by Rasmus Prehn, Minister for Food, Agriculture, and Fisheries, Denmark.

PART I: SETTING THE SCENE

The role of the keynote introductory presentations is to bring participants up to date with the latest available knowledge on climate change and its impacts on the fisheries and aquaculture sectors. It will also be an opportunity to lay out the challenges posed by adaptation policies and strategies.

09:40 Keynote 1: Impact of climate change on seafood production and adaptation measures. Professor Michaela Aschan, Norwegian College of Fishery Science, UiT the Arctic University of Norway.

10:10 Keynote 2: Fisheries and Climate Change: Insights from Life Cycle Assessments. Sara Hornborg, RISE- Research Institutes of Sweden

10:40 BREAK

11:10 Keynote 3: How does the fisheries and aquaculture value chains impact the climate? Identifying pathways to mitigating the impacts of our activities: An Economic Perspective. Max Nielsen, Department of Food and Resource Economics, Copenhagen University.

11:40 Discussion

12:00 Lunch

PART II: INDUSTRY CHALLENGES

Using a value chain approach Part II of the Workshop will highlight the fisheries and aquaculture industry challenges of addressing climate change. The session will provide examples of responses and provide an opportunity for participants to better understand how to implement actions to reduce CO₂ and other GHG while adapting industry to a new resource situation.

13:30 Capture Fisheries for Human Consumption. Climate Change Issues and Challenges. Hildur Hauksdottir, Fisheries Iceland

14:10 The Marine Ingredients Industry and Climate Change. Anne Mette Bæk, president IFFO, director EFFOP and MID.

14:40 Break

15:10 The Future of Aquafeeds, Vidar Gundersen. Global Sustainability Director BioMar Group.

15:40 Technical challenges in reducing CO2 emissions in Aquaculture. Jesper Heldbo, Aquacircle.

16:10 Processing Industry. Climate Change Issues and Challenges. Alex Olsen, former Espersen A/S.

16:40 Discussion

17:00 End of Day 1

18:30 Welcome drink followed by dinner.

10 December 2021 Chair: Árni M. Mathiesen, former Minister, Iceland

PART III: POLICY CHALLENGES AND RESPONSES

This Part III of the Workshop will present Nordic policy responses to climate change and provide an opportunity for participants to discuss with policy makers and industry stakeholders about what additional responses are needed to address the climate challenge. Also, the Workshop will debate how our governance structure and institutional cooperation needs to be reorganised to face up more efficiently to the climate challenge.

09:00 Angus Garrett: Understanding and adapting to a changing climate for UK seafood.

09:30 Managing fisheries and aquaculture under climate change: Perspectives from the frontline:

- a.) Jon Stefansson, Iceland: recent initiatives and preparatory steps on fisheries management.
- b.) Andreas Stokseth, Norway will update participants on recent initiatives regarding climate change in fisheries and aquaculture.
- c.) Henry Damsgaard Lanng, Denmark will provide an overview of recent initiatives.
- d.) Mats Svensson, Sweden: Short overview of the fisheries and climate change challenges.

10:30 Break

10:50 Mark Dickey-Collas: ICES climate and fisheries

11:10 Roundtable moderated by NMTT and ICES

The Roundtable will address the “HOW” to move forward with respect to further the understanding and need to address climate change by the fishing industry. What are the

pathways to ensure that all industry participants take appropriate action to reduce their CC impact and adapt to the changing climate? What questions and issues should be brought up in future events of the Forum?

11:45 Summing-up, Conclusions and Next Steps

12:00 Lunch and Departures