



PAME Work Plan

2019-2021

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PREFACE

PAME focuses on the marine agenda of the Arctic Council and provides a unique forum for collaboration on a wide range of activities directed towards the protection and sustainable use of the Arctic marine environment.

PAME's activities are based on its mandate to address marine policy measures and other measures related to the conservation and sustainable use of the Arctic marine and coastal environment in response to environmental change from both land and sea-based activities, including non-emergency pollution prevention control measures such as coordinated strategic plans as well as developing programs, assessments and guidelines, all of which aim to complement or supplement efforts and existing arrangements for the protection and sustainable development of the Arctic marine environment.

PAME provides a unique forum for collaboration on a wide range of Arctic marine environment issues and consists of representatives from the Arctic states, who are responsible for its work in their respective countries, and representatives of Permanent Participant organizations on behalf of Arctic indigenous peoples. Additionally, the other Arctic subsidiary bodies, accredited observers and other Arctic stakeholders contribute to the ongoing work of PAME.

PAME generally meets twice a year to assess progress and advance its work. PAME is headed by a Chair and Vice-Chair, which rotate among the Arctic States and are supported by a Secretariat based in Iceland. PAME reports to the Senior Arctic Officials (SAOs), and through them, to the Ministers of the Arctic Council who meet every two years. PAME's work plan is approved by the SAOs and the Ministers.

INTRODUCTION

The PAME Work Plan 2019-2021 was developed according to:

- PAME's mandate;
- priorities identified and recommendations made in reports and arrangements developed by or negotiated in Arctic Council subsidiary bodies that are approved by the SAOs and Arctic Ministers;
- direction provided in Ministerial declarations;
- follow-up on recommendations from Arctic Council projects and the Arctic Marine Strategic Plan (2015-2025), which outlines the overall direction of the Arctic Council for the protection of the Arctic marine environment, in addition to policy follow up to the scientific and other relevant assessments of the Arctic Council.

PROJECTS AND ACTIVITIES

Additional project proposals may be developed within the scope of this work plan between 2019-2021, subject to confirmed lead/co-lead commitment and financing.

AMSP Goal 1:

Improve knowledge of the Arctic marine environment, and continue to monitor and assess the current and future impacts on Arctic marine ecosystems.

BACKGROUND

There is increasing demand for reliable and pertinent information in the Arctic context, which will increase as the region undergoes more development with increased human activities and climatic changes.

The Arctic Council has proven to be an important provider of scientific-based assessments, taking into account traditional and local knowledge. Informed policy decisions depend on improved understanding of the Arctic marine environment and drivers of change, attained through accurate, accessible and foundational scientific data, such as topographic, hydrographic, oceanographic and meteorological information, and other marine spatial data, as well as traditional and local knowledge.

ARCTIC MARINE SHIPPING

PROJECT NAME

Black Carbon emissions from shipping activity in the Arctic and technology developments for their reduction

Annex I

DESCRIPTION

The objective of this project is to strengthen harmonization and foster dialogue and cooperation between the Arctic Council member states, Permanent Participants and Arctic Council Observers on research on various fuel and exhaust gas treatment methods as possible means by which to reduce the amount of harmful gases emitted by vessel engines.

To compile data on black carbon emissions from shipping activity in Arctic waters using PAME's Arctic Ship Traffic Database (ASTD) database to better understand the distribution and magnitude of these emissions in the region; and foster dialogue and sharing of information among PAME Members, industry, experts, and others as appropriate on technology developments, including information on cost-efficiency methodology and other relevant factors, for the reduction of black carbon emissions from shipping in the Arctic.

The final project proposal may consider, as appropriate, relevant work under the IMO, and may be revised accordingly, in light of complementarity, by the projects' correspondence group.

LEAD(S) AND PARTNERS

Iceland - Finland

PROJECT NAME

Arctic Shipping Status Reports

Annex II

DESCRIPTION

The project will utilize the Arctic Shipping Traffic Database (ASTD) System to develop user-friendly, illustrative informational factsheets on Arctic shipping to highlight important developments in Arctic shipping activities. Produce and communicate the information in an illustrative way, e.g. with Story maps or by another similar explanatory means online.

LEAD(S) AND PARTNERS

USA - PAME Secretariat

PROJECT NAME

Environmental toxicity and fate of light and intermediate fuel when spilled in cold waters

DESCRIPTION

The objective is to gather knowledge and explain the large variation in environmental toxicity of light and intermediate fuel oil. This is a joint project proposal by PAME and EPPR.

PAME anticipates finalizing and approving this project proposal intersessionally in coordination and consultation with EPPR.

LEAD(S) AND PARTNERS

Norway - Possible working group partner: EPPR

PROJECT NAME

Arctic Marine Tourism: Development in the Arctic and enabling real change

Annex III

DESCRIPTION

The project has the following two components: This project will follow up on recommendations contained in the Arctic Marine Tourism Project: Best Practice Guidelines (AMTP 2015).

Main activities include:

- compilation of data on tourism vessels in the Arctic using PAME's ASTD database to better understand recent developments, identify gaps in data, and explore the feasibility to map the use and carriage of Automatic Identification System (AIS) by vessels not obligated to do so by IMO regulations;
- summarizing existing site-specific guidelines for near-shore and coastal areas of the Arctic visited by passengers of marine tourism vessels and pleasure crafts.

The final product will be a summary report with recommendations on next steps, for Ministerial approval in May 2021, and an online repository of information collected for the purposes of the project.

LEAD(S) AND PARTNERS

Iceland - Canada

PROJECT NAME

Develop a non-binding PAME-ARHC Memorandum of Understanding

DESCRIPTION

The objective is to formalize the relationship between PAME and the Arctic Regional Hydrographic Commission (ARHC) through the development of a non-binding Memorandum of Understanding (MOU). The purpose of the MOU would be to foster greater communication between the two bodies and enhance coordination and cooperation on projects of mutual interest.

LEAD(S) AND PARTNERS

USA - Canada

PROJECT NAME

Underwater Noise in the Arctic – Understanding Impacts and Defining Management Solutions - Phase I

Annex IV

DESCRIPTION

The aim is to obtain a better understanding of, and estimate the current underwater noise emissions incidentally generated by commercial shipping in the Arctic, while using information from PAME's ASTD database, and collaborating with CAFF as appropriate to advance implementation of AMSA Report Recommendation II(G).

Main activities (phase I):

- Obtain a better understanding of, and estimate the current underwater noise emissions (or 'noiseprint') from shipping in the Arctic.
- Identify areas where underwater noise from shipping and areas of heightened ecological or cultural significance overlap as identified by the Arctic Council.
- Based on the results obtained, and recognizing the limitations inherent to high-level analyses, investigate possible mitigation strategy options to reduce the impact of underwater noise incidentally generated by shipping in the Arctic. Expert input and traditional and local knowledge will be used to inform any such options.

LEAD(S) AND PARTNERS

Canada - WWF

PROJECT NAME

Compendium of Shipping Accidents in the Arctic (CASA): Follow-up

Continued from previous work plan.

DESCRIPTION

The objective is to develop a compendium of shipping accidents in the Arctic for the period 2005-2017 and an overview report to update the corresponding information contained in the 2009 Arctic Marine Shipping Assessment (AMSA) Report.

This work will incorporate the CASA information using GIS mapping tools into PAME's ASTD database and conduct a further analysis and report to identify accident causes and potential options for reducing the risk of such accidents.

LEAD(S) AND PARTNERS

USA - Working group partner: EPPR (joint project)

PROJECT NAME

Collect, report and/or review information about on-shore use by indigenous peoples and local communities of HFO (HFO Phase IVb)

Continued from previous work plan.

DESCRIPTION

The objective is to develop a report summarizing the information collected in a field survey in 2018 and 2019 about on-shore use of heavy fuel oil (HFO) by Indigenous peoples and local communities, as well as the extent to which such peoples and communities rely on ships that burn HFO to deliver supplies and provisions. Consideration of a report to the 7th session of the IMO's sub-Committee on Pollution Prevention and Response (PPR) by one or more Arctic States.

LEAD(S) AND PARTNERS

USA - AIA - CCU - Working group partner: SDWG

PROJECT NAME

Collect and summarize information on Arctic State safe and low-impact marine corridor initiatives

Continued from previous work plan.

DESCRIPTION

The objective is to collect information on best practices for safe and low-impact shipping corridors in the Arctic and contribute to enhanced marine navigation safety.

Collect and summarize information on Arctic State safe and low-impact marine corridor initiatives and programs and contribute to enhanced marine navigation safety with a view to submitting a final report to PAME.

LEAD(S) AND PARTNERS

Norway - Possible working group partner: EPPR

PROJECT NAME

A framework for more systematically engaging with Observers on shipping related matters

Continued from previous work plan.

DESCRIPTION

Develop an approach for more systematically engaging with Observers on PAME's shipping-related work and identify opportunities for Observers to contribute to and/or support such work. PAME will convene one or more workshops during the two-year biennium to advance this project.

LEAD(S) AND PARTNERS

USA - Republic of Korea - Italy - Poland - Northern Forum (tbc)

PROJECT NAME

Update of PAME's shipping priorities and recommendations (AMSA recommendation update refresh)

Continued from previous work plan.

DESCRIPTION

The objective is to finalize updates of the Ministerial-approved 2009 AMSA Report Recommendations for consideration and adoption by the Arctic Council and prepare a report that explains and provides a rationale for the proposed changes.

LEAD(S) AND PARTNERS

USA - Canada

PROJECT NAME

Arctic Ship Traffic Data

Continued from previous work plan.

DESCRIPTION

The objective is to further refinement of information contained in the ASTD.

To further augment and refine the information contained in the ASTD as well as enhance its analytical and report generating capabilities. The ASTD was publicly launched on 7 February 2019 and the project will continue to strengthen and debug the database in response to empirical experience and user feedback.

LEAD(S) AND PARTNERS

USA - Norway - PAME Secretariat

PROJECT NAME

Arctic Shipping Best Practice Information Forum

Continued from previous work plan.

DESCRIPTION

The objective is to foster increased used of the Arctic Shipping Best Practices Information Forum web portal. Convene annual meetings of participants and continue the development and expansion of the Forum's web portal (arcticshippingforum.is).

The web-portal includes links to key information related to the IMO's Polar Code and serves as a resource hub of information, guidance and guidelines that aid decision makers involved in Arctic marine navigation and those affected by maritime operations related to the Polar Code. This is in accordance with the Terms of Reference (ToR) for the Arctic Shipping Best Practice Forum (2017).

LEAD(S) AND PARTNERS

Iceland - USA - Canada

PROJECT NAME

Develop an overview of Arctic States' and Observer States' interpretation of the Polar Code

DESCRIPTION

The adoption of the Polar Code was a first step towards ensuring safe and sustainable shipping in the Arctic. In order to ensure the success of the Polar Code there is a need to work towards facilitating, where applicable, consistent implementation and enforcement of the Code.

Based on input from the Arctic States as well as Observer states, a comprehensive overview of maritime administrations' interpretations of the Code will be developed. This exercise will contribute to the establishment of a 'common ground' for interpretation and give an overview of remaining challenges.

LEAD(S) AND PARTNERS

Norway

INVASIVE SPECIES

PROJECT NAME

Implementation Plan for the ARIAS Strategy and Action Plan

Continued from previous work plan.

DESCRIPTION

PAME Chair, will engage with the CAFF Chair and existing Implementation Coordinating Group (ICG) members to propose a new approach for ARIAS implementation. Implementation actions will be led by different Arctic States, PPs, WGs and other Arctic Council subsidiary bodies.

The objective is to reduce the threat of invasive alien species by developing and implementing common measures for early detection, reporting, identifying and blocking pathways of introduction, and sharing best practices and techniques for monitoring, eradication and control.

Any joint projects will need to be approved by both the CAFF and PAME (for marine) and by CAFF (for terrestrial).

LEAD(S) AND PARTNERS

Implementation Coordination Group (CG) co-led by CAFF and PAME

ARCTIC MARINE POLLUTION

PROJECT NAME

Regional Action Plan on Marine Litter

Annex V

DESCRIPTION

To develop a Regional Action Plan on Marine Litter in the Arctic (RAP-ML) addressing both sea and land-based activities, focusing on Arctic-specific marine litter sources and pathways that will play an important role in demonstrating Arctic States' stewardship efforts towards reducing the negative impacts of marine litter, including microplastics, to the Arctic marine environment. The RAP-ML may be updated in subsequent bienniums to address new and emerging information and priorities; therefore, the structure needs to be realistic and adaptable.

Collaboration with other Arctic Council WGs on marine litter activities to ensure that this work is adequately reflected in the first version of the Regional Action Plan.

LEAD(S) AND PARTNERS

Canada - Kingdom of Denmark - Finland - Iceland - Norway - Sweden - USA - AIA - OSPAR - Collaboration with other working groups

PROJECT NAME

Regional Action Plan on Marine Litter: Communication and Outreach activities

DESCRIPTION

Develop outreach and communications material in support of the RAP-ML project.

- i. Marine Litter workshop/conference
- ii. Plastic in a bottle
- iii. Project video
- iv. Arctic marine litter competition
- v. Marine Litter graphics site on the PAME website for outreach purposes

LEAD(S) AND PARTNERS

Same as for the RAP-ML

STRATEGIC DOCUMENTS

PROJECT NAME

AMSP Implementation Status Report 2019-2021

DESCRIPTION

To track progress on implementation of the AMSP forty strategic actions and develop the 3rd AMSP Implementation Status Report in collaboration with other Arctic Council working groups for the period 2019-2021 for submission to the Arctic Council Ministerial meeting in 2021.

LEAD(S) AND PARTNERS

PAME HoDs - PAME Secretariat - Collaboration with other working groups

AMSP: Goal 2

Conserve and protect ecosystem function and marine biodiversity to enhance resilience and the provision of ecosystem services.

BACKGROUND

Arctic marine ecosystems are under increasing pressure from multiple stressors including climate change, ocean acidification, long-range pollution, invasive species and increased human activities. These stressors, individual and cumulative, pose a challenge to the health and sustained viability of Arctic marine ecosystems. Stressors often exacerbate one another, leading to amplified cumulative impacts. Adding to that is the complex and trans-boundary nature of those stressors, which means that solutions often will require international and regional co-operation.

Arctic ecosystem services are of local, regional and global importance. Taking an ecosystem approach to management (EA) can enhance the resilience of marine and coastal biodiversity and help to safeguard marine ecosystems and their functions, allowing people to continue to benefit from the services that flow from healthy ecosystems.

PAME's overall objective is to continue to integrate the ecosystem approach into assessments and management recommendations through follow-up to the 2013 EBM marine-related recommendations, taking into account previous work on Large Marine Ecosystems (LMEs), and new and ongoing EA activities of cross-cutting nature.

ECOSYSTEM APPROACH TO MANAGEMENT

PROJECT NAME

The 2nd International Science and Policy Conference on Implementation of the Ecosystem Approach to Management in the Arctic

DESCRIPTION

Continue to integrate the ecosystem approach into assessments and management recommendations through follow-up to the 2013 EBM marine-related recommendations, taking into account previous work on Large Marine Ecosystems (LMEs), and new and ongoing EA activities of cross-cutting nature. The title of the conference is The Ecosystem Approach to Management of Arctic Marine Ecosystems: Integrating Information at Different Scales in the Framework of EA Implementation.

Topics to be addressed include Integrated Ecosystem Assessment, Ecological Quality Objectives, Marine Protected Areas, National EA Implementation by Arctic States, and the Central Arctic Ocean. While the focus is on EA implementation in the Arctic, the topic of scale integration is general and universal.

The Conference will be held in Bergen, Norway, 25-27 June 2019.

LEAD(S) AND PARTNERS

USA - Norway in close collaboration with the EA expert group

PROJECT NAME

7th EA Workshop

DESCRIPTION

The objective is to continue to integrate the ecosystem approach into assessments and management recommendations through follow-up to the 2013 EBM marine-related recommendations, taking into account previous work on Large Marine Ecosystems (LMEs), and new and ongoing EA activities of cross-cutting nature.

The 7th EA workshop in 2020 with focus on element No. 5 of the EA framework: Value the cultural, social, and economic goods and services produced by the ecosystem.

LEAD(S) AND PARTNERS

USA - Norway in close collaboration with the EA expert group

PROJECT NAME

Report on development in defining or setting Ecological objectives

DESCRIPTION

The objective is to continue to integrate the ecosystem approach into assessments and management recommendations through follow-up to the 2013 EBM marine-related recommendations, taking into account previous work on Large Marine Ecosystems (LMEs), and new and ongoing EA activities of cross-cutting nature.

Report on developments in defining or setting ecological quality objectives in the context of EA implementation in national and international processes.

LEAD(S) AND PARTNERS

USA - Norway in close collaboration with the EA expert group

PROJECT NAME

Integrated Ecosystem Assessment (IEA) of the Central Arctic Ocean

DESCRIPTION

The objective is to provide scientific advice on issues such as the prospect for future fisheries in the central Arctic Ocean and sensitivity and vulnerability to shipping activities. Contribute to the implementation of the EA in the Central Arctic Ocean.

Continue emphasis on development of Integrated Ecosystem Assessment (IEA). Continue to report on developments within ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (WGICA) as well as other ICES activities on IEA, the meetings of scientific experts on fish stocks in the Central Arctic Ocean, and any other relevant activities.

LEAD(S) AND PARTNERS

USA - Norway in close collaboration with the EA expert group

MARINE PROTECTED AREAS

PROJECT NAME

Modelling Arctic oceanographic connectivity to further develop PAME's MPA toolbox

Annex VI

DESCRIPTION

Ongoing climate change may facilitate increased access to the Arctic region, and potential new economic opportunities, but may also bring potential threats to the Arctic marine and coastal environments. These changes could benefit from more integrated approaches to Arctic marine management, including the consideration of MPA networks designed to aid in the conservation and sustainable use of the Arctic environment.

Activities will include the development of models as a tool to help decision makers in designing MPA networks and identifying possible optimal networks of (multiple) MPAs; calculation of optimal network and barriers; coordination meetings and collaboration with other Arctic Council working groups as relevant, in particular with CAFF and its Circumpolar Biodiversity Monitoring Program (CBMP).

LEAD(S) AND PARTNERS

Sweden

PROJECT NAME

Arctic Protected and Important Areas

DESCRIPTION

CAFF and PAME will work jointly to update the 2017 Arctic Protected Areas Indicator Report (APAI) to incorporate protected areas established since 2017.

The APAI data will be compared to the data for the Arctic in the ProtectedPlanet database, managed by the United Nations Environment World Conservation Monitoring Centre. The purpose of this comparison is to determine differences between the two databases and update each database accordingly.

LEAD(S) AND PARTNERS

PAME and CAFF Secretariats in collaboration with the MPA Expert Group

PROJECT NAME

Develop two factsheets on Marine Protected Areas (MPAs) under change

Annex VII

DESCRIPTION

Develop two factsheets on MPAs under change with the aim to leverage and synthesize factual information from the Arctic Council's work on this topic and communicate to decision makers and the public; and contribute to cross-working groups cooperation on common topics.

The 1st factsheet will synthesize factual information on MPAs under change and the role of MPAs in building resilience.

The 2nd factsheet will synthesize factual information on impacts of these changes on indigenous peoples. Translation of the factsheet into the Arctic States' main and minority languages would be a priority.

LEAD(S) AND PARTNERS

USA - Norway in close collaboration with the EA expert group

PROJECT NAME

Expansion and Refinement of the MPA Network Toolbox

(continuation from previous work plan)

DESCRIPTION

Continue enhancing PAME's work on a Pan-Arctic Network of Marine Protected Areas and contribute to some of the near-term actions listed in the Framework for a Pan-Arctic Network of MPAs and the AMSP strategic action 7.2.10.

Expand the MPA Network Toolbox based on the outcomes of the 4th MPA Workshop held on 19-21 March 2019 in Cambridge Bay, Nunavut, Canada, on Exploring ways to support Indigenous/Local involvement in, and Indigenous/Local led, marine protection in the circumpolar Arctic Ocean.

LEAD(S) AND PARTNERS

USA - Norway in close collaboration with the EA expert group

AMSP: Goal 3

Promote safe and sustainable use of the marine environment, taking into account cumulative environmental impacts.

BACKGROUND

Improved access to the Arctic, national and regional priorities, and growing global demand for natural resources are driving an increase in resource extraction, shipping activities, and interest in living marine resources. Safe and sustainable use of living and non-living marine resources should be promoted in a manner that maintains the structure of eco-systems, their functions and productivity, applies EBM and provides economic opportunity. There is substantial potential for economic development in the Arctic that will benefit both local communities as well as the Arctic states.

Pollution in the Arctic marine environment comes primarily from sources outside the region. Impacts from increased economic activities inside the region can, combined with impacts from climate change, ocean acidification and long range pollution, produce cumulative impacts that put strain on these ecosystems. Mining, oil and gas activities, shipping, Arctic settlements, legacy sites such as military bases and mines, and land-based activities, are current and potential sources of marine pollution within the Arctic.

RESOURCE EXPLORATION AND DEVELOPMENT

PROJECT NAME

MEMA Information handbook for engagement with indigenous peoples and local communities

DESCRIPTION

To develop an Information handbook or a reference guide as a practical tool for engagement with indigenous peoples and local communities as a follow-up to the Meaningful Engagement of Indigenous Peoples and Local Communities in Marine Activities (MEMA) project.

LEAD(S) AND PARTNERS

USA - Canada - AIA - ICC - Saami Council in close collaboration with the REDEG expert group. PAME has invited SDWG to participate in this project.

PROJECT NAME

Update/status report on current offshore oil and gas activities by Arctic States

DESCRIPTION

The objective is to describe current oil and gas activities of the Arctic States based on States' submissions of information including on relevant legislation, regulations and practices.

prepare an update/status report on current offshore oil and gas activities by Arctic States. To this end, REDEG will develop a template to facilitate States' submissions.

LEAD(S) AND PARTNERS

USA in close collaboration with the REDEG expert group.

PROJECT NAME

Follow-up on the Framework Plan on Oil Pollution Prevention (FP-OPP)

DESCRIPTION

EPPR, in cooperation with PAME, will continue to report on the status of implementation of the FP-OPP. The Status Report on implementation identifies follow-up activities that support the objectives in the Framework Plan. The report will include input from other Arctic Council working groups and relevant stakeholders capturing activities that are already taking place.

LEAD(S) AND PARTNERS

USA - Canada in close collaboration with the Shipping Experts Group
Working group partner: EPPR

AMSP: Goal 4

Enhance the economic, social and cultural well-being of Arctic inhabitants, including Arctic Indigenous Peoples and strengthen their capacity to adapt to changes in the Arctic marine environment.

BACKGROUND

The health, well-being, and adaptability of Arctic indigenous peoples and local communities are closely linked to the health of the marine ecosystems upon which they rely for food, commerce and cultural needs. Changes to marine ecosystems resulting from global climate change, the introduction of contaminants from outside the region, and other stressors can affect both the access to traditional foods and the quality of that food for indigenous peoples and local communities. It is likely that those living a traditional lifestyle will be most vulnerable to human health impacts from climate change related issues.

CAPACITY BUILDING, INFORMATION OUTREACH AND COLLABORATION

PROJECT NAME

Capacity building, information outreach and collaboration

DESCRIPTION

1. Strengthen information outreach and cooperation and collaboration with international and regional organizations and to build the capacity and engagement of indigenous communities and other Arctic inhabitants.
2. Liaise and exchange information with relevant organizations and programs (e.g. UNEP Regional Seas Programme), and other regional programs.
3. Encourage activities and proposals from Permanent Participants.
4. Strive for the development of outreach and communication efforts and plans for PAME's activities (e.g. through updates on the PAME homepage, brochures, roll-up stands, other communication material)

LEAD(S) AND PARTNERS

PAME Chair - PAME Secretariat

Annex I: Black Carbon emissions from shipping activity in the Arctic and technology developments for reduction

Note: The final project proposal may consider, as appropriate, relevant work under the IMO, and may be revised accordingly, in light of complementarity, by the projects' correspondence group.

Summary

Iceland has conducted research on exhaust gas cleaning and water-in-fuel emulsification and now seeks to expand this work within PAME. The aim of this project is to compare methods of fuel and exhaust gas treatment to find the best way forward to reduce the amount of harmful gases emitted by vessel engines with the goal to write a summary report with recommendations to the Arctic Council and identify common challenges and results within the Arctic Council Member States. Observers are also encouraged to participate.

To date, PAME has undertaken a number of projects that relate to Heavy Fuel Oil (HFO) use and carriage by ships in the Arctic. One aspect of concern in using HFO is the release of air pollutants, such as carbon dioxide (CO₂) and black carbon – the second largest contributor, after CO₂, to human induced climate change (Bond et al., 2013) from all sources. Black Carbon emitted in the Arctic warms Arctic surface temperatures nearly five times more than Black Carbon emitted in mid latitudes (Bond et al., 2013). It is therefore of specific interest and importance to the Arctic region to examine emission control measures.

A great majority of engines used for vessel propulsion are driven by fossil diesel oil. Smaller vessels and smaller engines are generally powered by Marine Diesel Oil (MDO). For larger engines, Heavy Fuel Oil (HFO) is the fossil diesel used as it has greater viscosity than the former. HFO is less refined and cheaper than MDO and is therefore the favored choice among owners of larger vessels. The combustion of any type of fossil diesel creates numerous exhaust gases which are harmful to the environment and human health.

The summary report will be supplemented with an online resource of the information collected for this project.

The project and its result serve as shipping-specific input from PAME on mitigation measures for shipping in the Arctic, which may contribute to the ongoing work within the EGBMC, IMO's PPR Committee, and serve as a basis for future projects within PAME. Special attention will be given to the work within IMO to not duplicate its work.

Background

The 2017 Summary of Progress and Recommendations Report by the EGBCM identified emission abatement technologies as one of the possible ways of achieving the goal of reducing emissions in the Arctic¹. The EGBCM also concluded that Arctic shipping currently accounts for about 5 percent of black carbon emissions within the Arctic and that, absent emission controls, shipping emissions within the Arctic could double by 2030 under some projections of Arctic vessel traffic.²

¹Expert Group on Black Carbon and Methane (EGBCM), *Summary of Progress and Recommendations*, pp. 17. (link to the full report is [here](#))

²Ibid.

Efforts have been undertaken to respond, such as the 2020 global sulphur limit regulation, and the current discussion within the IMO to ban the use and carriage of HFO in the Arctic. Iceland is fully aware of the work within the IMO on this topic and is one of the countries which proposed the HFO ban in the Arctic, and participates fully in work within the IMO, including the Marine Environment Protection Committee (MEPC), the Maritime Safety Committee (MSC) and the sub-committee on Pollution Prevention and Response (PPR). The intent of this project is to supplement and contribute to the ongoing work within IMO on this topic, and project leads will ensure that IMO's work will not be duplicated.

This project will give full consideration to the work of the newly appointed working group within IMO's sub-committee on Pollution Prevention and Response (PPR) i.e. to *"identify candidate control measures to reduce the impact on the Arctic of Black Carbon emissions from international shipping"* and to *"assess the feasibility, safety, availability and effectiveness of the identified candidate control measures, with a view to finalization of the investigation of appropriate control measures at PPR 6"*. Iceland is willing to host a workshop for the project going forward to advance and further streamline its work.

Rationale

In support of this project, reference is made to:

The Arctic Council Task Force on Short-Lived Climate Forcers "Recommendations to Reduce Black Carbon and Methane Emissions to Slow Arctic Climate Change" (2013)³:

- IMO's sub-committee on pollution prevention and response (PPR) comment that it has "noted the need for Black Carbon (BC) measurement studies to gain experience with the application of the definition and measurement methods, invited interested Member Governments and international organizations to initiate, on a voluntary basis, BC measurement studies to collect data. At the same time, information of different potential options to reduce BC is gathered."⁴
- The Summary of Progress and Recommendations Report submitted by the Expert Group on Black Carbon and Methane (EGBCM) to the Fairbanks Ministerial meeting in Fairbanks 2017.
- Fairbanks Ministerial declaration, (paragraph 24) i.e. *"Adopt the first Pan-Arctic report on collective progress to reduce black carbon and methane emissions by the Arctic States and numerous Observer States and its recommendations....."*
- Report to the MEPC from the sub-committee on Pollution Prevention and Response, dated 23 March 2018.
- Greenhouse Gas Emissions from Global Shipping, 2013-2015, published by the ICCT in October 2017.

³https://oaarchive.arctic-council.org/bitstream/handle/11374/80/MM08_ACTF_SLCFsFinalSummaryReport_English_5-13-2013%20%283%29.pdf?sequence=1&isAllowed=y

⁴https://pame.is/images/05_Protectec_Area/2018/Other/PPR_5-7-2_-_Black_Carbon_emission_measurement_results_for_4-stroke_marine_diesel_enginesusing_various_Finland.pdf

- Black Carbon Emissions and Fuel Use in Global Shipping published by the ICCT in December 2017.
- PPR 5/INF.7 – Update to the investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping, submitted to PPR 5 and dated 29 November 2017.
- Communication between PAME and ACAP, AMAP and EGBCM on black carbon, sent July 2018. In their reply to PAME, EGBCM stated that no efforts have yet been made to *“dig deeply into shipping as this could potentially lead to a duplication of work.”* Furthermore, the EGBCM stated that they were *“interested to hear of the progress in PAME and [...] happy to continue with a dialogue.”*

Key Objective

The objective of this project is to compare methods of fuel and exhaust gas treatment to find the best way forward to reduce the amount of harmful gases emitted by vessel engines with the aim to strengthen harmonization, dialogue and cooperation between the Arctic Council member states and Arctic Council Observers on research on possible means by which to reduce the amount of harmful gases emitted by vessel engines.

Scope

- ✓ The project falls under AMSA recommendation II(H) which states: *“That the Arctic states decide to support the development of improved practices and innovative technologies for ships in port and at sea to help reduce current and future emissions of greenhouse gases (GHGs), Nitrogen Oxides (NOx) Sulfur Oxides (SOx) and Particulate Matter (PM) taking into account the relevant IMO regulations.”*
- ✓ The project will seek to gather information from all available sources, including governmental authorities, the maritime industry and indigenous and local communities throughout the Arctic.
- ✓ The project can utilize data from the ASTD database on emissions from ships
- ✓ Synergies with the work of IMO will be ensured
- ✓ The project will have relevance to PAME’s shipping work, including HFO
- ✓ The project will feed into discussions by experts from the member states and observers to work together on the best ways to reduce harmful emissions by ships

Main Components and Implementation

This project will require a nomination of an expert from each of the member states, permanent participants and observers of the Arctic Council. A workshop is scheduled for September 2019, back-to-back with PAME-II 2019. One of the background documents for this project is a study conducted by the Icelandic Transport Authority on this topic: [here](#).

Any local research, data or knowledge will be valuable to the final outcome, as the project will seek to collect a varied and extensive overview.

Timeline and Major Milestones

- ✓ February 2019: PAME-I 2019 meeting approval and confirmation of project leads for inclusion into the 2019-2021 Work Plan.

- ✓ May 2019 – September 2019: Undertake information gathering from publicly available sources and Arctic Council member states.
- ✓ September 2019: Half or whole day workshop, back-to-back with PAME-II 2019.
- ✓ September 2019-February 2020: Continue information gathering and compilation.
- ✓ February 2020: Provide update to PAME-I 2020 on project status, including an outline of the report and a list of information sources.
- ✓ February 2020 – September 2020: Continue information gathering, compile and synthesize information received by 1 June and begin drafting report.
- ✓ September 2020: Submit a draft report to PAME-II 2020 and invite review and comment by 15 November 2020.
- ✓ November 2020 – February 2021: Revise draft report in light of comments received.
- ✓ February 2021: Final draft submitted to PAME-I 2021 for approval and submission to SAOs and Ministerial.
- ✓ March 2021: Present any revisions to SAOs.
- ✓ May 2021: Finalize report for Ministerial.

Indicative Budget

Consistent with the overall Arctic Council approach, the development of this project will be financed through voluntary contributions and in-kind support from member governments. Financial contributions may be sought from other sources as well, such as the Nordic Council of Ministers.

Item/activity	Budget (USD/in-kind)
Project management, coordination, consultation and outreach	50.000
External expert(s)	15.000
Workshop	30.000
Editing, final layout and printing	10.000
Estimated Total:	105.000

Main outcomes

The final product will be a written summary report and an online resource containing an overview of different ongoing research projects, preferably with information related to methodology, technical execution, necessary equipment and key measurements. It will serve as shipping-specific input from PAME on mitigation measures for shipping in the Arctic, which may contribute to the ongoing work within the EGBMC, IMO's PPR Committee, and serve as a basis for future related projects within PAME.

Project Team Structure/Lead Countries

- ✓ Leads: Iceland (Jon Bernodussón, Icelandic Transport Authority; Anna Margret Björnsdóttir, Icelandic Transport Authority); Others?
- ✓ Each Arctic Council member government and Permanent Participants' organization to appoint a project team member.
- ✓ Collaboration, inputs and synergies will be important, in particular with the EGBCM, IMO and the industry, as relevant.
- ✓ The PAME Secretariat will provide administrative and project assistance.
- ✓ Other Arctic Council working groups will be consulted accordingly.

Annex II: Arctic Shipping Status Reports (ASSR)

Final project proposal prepared by the PAME Secretariat

Background

The project will illustrate ship traffic in the Arctic through maps, graphs and tables with explanatory text, using selected data extracted from the Arctic Ship Traffic Database (ASTD) and other sources as relevant. The aim is to provide a snapshot on Arctic shipping to illustrate, for example, a graphical depictions of the number, type, size, and flag of ships sailing in the Arctic over a defined period and/or a defined area, shipping routes, distances traveled, aggregate air emissions, fuel types, and traffic destinations in the Arctic, coupled with e.g sea-ice information and LMEs. The project will produce and communicate the information in an illustrative way, e.g. with Story maps or by other similar explanatory means online – to be decided by the project team. A good explanation of story maps can be found [online here](#). Synergies and cross-reference will be made to other PAME shipping-related projects and other Arctic Council projects.

Key Objectives

- ✓ Utilize the ASTD System to develop a user-friendly, illustrative informational factsheets online on Arctic shipping through e.g. the producing of a number of Story maps to highlight interesting aspects of Arctic shipping activities – or by other means to be decided by the project team.

Inclusion/involvement/contribution by Permanent Participants: The project will invite Permanent Participants to co-lead the project and/or to participate in the project team and to overview the informational factsheets.

Traditional and Local Knowledge (TLK): TLK will be considered in this project, as relevant.

Main Components and timeline

1. **Data selection** (based on agreement by the project team and input from the Shipping Expert group):

Identify which data to use for the project, such as:

- ✓ Arctic shipping (number of ships in the Arctic, sailed distance, operational time/hours spent in certain areas, type of ships, size of ships and flag)
- ✓ Ports information (e.g. information on changes in ship types docking in certain ports)
- ✓ Area shipping (ships in certain areas, including the Arctic LME's and Arctic Marine Protected Areas)
- ✓ Pollution by ships (e.g. ship emissions)
- ✓ And others as available and identified, including sea ice information, biodiversity e.g.

2. **Data synthesis**

To decide how to portray and compile the data. This can range from a status report, informational factsheets online, text and other information on a website, or Story maps. This also includes to identify input from others, including to identify experts to assist with specific

sections of the project, e.g. the EA-Expert Group if information on shipping in LME's is compiled or the MPA Expert Group in relation to shipping within the MPA's.

3. Communication and outreach

- ✓ Dependent on the Data synthesis and what the project team decides is the best way forward, will include posting of all information online.
- ✓ Twitter communication series: Highlighting certain information from the project and post online in a series of tweets for communication and outreach.
- ✓ Other social media activities, including postings PAME's Facebook and Arctic Council Secretariat social media accounts.

Timeline and Major Milestones:

(to be further developed)

May-Aug 2019: Data selection and synthesis

Aug 2019-May 2021: Develop information products

May 2021: Submit the products to the Arctic Council ministerial meeting as information items

Main outcomes

- ✓ Informational product or products on Arctic shipping activities
- ✓ Online products on PAME website

Overall Estimated Budget:

Consistent with the overall Arctic Council approach, this project will be financed with in-kind support. Financial contributions will be sought from other sources, such as the Nordic Council of Ministers. The PAME Secretariat will provide website expertise, data gathering, and the Story maps production.

Item	Budget (USD/in-kind) ⁵
Project management, coordination, consultation and outreach	25.000
Data gathering and synthesis	30.000
Communication and outreach	20.000
Editing, final layout and online posting	10.000
Estimated Total:	85.000

⁵ The budget is based on in-kind contributions and is not considered as a part of the ASTD budget.

Project team

USA will lead this project. The PAME Secretariat will provide administrative and project assistance. The project will seek input from the Shipping Experts Group. Other Arctic Council working groups will be consulted accordingly.

Annex III: Arctic Marine Tourism: Development in the Arctic and enabling real change

Background:

The [Arctic Marine Tourism Project – Best Practice Guidelines document \(AMTP\)](#), was approved at the Iqaluit 2015 Ministerial Meeting. It is a voluntary document encouraging action on behalf of the Arctic Council, Arctic States, and in some instances collaboration between the two, and is meant to strengthen, not preclude, the range of existing mandatory requirements and voluntary policies and guidance currently in place to support sustainable and responsible Arctic marine tourism issued by levels of government, Indigenous communities, industry, industry associations and the NGO community.

AMTP recommended that the Arctic Council should note the potential benefits of sustainable Arctic marine tourism and be mindful that these benefits are best realized through active and collaborative engagement among coastal communities, government agencies, industry, academia, and other stakeholders. Based on this, follow up on selected AMTP recommendations is proposed during the 2019-2021 period with the aim to better understand and assess impacts from the growing Arctic marine tourism sector. Potential next steps in 2021-2023 could e.g. involve more specific socio-economic activities/tasks carried out by other Arctic Council working groups, such as the SDWG, potentially in collaboration with PAME.

This project will contribute to the following AMTP recommendations:

- ✓ *Compile a publicly available repository of circum-Arctic marine tourism information.*
- ✓ *Develop a standardized framework for, and encourage the preparation of, site-specific guidelines for near-shore and coastal areas of the Arctic visited by passengers of marine tourism vessels and pleasure craft.*

Furthermore, this project contributes to follow-up on the following Arctic Council documents:

- ✓ The 2006 Final Report on Sustainable Model for Arctic Regional Tourism (SMART) (download [here](#)).
- ✓ The Arctic Marine Shipping Assessment (2009) Recommendation I(D): Strengthening Passenger Ship Safety in Arctic Waters.
- ✓ The Arctic Ocean Review (2013), recommendation (4) that the “Arctic states should explore the possibility of developing voluntary guidelines and, if appropriate, best practices in implementing such guidelines for sustainable tourism. Moreover, that the role the cruise industry plays in facilitating tourism in the region and the impacts of this industry on Arctic peoples, ecosystems and the environment should be acknowledged. The Arctic Council should also give consideration towards the development of a broader sustainable tourism initiative.”
- ✓ The Arctic Marine Strategic Plan, including Strategic action 7.3.5: “Develop recommendations for consideration by Arctic states to promote maritime safety and environmental protection with the objective of reducing risks related to international shipping activities in Arctic waters.”

Objectives

The project has the following two components:

Work package 1 objective: Arctic Marine Tourism knowledge and information

- To compile data on tourism vessels in the Arctic using the ASTD database to better understand recent developments, identify gaps in data, and explore the feasibility to map the use and carriage of AIS by vessels not obligated to do so by IMO regulations.

Work package 2 objective: Framework for Best Practice Guidelines

- To summarize existing site-specific guidelines for near-shore and coastal areas of the Arctic visited by passengers of marine tourism vessels and pleasure crafts.

The final product would be a summary report with recommendations on next steps, for Ministerial approval in May 2021.

Scope and Approach

- ✓ The project has direct relevance to PAME's Arctic Ship Traffic Data (ASTD) system, which contains detailed information about ships in the Arctic.
- ✓ The geographic scope of the project is left to each Arctic state to determine and should focus on areas of Arctic-specific nature.
- ✓ The project will contribute to PAME's work on HFO, as it could contribute to gathering information about emissions and other vectors of pollution (e.g. greywater) by cruise ships and, where appropriate, pleasure crafts.

Main Activities

This project is composed of two work packages which can either run in parallel or as back-to-back activities.

Work package 1: Arctic marine tourism knowledge and information

To compile data on tourism vessels in the Arctic using the ASTD database to better understand recent developments, identify gaps in data, and explore the feasibility to map the use and carriage of AIS by vessels not obligated to do so by IMO regulations.

- i. Assessing the trends in the Arctic marine tourism based on e.g. available information in the ASTD system to include the number of cruise ships, their size, pollution information etc.
- ii. The project will also identify where there are gaps in data, including in remote areas, the effect of gaps and potential next steps to close these gaps.

Work package 2: Framework for Best Practice Guidelines

To summarize existing site-specific guidelines for near-shore and coastal areas of the Arctic visited by passengers of marine tourism vessels and pleasure crafts.

- i. The aim is to identify common themes in existing guidelines, and make them publically available in one place.
- ii. Seek input from the Indigenous Peoples and local communities who are impacted by the marine tourism industry.

- iii. Coordinate with the marine tourism industry, such as the Association of Arctic Expedition Cruise Operators (AECO) as they have made [guidelines](#), including visitor guidelines and site-specific guidelines in Svalbard and Franz-Josefs land.
- iv. Next steps and recommendations will be a key component of the project.

Timeline and Major Milestones

- ✓ Feb. 2019: Approval by PAME of project proposal – co-leads identified
 - Project team assembly in succession
 - Finalization of project plan, including report content and project scope
 - Seek input from other working groups
- ✓ May 2019: Project in approved PAME Work Plan at Ministerial meeting
- ✓ Sept. 2019: PAME II-2019 meeting
 - Project team meeting
- ✓ Oct. 2019: Possible project workshop
 - Invitation of AECO and other related tourism industry bodies
 - Aim to feed into the report
 - Identify data from the ASTD database to analyze and portray in repository
 - Identify relevant conferences/meetings to participate in to present the work
- ✓ Nov. 2019: Work on online repository
- ✓ Feb. 2020: PAME I-2020 meeting
 - Project team meeting, including on communication material
- ✓ Sept. 2020: PAME II-2020 meeting
 - Draft report submitted to PAME
 - Launch of the online repository of shipping analysis
- ✓ Feb. 2021: PAME I-2021 meeting
 - Products approved by PAME
 - Project team meeting
- ✓ May 2021: Report (for approval) and repositories (for information) presented at ministerial meeting

Overall estimated Budget:

Consistent with the overall Arctic Council approach, the development of this project will be financed through voluntary contributions and in-kind support from member governments. The proposed stepwise approach, with PAME approval required for each phase, will facilitate financial planning and budgets. Financial contributions will be sought from other sources as well, such as the Nordic Council of Ministers.

Item	Budget (USD/in-kind)
Project management and coordination	30.000
External expert(s)	15.000
Project team meeting/Workshop	20.000
Technical: Operability of the Repository with the ASTD system	15.000
Communication and outreach material	15.000
Editing, final layout and communication	15.000
Estimated Total:	110.000

The PAME Secretariat will provide support with data and will be responsible for setting up the online repository.

Main outcomes:

- ✓ A summary document with recommendations.
- ✓ Online repository of information, including data, maps, and a repository of best practice guidelines.
- ✓ Outreach material, e.g. factsheets or online information campaigns.

Project Team Structure/Lead Countries

Iceland and Canada will co-lead. the project. All Arctic Council Member States, Permanent Participants and Observers are invited to participate.

Annex IV: Underwater Noise in the Arctic – Understanding Impacts and Defining Management Solutions - Phase I

Background and Project Summary

Sound levels in the Arctic are generally lower than in non-polar regions, however, levels are projected to rise in the coming decades. Declines in sea ice extent and duration, and increases in human activity – in particular shipping, oil & gas exploration and development, construction and other industrial activities – will contribute to a louder, busier Arctic. In absolute terms, the Arctic is likely to remain quieter than many regions around the world where activity is particularly intense, but the relative change may be dramatic.

The Arctic is a special case for underwater noise:

- 1) Any introduction of noise in the Arctic is likely to have a greater impact than in a region where the levels are already high. Indeed, Arctic wildlife are not acclimated to noisy environments and therefore may be disproportionately affected by even modest noise increases;
- 2) There are noise sources that are particular to the Arctic such as ice formation and break-up as well as current anthropogenic noises associated with ice breaking activity;
- 3) Sound travels differently in Arctic waters over much greater distances at shallower depths than in non-Arctic waters; and
- 4) Most importantly, the culture and livelihoods of Indigenous peoples in the Arctic depend on the continued health of marine mammals, more so than in other regions of the world. Noise impacts affecting the behaviour of these mammals will be immediately felt in these communities.

Internationally, work is currently underway in numerous fora to better understand the impacts and identify ways to mitigate the effects of underwater noise, including at the International Maritime Organization (IMO), the International Whaling Commission (IWC) and at the United Nations (UN) more generally. Accordingly, given its mandate to address marine policy measures, PAME has a valuable role to play in providing insight and information to these and other fora.

The *Underwater Noise in the Arctic – Understanding Impacts and Mitigation Strategy Options* proposal for 2019-2021 is designed as an adaptable and multi-phased project, with a scope that will focus on coordinating and collaborating with other Arctic Council working groups (e.g., CAFF) to assemble and integrate existing information about shipping patterns in the global Arctic, estimating and mapping vessel noise levels and areas of ecological and cultural overlap, and identifying possible mitigation strategy options.

Key Objectives

Phase One

Using information from the PAME Arctic Ship Tracking Data (ASTD) project, and in collaboration with CAFF as appropriate:

- Obtain a better understanding of, and estimate the current underwater noise emissions (or ‘noiseprint’) from shipping in the Arctic.

- Identify areas where underwater noise from shipping and areas of heightened ecological or cultural significance overlap as identified by the Arctic Council.
- Based on the results obtained, and recognizing the limitations inherent to high-level analyses, investigate possible mitigation strategy options to reduce the impact of underwater noise incidentally generated by shipping in the Arctic. Expert input and traditional and local knowledge will be used to inform any such options.

Phase Two (for consideration during 2021-2023)

- Consider the impacts to marine biodiversity from underwater noise in the Arctic outside the shipping sector
- Consider the economic costs and benefits to communities and vessel operators of potential management options from related sources of anthropogenic underwater noise.

Scope and Arctic Council Goals

These projects will follow on and utilize information from, *inter alia*, PAME's Arctic Marine Shipping Assessment (2009), AMAP/CAFF/SDWG's report to identify Arctic marine areas of heightened ecological and cultural significance (2013), and PAME's state of knowledge report on the impacts of underwater noise to Arctic biodiversity (in review, 2019).

Geographically, the project will encompass the CAFF defined Arctic and focus, in phase one, on noise generated by ships. The project will involve PPs, observers and member states of PAME and CAFF; recognized experts, especially those involved with the ASTD project and local Indigenous knowledge holders; and international academics and those following IMO, United Nations, European Commission and International Whaling Commission-relevant processes.

Note: See below linkages to all four goals of the Arctic Council's Arctic Marine Strategic Plan (2015-2025) and AMSP strategic actions.

Main Components and Implementation

Note: Individual components/projects to be done in order and to be completed as time/resources allow.

Phase One

Project 1, 2019-2021: Noise Intensity Maps

Focusing on the shipping sector, project leads will convene interested PAME and CAFF participants along with ASTD leads to develop a report on determining, cataloging, and potentially mapping estimated noise emissions of vessels in the Arctic. Through a series of webinars, and one in person meeting on the margins of either a CAFF or PAME regular working group meeting, participants with (if deemed necessary) the help of a contractor to lead and manage the project, and to produce noise intensity maps for ships in the CAFF defined Arctic based on available data.

Methods:

- Ship tracks mapped through the PAME ASTD project.
- Noise outputs estimated using existing knowledge on ship noise emissions complemented as needed by other data sources available through the ASTD project

(e.g. IHS Fairplay, Shipinfo, DNV-GL, etc).

Outputs:

- A catalogue of noise intensity maps throughout the Arctic Region, where maps spatially and seasonally depict and quantify estimated underwater noise from shipping. More discrete areas of the Arctic Region could be prioritized based on workload and resource availability.
- A high-level ‘snapshot’ of ship-produced underwater noise levels across the Arctic.

Project 2, 2019-2021: Exposure Risk Analysis

This work item utilizes previous Arctic Council work^{6,7,8} with an aim to understand the spatial and seasonal intersection of underwater ship noise with areas of heightened ecological or cultural significance in the Arctic.

Methods:

- Define areas of cultural and ecological sensitivity to underwater noise. Use existing Arctic Council reports and other available data.
- Identify areas of overlap between increased noise due to shipping and areas of ecological and or cultural significance in the Arctic Region.

Outputs:

- Maps produced by overlaying noise intensity maps with existing information on marine areas of heightened ecological or cultural significance.

Project 3, 2019-2021; Understanding Impacts and Impact Reduction Options

Methods:

- Develop a matrix of existing guidelines and protocols pertaining to mitigating underwater noise impacts. A comprehensive matrix would include guidelines or recommendations developed by intergovernmental agencies (e.g. IMO, IWC), national jurisdictions, Indigenous communities, scientific or environmental organizations and shipping industry associations.
- Assess guidelines and protocols and their degree of uptake as well as, if possible, their efficacy. Consider employing user surveys and draw on case studies of specific regions where marine mammals have been closely studied before and during the implementation of noise limitation or marine mammal avoidance guidelines.
- Convene an experts’ workshop or Delphi process to rate or assess the guidelines for their pertinence in Arctic waters.

⁶ AMAP/CAFF/SDWG, 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Programme (AMAP), Oslo. 114 pp.

⁷ Arctic Council Arctic Marine Shipping Assessment 2009 Report.
www.pame.is/images/stories/PDF_Files/AMSA_2009_Report_2nd_print.pdf

⁸ PAME, 2019. Underwater noise in the Arctic: A state of knowledge review. In prep.

Outputs:

- Potential approaches for the Arctic Council to communicate to regulators and state authorities to mitigate underwater noise across the Arctic.
- Based on the results obtained, and recognizing the limitations inherent to high-level analyses, investigate possible options to reduce the impact of underwater noise from shipping in the Arctic. Expert input and traditional knowledge will be used to inform any such options.

Phase Two

TBD, potentially 2021-2023 PAME workplan

- Consider the impacts to marine biodiversity from underwater noise in the Arctic outside the shipping sector
- Consider the economic costs and benefits to communities and vessel operators of potential management options from related sources of anthropogenic underwater noise.

Budget:

Consistent with the overall Arctic Council approach, the development of this project will be financed through voluntary contributions and in-kind support from member governments, though will leverage wherever possible information from existing Arctic Council reports, and outputs from the recently created ASTD system.

The proposed stepwise or 'project-based' approach is designed to be conservative and to take into consideration financial and resource limitations. This notwithstanding, financial contributions will be sought to supplement in-kind work from other sources as well, including the Nordic Council of Ministers.

Main Outcomes:

- The production of noise intensity maps for shipping in the CAFF defined Arctic region, overlaid with areas of ecologically and/or cultural significance;
- Based on the results obtained, and recognizing the limitations inherent to high-level analyses, investigate possible options to reduce the impact of underwater noise from shipping in the Arctic. Expert input and traditional knowledge will be used to inform any such options.

Project Team Structure/Lead Countries:

Canada, WWF

Proposed Timeline:

Note: While projects below are generally designed to follow in chronological order, the exact year of completion will be subject to resource availability.

Year 1:

Project 1: Noise intensity maps produced. 'Snapshot' of estimated noise levels estimated for all or parts of the Arctic Region as agreed upon by Project Team.

Project 2: Sensitivity of marine areas to shipping reviewed and updated, sensitivity of marine areas to other sources of noise completed.

Project 3: Existing guidelines on mitigation of ship noise impacts reviewed.

Year 2:

Project 2: Noise intensity maps overlaid with existing information on marine areas of heightened ecological and cultural significance. Maps reviewed and updated as needed.

Project 3: Mitigation strategy options defined for underwater noise from shipping in the Arctic.

-
- The proposal will advance the implementation of all 4 goals of the Arctic Council's Arctic Marine Strategic Plan (2015-2025); more precisely it will contribute to implementing the following AMSP strategic actions:

(http://www.pame.is/images/03_Projects/AMSP/AMSP_implementation_Final.pdf)

- 7.1.2 Improve, synthesize, and respond to emerging knowledge across all disciplines and sectors to include government, academic and industry information, and traditional and local knowledge
- 7.1.3 Improve the understanding of cumulative impacts on marine ecosystems from multiple human activity-induced stressors such as climate change, ocean acidification, local and long range transported pollution (land and sea-based), marine litter, noise, eutrophication, biomass overharvesting, invasive alien species and other threats
- 7.1.8 Improve awareness of Arctic shipping activity and its impacts, promote expanded information sharing of ship traffic data among Arctic states and, as appropriate, other stakeholders, and update selected parts of the 2009 Arctic Marine Shipping Assessment (AMSA) Report, including those pertaining to the volume, composition and destination of Arctic shipping, shipping impacts, and key infrastructure needs such as hydrographic surveying and nautical charting.
- 7.1.11 Support continued development of circumpolar indicators of changes and stressors across the Arctic marine environment, as well as metrics for monitoring biodiversity. [not sure]
- 7.2.1 Promote the implementation of the ecosystem approach to management in the Arctic through synthesis and application of the results of relevant work by the Arctic Council and associated efforts by relevant organizations.
- 7.2.2 Identify and assess threats and impacts to areas of heightened ecological and cultural significance and how such areas may be influenced in the future by climate change and other human induced changes and activities.
- 7.2.3 Identify and develop tools and methodologies for assessing cumulative impacts and risks for Arctic marine ecosystems and areas of heightened ecological and cultural significance with the aim of using them for integrated assessments.

- 7.2.4 Encourage the Arctic states to implement appropriate measures, – or to pursue such measures at relevant international organizations to protect Arctic marine Areas of Heightened Ecological and Cultural Significance. Focus should be on species and ecosystems particularly at risk from climate change and cumulative impacts, including areas of refuge for ice-associated species that are, or are expected to become particularly important to Arctic marine biodiversity under future climate conditions.
- 7.2.7 Promote cooperation among Arctic and non-Arctic states to address threats to the staging and wintering grounds and migrating corridors of migratory species using the marine environment.
- 7.2.10 Develop a pan-Arctic network of marine protected areas, based on the best available knowledge, to strengthen marine ecosystem resilience and contribute to human wellbeing, including traditional ways of life.
- 7.3.1 Advance EBM as an overarching framework for conservation and sustainable use of living and non-living resources in the Arctic marine environment, taking into account cumulative impacts on the Arctic and the need for adaptation to climate change.
- 7.3.2 Improve the understanding of risks and risk reducing measures related to Arctic shipping and oil and gas exploration and development activities, including gap analysis and sharing of best practices related to oil spill prevention, preparedness and response to emergencies in the Arctic
- 7.3.5 Develop recommendations for consideration by Arctic states to promote maritime safety and environmental protection with the objective of reducing risks related to international shipping activities in Arctic waters.
- 7.3.6 Advance continuous improvement of safety and environment protection performance and the use of best and most appropriate practices and technology for all marine activities.
- 7.3.8 Promote the management of human activities in the circumpolar Arctic in accordance with Ecosystem Based Management and international law to ensure long term sustainability of stocks and ecosystems.
- 7.3.12 Strengthen the dialogue with relevant business, industry and environmental stakeholders and Arctic inhabitants in order to foster conservation and sustainable use of the Arctic marine environment.
- 7.3.13 Strengthen the dialogue with industry (including through the Arctic Economic Council) in order to foster sustainable development in the Arctic.
- 7.4.1 Improve meaningful engagement of Arctic indigenous peoples and other Arctic inhabitants in relevant decisions, including through the consideration and use of traditional and local knowledge (TLK) in avoiding or mitigating negative environmental, subsistence, and cultural impacts, as well as in maintaining or increasing wellbeing and socioeconomic opportunities.
- 7.4.2 Facilitate coastal community exchanges between Arctic states to improve sharing of knowledge and experiences and to strengthen the dialog with relevant business and industry in the Arctic in order to foster the conservation and sustainable use of the Arctic marine environment.

- 7.4.4 In cooperation with the Permanent Participants, encourage engagement, as appropriate, with indigenous peoples organizations and bodies, that have specialized in traditional knowledge and that can inform the work of the Arctic Council in the protection of the marine environment and in enhance the well-being and the capacity of Arctic inhabitants, including Arctic indigenous peoples to deal with a changing Arctic and increased activity.
- The proposal will also support the implementation of recommendations from the Arctic Marine Shipping Assessment:
 - IIG. Addressing Impacts on Marine Mammals: That the Arctic states decide to engage with relevant international organizations to further assess the effects on marine mammals due to ship noise, disturbance and strikes in Arctic waters; and consider, where needed, to work with the IMO in developing and implementing mitigation strategies.
- The proposal will also advance the implementation of the following CAFF Actions for Arctic Biodiversity:
 - Advance ecosystem-system based management recommendations approved in the Kiruna Declaration (including Actions 3.1 to 3.4).
 - Strengthen and develop new strategic partnerships, particularly with industry, to seek innovative solutions and expand responsibility for taking care of biodiversity (Action 4.1).
 - Provide information, expertise, and recommendations on conservation of Arctic ecosystems to policymakers (action 4.5).
 - 16.7. Assess the effects on marine mammals of ship noise, disturbance and strikes in Arctic marine waters and, where needed, develop and mitigation strategies (AMSA IIG).

Annex V: Regional Action Plan on Marine Litter

Phase II: Marine Litter in the Arctic

The development of a Regional Action Plan (RAP) on Marine Litter in the Arctic builds upon the Phase I Project “Desktop Study on Marine Litter including Micro-plastics in the Arctic (2019)”, which was based on best available science, indigenous knowledge, and other information at the time of completion. The RAP may be updated in subsequent bienniums to address new and emerging information and priorities; therefore the structure needs to be realistic and adaptable. This project will address both sea and land-based activities, focusing on e.g., Arctic-specific marine litter sources and pathways, which will play an important role in demonstrating Arctic States’ stewardship efforts towards reducing the negative impacts of marine litter, including microplastics, to the Arctic marine environment.

Project Title:

Regional Action Plan on Marine Litter in the Arctic

Phase II (2019-2021):

- a) Develop a first version of a Regional Action Plan on Marine Litter in the Arctic based on the Desktop Study on Marine Litter (Phase I) and other resources and information, as relevant and specific to the Arctic.
- b) Collaborate with other Arctic Council Working Groups working on marine litter activities, such as AMAP’s work on monitoring, CAFF’s work on impacts of marine litter on wildlife, ACAP’s work on solid waste management, and others as relevant to marine litter in the Arctic to ensure that this work is adequately reflected in the first version of the Regional Action Plan.
- c) Continue the development of outreach and communication material.

Background

The universal challenge of addressing and managing marine litter is a useful illustration of the global and transboundary nature of many marine environmental problems, and marine litter is one of the most pervasive pollution problems affecting the marine environment globally. The United Nations Environment Programme (UNEP) defines marine litter as ‘any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment’. Marine litter consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds; or accidentally lost, including material lost at sea in bad weather.

Arctic Council Ministers adopted the Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities (Arctic RPA) in 1998 and updated it in 2009. The Arctic-RPA is a dynamic programme of action that uses a step-wise approach for its implementation and recognizes the continually evolving and dynamic situation in the Arctic environment and the need for an integrated and holistic approach. It is the regional extension of the [Global Programme of Action for the Protection of the Marine Environment from Land-based Activities \(GPA\)](#), and as such provides a framework for addressing the main pollution

source categories and responding to the global concerns. Marine litter is one of nine⁹ contaminant categories of the GPA and the Arctic RPA. Other international organisations such as UNEP, the International Maritime Organisation, and Regional Seas Conventions such as OSPAR have instigated processes to combat marine litter.

The development of a RAP on Marine Litter in the Arctic builds upon the Phase I Project “Desktop Study on Marine Litter including Micro-plastics in the Arctic (2019)” with the aim to provide information on the current status on this topic in the Arctic. (further information [here](#)). The Desktop Study lists a number of findings, gaps, and recommendations on next steps for PAME’s and other Arctic Council Working Groups’ considerations as relevant to their respective mandates.

It is envisioned that the RAP may be updated in subsequent bienniums to address new and emerging information and priorities, necessitating a realistic and flexible structure that remains adaptable. This project will address both sea and land-based activities, focusing on Arctic-specific marine litter sources and pathways, which will play an important role in demonstrating Arctic States’ stewardship efforts towards reducing negative impacts of marine litter, including microplastics, to the Arctic marine environment.

Objectives

The overarching objective is to develop a Regional Action Plan on Marine Litter addressing both sea and land-based activities, focusing on Arctic-specific marine litter sources and pathways. The flexible structure will allow for periodic updates, as appropriate, and incorporation of new and emerging information and priorities as identified through ongoing or novel studies by the Arctic Council, the Arctic States, and others.

Phase II Objectives (2019-2021):

- ✓ Develop a first version of a Regional Action Plan on Marine Litter in the Arctic reflecting findings, gaps, and recommendations of the Desktop Study on Marine Litter (Phase I).
- ✓ Consult and coordinate with other Arctic Council Working Groups as relevant in scoping out a Regional Action Plan on Marine Litter in the Arctic.
- ✓ Continue the development of outreach and communication material to enhance knowledge and awareness of marine litter in the Arctic.
- ✓ Engage with Indigenous and local communities and other relevant stakeholders.
- ✓ Contribute to the prevention and/or reduction of marine litter in the Arctic and its impacts on marine organisms, habitats, public health and safety, and society.

In the long term, a Regional Action Plan on Marine Litter in the Arctic can assist Arctic States in working toward Sustainable Development Goal (SDG) 14, target 14.1: *“by 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.”*

⁹ The other eight are: Sewage/Wastewater, Physical alterations and destruction of habitats, Nutrients, Sediments mobilization, Persistent organic pollutants (POPs), Oils, Heavy metals and Radioactive substances

Scope and Approach

This project will address both sea and land-based activities, focusing on Arctic-specific marine litter sources and pathways, which will play an important role in demonstrating Arctic States' stewardship efforts towards reducing negative impacts of marine litter, including microplastics, to the Arctic marine environment. It is envisioned that the Regional Action Plan may be updated in subsequent bienniums, as appropriate, based on emerging information (e.g., ongoing or new studies by the Arctic Council, the Arctic States, and others, as relevant) and/or evolving priorities. Thus it is important that the Regional Action Plan be realistic, flexible, and structured in a manner that can easily be adapted to modify scope and content.

It may be necessary to revisit the scope and approach at a later stage as work proceeds.

Main activities during the 2019-2021 period:

- i. **Develop a first version of a Regional Action Plan on Marine Litter in the Arctic:**
 - a) Take stock of existing sources of information, including from the Desktop Study on Marine Litter (Phase I), national and regional efforts, other guidelines, as relevant.
 - b) Consider the themes listed below for potential sections of the Action Plan as guidance in developing a stepwise approach in selecting action measures. It is preferable that actions be supported by scientific assessments on marine litter at the regional level to allow baselines to be set:
 - Actions to reduce or eliminate sea-based sources of marine litter
 - Actions to reduce or eliminate land-based sources of marine litter
 - Removal Actions and Disposal
 - Monitoring/Scientific Research
 - Education and Outreach
 - c) Consider setting priority actions based on elements such as:
 - Data and information in Phase I: Desktop Study on Marine Litter including Micro-plastics in the Arctic
 - Data gaps and research needs
 - Indigenous Peoples and other stakeholder input, as appropriate
 - Major sources and pathways of marine litter
 - Efforts and priorities of other Arctic Council Working Groups
 - d) Take into account relevant principles and approaches applicable to efforts to combat marine litter

Education and Outreach (see Annex): Develop a project video, on-line brochures, and launch of the “plastic-in-bottle” project. An education package will be launched in August 2020, including an international litter competition, targeting students to increase awareness of marine litter and how to decrease the challenge with litter. *(Main responsibility: PAME, in close coordination with other AC Working Groups)*

Coordination and collaboration: with other Arctic Council Working Groups working on marine litter activities, such as AMAP's work on litter monitoring, CAFF's work on impacts of

marine litter on wildlife, ACAP's work on solid waste management, and others as relevant to marine litter in the Arctic to ensure that this work is adequately reflected in the first version of the Regional Action Plan

The Development of a first version of the Regional Action Plan is an iterative process with formulation of detailed measures which may be revised or revisited during future phases of this work, or when further knowledge and information has been gained.

Timeline and Major Milestones (2019-2021):

In addition to the main activities, this phase will follow-up with activities from phase I, including outreach and communication. It is envisioned that the project will commence an expert group workshop to advance this work, in addition to meetings and teleconferences as needed.

Main tasks:

April 2019	Arctic Council Ministerial – approval of PAME Work Plan
May 2019	Establish a marine litter expert group and invite experts from other Arctic Council Working Groups to join.
May 2019	First teleconference to develop Terms of Reference (ToR) for the expert group
June 2019	Follow-up expert group teleconference
September 2019	Presentation by project co-leads and discussions/inputs at PAME II-2019
2019	Potential workshop/conference to advance the Regional Action Plan development (details to be provided and this may become a part of the proposed Plastic Conference plan by the Icelandic Arctic Council Chairmanship),
October 2019	Presentation at the SAO meeting and guidance sought, as appropriate
February 2020	Presentation by project co-leads and discussions/inputs at PAME II-2020
March 2020	Presentation at the SAO meeting and guidance sought, as appropriate
August 2020	Launch the Arctic marine litter education and competition package
September 2020	Presentation by project co-leads and discussions/inputs at PAME II-2020
October 2020	Presentation at the SAO meeting and guidance sought, as appropriate
February 2021	Presentation by project co-leads and discussions/inputs at PAME II-2019
September 2021	Presentation by project co-leads and discussions/inputs at PAME II-2019

March 2021	Submission of an outline of a Regional Action Plan outline to SAOs for approval
Mars/Apr 2021	Final layout and preparation for Ministerial
April 2021	Arctic Council Ministerial

Overall estimated budget: Phase-II (2019-2021)

Consistent with the overall Arctic Council approach, the development of this project will be financed through voluntary contributions and in-kind support from PAME members. The proposed stepwise approach, with PAME approval required for each phase, will facilitate financial planning and budgets. Financial contributions will be sought from other sources as well, such as the Nordic Council of Ministers and the Arctic Council Project Support Instrument (PSI).

Item	Budget (USD/in-kind)
Project management, coordination, consultation and outreach	100.000
External expert(s)	20.000
Workshop	40.000
Editing, final layout and printing	10.000
Arctic marine litter education and competition package	50.000
Estimated total	220.000

Project team Structure/Lead Countries

- ✓ Leads: Iceland, Norway, Sweden, Canada, Finland, Kingdom of Denmark,, USA, AIA, OSPAR.
- ✓ Each Arctic State government and Permanent Participants' organization are invited to appoint a project team member for the project team, as well as participating at the Marine Litter Expert Group meetings twice a year.
- ✓ Collaboration with other Arctic Council Working Groups, as relevant, and other organizations, as appropriate.
- ✓ The PAME Secretariat will provide administrative and project assistance.

Annex: Communication and outreach activities

The communication and outreach activities will continue from the 2017-2019 period and include the following activities:

- i. Marine Litter workshop/conference
- ii. Plastic in a bottle
- iii. Project video
- iv. Arctic marine litter competition
- v. Marine Litter graphics site on the PAME website for outreach purposes [here](#)

i. Marine litter workshop/conference

The project team will consult with the PAME HoDs on how best to contribute to the Plastic Conference planned during the Icelandic Chairmanship of the Arctic Council when further details have been provided.

Alternatively, or possibly in conjunction with such a conference, a project workshop/side event could be considered to be convened.

ii. Plastic in a bottle

One aspect of PAME's work on marine pollution is to set afloat up to five "plastics in a bottle" from across and around the Arctic. The specially designed capsules will be equipped with a GPS transmitter to illustrate how marine litter can travel, even between continents, contributing to the adverse effects of marine litter.

Note: A delay in the production of the transmitters from the manufacturer has delayed this process significantly. The aim is to set the first capsules afloat in mid-2019.

Drift predictions of Plastic in a bottle

- Based on discussions with the Icelandic Meteorological Office and a leading expert in ocean currents.

Five areas have been identified as potential points to release the bottles, East Coast of USA (e.g. Maine), Netherlands, Iceland (east coast), Northern Norway and Alaska. These areas have been discussed with an expert on oceanography and meteorology (Dr. Halldór Björnsson) and a leading expert in Iceland on ocean currents (Dr. Steingrímur Jónsson).



Figure 1: Potential capsule drift.

According to them, one cannot expect an object like the plastic capsules to travel to certain areas with ocean currents. Weather and waves have big effects as well as currents. The map below illustrates broadly how these capsules could travel if released at these areas.

PAME and Verkís

The PAME Secretariat met with the Icelandic Engineering company *Verkís*. They have designed and manufactured bottles, equipped with a satellite transmitter that provides its location every four hours via a GPS receiver, enabling viewers to observe the journey of the bottle. Previous experiments by *Verkís* have seen their bottles travel thousands of miles across the Atlantic sea, lasting well over a year and reaching destinations as far as Scotland and Faroe Islands (having begun in Iceland).

The image below shows the design of the bottle, and how its travel is shown on a map.



Costs

- All costs in USD

Item	Costs	Total for 5 bottles
<i>Verkís</i>		
Bottle	500\$	2500
GPS transmitter	300\$	1500
Launch / transportation	300\$	1500
Other costs	2000\$	2000
		<u>7500</u>

The PAME Secretariat will look into funding opportunities.

Outreach

The PAME Website will host the map. It can be further distributed (embedded) to other websites. Snapshots will be shown frequently on PAME's Social media accounts, and the Arctic Council website/social media.

Local media in Iceland will be sent press releases and assistance with similar efforts amongst the co-leads will be endorsed.

Finally, a video will be made when the plastic bottles have all washed ashore to show their journey.

iii. Project video

A simple video about the project is in production as of January 2019 which will be released in early 2019. Additional video may be produced during the Icelandic Chairmanship in coordination with the Plastic Conference.

iv. Art Marine Litter Competition

TBC. Keep Sweden Clean to be contracted to run Arctic competition. Proposal to be presented at PAME I-2019.

v. Marine Litter Graphics Site

Continue the work on the Arctic marine Litter graphics site on the PAME website ([here](#))

This site currently holds numerous graphics and videos, produced by PAME and others. In addition, GRID-Arendal is in the process of developing further graphics for the Marine Litter desktop study which will be posted on this site.

Annex VI: Modelling Arctic oceanographic connectivity to further develop PAME's MPA toolbox

Note: This project proposal is a continuation to PAME's Framework for a Pan-Arctic Network of Marine Protected Areas

The Arctic Council's Protection of the Arctic Marine Environment Working Group (PAME) released a Framework for a Pan-Arctic Network of Marine Protected Areas in 2015. This report sets out the vision for an 'ecologically connected, representative and effectively-managed network of protected and specially managed areas'. Further technical work and coordination at the pan-Arctic level is needed to advance this vision, which this proposal aims to address.

The modelling of Arctic oceanographic connectivity will support further development of PAME's MPA toolbox. It will require close collaboration with CAFF and is considered a multi-year and iterative project based on best available baseline data, incorporating new data and studies by the Arctic Council, the Arctic States and others, as relevant.

PAME recognizes that each Arctic State pursues MPA development based on its own authorities, priorities and timelines.

Project Title:

Modelling Arctic oceanographic connectivity to further develop PAME's MPA toolbox

Aim & objectives

- To further develop the PAME MPA toolbox;
- To map oceanographic connectivity in the Arctic region using biophysical modelling; and
- To identify major barriers to gene flow based on modelled marine connectivity.

Background

PAME's mandate is 'To address marine policy measures and other measures related to the conservation and sustainable use of the Arctic marine and coastal environment in response to environmental change and from both land and sea-based activities, including non-emergency pollution prevention control measures such as coordinated strategic plans as well as developing programs, assessments and guidelines, all of which aim to complement or supplement efforts and existing arrangements for the for the protection and sustainable development of the Arctic marine environment'.

PAME's Framework for a Pan-Arctic Network of Marine Protected Areas sets out the vision for an 'ecologically connected, representative and effectively-managed network of protected and specially managed areas'. Further technical work and coordination at the pan-Arctic level is needed to advance this vision. The proposed project is a tool to further develop this framework. PAME recognizes that each Arctic State pursues MPA development based on its own authorities, priorities and timelines.

This project could also help inform the scoping process that is planned in the Conservation of Arctic Flora and Fauna's (CAFF) Circumpolar Biodiversity Monitoring Program (CBMP). Therefore, this project will be in close collaboration with CAFF/CBMP, so to include the expertise from countries participating in the CBMP expert networks supported by the Arctic

countries. CAFF plans to hold a marine scoping project workshop in 2019 about future monitoring of the biotic components in the Arctic marine ecosystems. This workshop could be an opportunity to share preliminary results from this project and exchange expertise and knowledge ensuring knowledge sharing of Arctic marine ecosystems. Discussions have also been held with CAFF/CBMP to have a general CAFF/PAME meeting in 2019 about marine projects, and this project could be part of such a meeting as well.

Biophysical modelling

Ongoing climate change may facilitate increased access to the Arctic region, and potential new economic opportunities, but may also bring potential challenges to the Arctic marine and coastal environments. These changes could benefit from more integrated approaches to Arctic marine management, including the consideration of MPA networks design to aid in the sustainable use of the Arctic environment.

Networks of MPAs can be one effective tool to moderate the impacts of extractive activities and local disturbance on marine ecosystems and their services (Lester & Halpern 2008). When considering the geographic boundaries of MPAs in networks, it is important to ensure that the overall network design has the capacity to protect target populations. Design criteria should engender “ecologically coherent” networks (HELCOM 2016). Key aspects of this design are management objectives of the network as a whole, as well as for individual MPAs, the geographic boundaries of individual MPAs, and how they are connected through dispersal to the ambient environment. Organisms with long-distance dispersal may require very large MPAs, or a network of smaller MPAs that can exchange dispersal stages within the network, or with surrounding areas.

More than 70% of marine invertebrates and fish disperse with large numbers of tiny larvae that may drift for days to months with the ocean circulation. Although larvae disperse passively, they may nonetheless influence their own transport through vertical migration to different depths with different current patterns. This makes it very difficult to make direct observations of dispersal in the field, although genetic methods can be used to coarsely infer dispersal. Biophysical modelling is increasingly used to estimate dispersal in the seascape. A physical oceanographic circulation model predicts how the physical water transport varies in space and time. The predicted current velocity fields are then used to simulate transport paths of virtual larvae *in silico*. This method permits the simulated “release” of many millions of virtual larvae at many spawning sites (sources), and includes temporal variability in currents on scales from days to years. These patterns are then combined with a biological model that defines the traits for a particular species (or dispersal strategy), such as spawning time, drift (planktonic) duration of the larvae, and any larval behavior, e.g. vertical migration or ontogenetic shifts in drift depth. The results from such biophysical modelling are usually summarized in a connectivity matrix where each element gives the probability of dispersal from site A to site B for each of the simulated species or dispersal strategies. For the area included in the model, the connectivity matrix fully describes connectivity for the target species (or dispersal traits) in the seascape (Cowen and Sponaugle 2009).

Design of Marine Protected Areas

Given the marine environment is highly complex, models can be useful tools to help decision makers in designing MPA networks.

These connectivity matrices help bring into focus possible ecologically coherent networks of MPAs. The first step in this process is to calculate the weighted mean dispersal distance and direction from each location. This is a good indicator to use when considering geographic boundaries and overall network design. Where there is sufficient information about the geographic distribution of a species, this can easily be incorporated into the connectivity model. Technically, the connectivity matrix is simply multiplied with a distribution matrix.

The second step is to identify possible optimal networks of (multiple) MPAs. This is defined as the network in which the joint connectivity best supports the overall network objective. The identification of optimal networks applies a new theoretical framework (Nilsson Jacobi & Jonsson 2011) based on eigenvalue perturbation theory (EPT). When the conservation objectives concern several species – perhaps a specific community – different species will often have different dispersal strategies. In such cases, each species (or dispersal strategy) will typically result in a unique optimal MPA network. However, by using a variant of the EPT framework, it is possible to identify a ‘consensus network’ that provides the optimum design for multiple species, in support of network objective(s) (Jonsson et al. 2016).

The third, and final, step in this process involves identifying dispersal barriers, such as the Lagrangian Coherent Structures, that might restrict gene flow between subpopulations. Again, the connectivity matrix is used together with a cluster analysis where results can be easily visualized on a map as color-coded areas where color transitions indicate barriers (Nilsson Jacobi et al. 2012). Such barrier maps can be used to generate hypotheses of where important local adaptations may be present, and can also be used to ensure that areas separated by barriers are considered for inclusion in an MPA network.

Project description

We welcome and encourage engagement with Permanent Participants and the inclusion of traditional and local knowledge.

Oceanographic circulation model

We intend to use an existing oceanographic model. There are several options, but the data assimilative TOPAZ4, which includes the Arctic Sea and North Atlantic, is a possible candidate (Xie, Girshick et al. 2017). This model has been developed at the Nansen Centre in Bergen over a number of years, and as of today its operational mode is run by the Norwegian Meteorological Institute. It is the main operational model for the Arctic Sea in the marine Copernicus data portal. This model has a horizontal resolution of 11-16 km with 28 horizontal layers. Daily averaged velocity fields are available for 1991-present. It also includes wave model output, which can be used to describe wave-induced drift from 2016. All available velocity fields will be downloaded and prepared for use in a Lagrangian particle tracking model that simulates dispersal trajectories. Mean drift patterns as well as interannual variability will be analysed. Model setups with higher resolution exist, but results are not easily available for long-term analyses (i.e., they may require new production of velocity fields from the hydrodynamical model).

Particle tracking model

The Lagrangian particle model uses available model prediction of ocean currents (including Stokes drift, or the wave induced drift) to move particles in the horizontal. Ice drift can also be included if required. We will use in-house models such as an own developed code in

MATLAB and/or the freely available code OpenDRIFT, that runs in a Python environment, developed by Norwegian Meteorological institute.

A critical decision for the particle tracking simulations is how many release sites to select, the number of release time points, and how many particles to release on each occasion. The first step is to identify the relevant (dominant) elements of Focal Ecosystem Components (FECs, e.g. ecological key species, species relevant for ecosystem services) and their respective habitat distributions for which connectivity will be modelled. The ideal situation is if all model grid cells that overlap with the target habitat are included as sources of particles in the Lagrangian tracking model. Initial studies will be needed to collate information about habitat distribution of key elements within FECs. The recent State of the Arctic Marine Biodiversity Report (CAFF, 2017), together with additional literature, provides a starting point from which such data can be collated, and gaps identified, e.g. on biodiversity hotspots, taxonomic composition, and key invertebrate and fish species. The project may also show how habitat use and historically important areas for seabirds and sea mammals can be linked to the results. Where habitat distribution data are absent, or have low coverage, an alternative approach is to use depth intervals to define habitat for different classes of species. Then model grid cells that represent a certain depth interval are included in the Lagrangian simulation of dispersal within each habitat. For example, depth intervals of 0-50 m, 50-100 m, 100-200 m, will represent different coastal/shelf habitats. Depending on funding, we aim to model 3-5 dispersal strategies covering a range of FECs that could benefit from MPAs. Simulation designs could take many forms, for example, to repeat each combination of dispersal strategy and habitat for 5 years and to record the trajectory position after 5, 10, 20, 30 and 60 days. Such approaches can be used to provide a suite of scenarios that encompass most of the connectivity patterns among FECs.

The dispersal trajectory data produced by the Lagrangian particle tracking model are summarized into connectivity matrices specifying dispersal probabilities between all model grid cells that represent each habitat. Each dispersal strategy and habitat combination will result in a specific connectivity matrix. With 3 habitats, 3 spawning times, 5 drift durations and 5 years this would result in 225 connectivity matrices, however we anticipate that these would be averaged over the 5 year experimental period to yield 45 mean matrices.

Calculation of dispersal range as a guide to minimum MPA size

For each model grid cell that was included in the Lagrangian trajectory model, the weighted mean of dispersal distance is calculated as an indicator of MPA minimum size to allow persistence based on self-recruitment (Jonsson et al. submitted). Minimum size will be context-dependent and vary between geographic locations, habitat distributions and for different dispersal strategies.

Identification of optimal MPA networks

Based on the connectivity matrices we will identify a preliminary set of optimal MPA networks for individual dispersal strategies for species with planktonic larvae (Nilsson Jacobi & Jonsson 2011), but also a combined network that offers conservation opportunities for multiple strategies (Jonsson et al. 2016).

Identification of dispersal barriers

Bathymetric features, habitat distribution and consistent circulation patterns may lead to dispersal barriers in the seascape with consequences for exchange of individuals and genes

between sub-populations. With a newly developed clustering method, we will identify such barriers based on the connectivity matrices (Nilsson Jacobi et al. 2012). Barriers may differ among dispersal strategies and habitats. Strong barriers may indicate the presence of locally adapted sub-populations with unique genetic combinations, as exchange of individuals is fully or near-fully prevented. Weaker barriers may indicate some, but limited, exchange of individuals, which may call for separate management plans for harvested populations.

Timeline and major activities during the 2019-2020 period

The time required for computer simulations of dispersal trajectories will depend on the number of connectivity matrices that the project will produce.

1. Downloading of velocity fields from the oceanographic model (e.g. TOPAZ4), and preparation of velocity fields to drive the Lagrangian trajectory model – 2 months (100%)
2. Development of existing code for Lagrangian trajectory model – 1 month (100%)
3. Review of available data on habitat distribution of key species / elements of FEC's – 3 months (100%)
4. Simulation of dispersal trajectories and summarizing into connectivity matrices – 6 months (30%)
5. Calculation of the MPA metrics: dispersal range, optimal networks, dispersal barriers – 3 months (100%)
6. Coordination, meetings and report – 4 months (100%)

Regular meetings (in person and via phone) will be planned to maximize expert input from PAME, CAFF, and other Arctic Council Working Groups and organisations wishing to participate. The work will be presented periodically at CAFF's and PAME's biannual meetings, as well as at expert group meetings. Should the CAFF/PAME meeting on marine projects take place in 2019, this project could be part of that.

Overall estimated budget (2019-2020)

Consistent with the overall Arctic Council approach, the development of this project will be financed through voluntary contributions.

Item	Budget (USD)
Data management and trajectory simulation	65.000
Planning, calculation o MPA metrics, reporting	38.500
Review of habitats and dispersal traits	38.500
Calculation of optimal network and barriers	15.200
Travels	3.335
Hardware	1.200
Software	1.200

Estimated total	162.935
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Project team structure/lead Countries

- ✓ Lead: Sweden
- ✓ Sweden welcomes co-leads that are working on oceanographic connectivity in the Arctic.

Collaboration with other Arctic Council working groups as relevant, in particular with CAFF and its [Circumpolar Biodiversity Monitoring Program](#) (CBMP).

References

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Annex VII: Develop two factsheets on Marine Protected Areas (MPAs) under change

Main Tasks 2019-2021:

- Develop two factsheets on MPAs and Indigenous People's Lives under change, starting with MPAs.

Background

The rate of change in the Arctic is unprecedented in the climate record for at least the past few thousand years, with average Arctic temperatures increasing at about twice the global average. The warming has led to massive retreats in the extent and thickness of summer sea ice and the disintegration of ice shelves that have persisted for millennia. Simultaneously, acidification of the Arctic Ocean increases. On land, the warming increases the Active-Layer Thickness (ALT)¹⁰. The average active-layer thickness (ALT; determined by mechanical probing and typically accurate to 0.5 cm) in 2016 for 20 North Slope sites was 0.52 m, which is 4 cm greater than the 1996-2016 average¹¹. Coastal erosion is also increasing, and the temperature is threatening the existence of unique Arctic environments such as Palsa mires¹². These changes are devastating not only to Arctic biota, but also to today's way of life of Arctic indigenous people.

The Arctic Council has a unique voice to leverage in communicating these facts. However, in order to do so, the Arctic Council needs something to complement the high-quality reports produced by its working groups when addressing decision makers.

Project goals

- To leverage and synthesize factual information from the Arctic Council's work in a layman's format to communicate to decision makers and the public;
- Contribute to cross-working groups cooperation on common topics; and
- Contribute to the outreach aspect of the Arctic Council and ensuring close collaboration with the Arctic Council Secretariat.

Building on previous work

This work will draw from AMAP's and CAFF's publications on climate change, and the NOAA's Arctic Report Cards to develop a factsheet on MPAs in a changing climate.

Project components and products

The project will take into consideration various successful templates such as the UK's MCCIP's template, which is a concise, well informed, and easy to understand factsheet that inspires

¹⁰ 1 V. E. Romanovsky, S. L. Smith, K. Isaksen, N. I. Shiklomanov, D. A. Streletskiy, A. L. Kholodov, H. H. Christiansen, D. S. Drozdov, G. V. Malkova, S. S. Marchenko 2017: Terrestrial Permafrost. In: The 2017 NOAA Arctic Report Card Essays.

¹¹ 2 NOAA Climate.gov 2018: <https://www.climate.gov/news-features/featured-images/warming-climate-claims-chunks-alaskas-northern-coast> (and references therein).

¹² 2 NOAA Climate.gov 2018: <https://www.climate.gov/news-features/featured-images/warming-climate-claims-chunks-alaskas-northern-coast> (and references therein).

3 Luoto, M., Heikkinen, R.K., Carter, T.R. 2004: Loss of palsa mires in Europe and biological consequences. - Environmental Conservation. 31(1): 30-37

the reader to reach his or her own conclusions of what actions need to be taken, without giving direct recommendations (Annex I). The project setup should ensure the active participation of all interested Arctic Council working groups toward a joint product.

Structure and Main Products

Structure

The factsheets will be developed according to the following outline:

1. A template/shared design that can be used for all of the fact sheets to include the following:
 - i. a summary of the state of affairs today,
 - ii. a bulleted list of key facts, and
 - iii. “what this means for you” – impacts for the daily lives of humans who are not intimately engaged with these issues in this part of the world.
2. The first factsheet will focus on impacts from changes to the marine environment and the role of MPAs in building resilience to these impacts, followed by the impact of these changes on indigenous people’s Translation of the factsheet into the Arctic States’ main and minority languages would be a priority. .
3. Length: ideally a half-folded A3 (4 pages total), but the maximum length should preferably not exceed 8 pages.
4. Digital/paper: Primarily seen as digital resources but should be print-ready as well.
5. Brand/layout: The Arctic Council will probably be the primary brand with other working group’s logos following, as relevant to the topic.
6. Audience: The expected audience for all factsheets would be policy makers at all levels and sectors within and outside the Arctic, but important additional audiences would be the public, educators and students. Different factsheet topics may have different target audiences. The factsheets would not advocate specific policy positions or provide recommendations, but rather they would lay out major findings to inform the readers of the facts. The factsheets will help integrate and communicate recent products by Arctic Council working groups on climate change as they relate to MPAs and indigenous peoples.

Main Products

It is proposed that this project be developed in a stepwise approach by starting on the following activities/work packages:

1. Develop a template/outline for the factsheets based on the proposed structure;
2. Develop the 1st thematic factsheet on MPAs under change

Develop a 2nd thematic factsheet on impacts of these changes on indigenous people’s lives .These products will be developed in close coordination and cooperation with other working groups (tbc), and the Arctic Council Secretariat.

Tentative timetable and Key Milestones

PAME-1-2019	The updated project proposal will be presented at PAME 1 2019 for a decision.
February - May 2019	A detailed project plan will be drafted by the parties interested to participate in the project
February - May 2019	The project leads, and project participants, and the PAME Secretariat, identify potential funding opportunities and draft joint funding proposals, as appropriate.
May-June 2019	The project begins (depending on the funding)
PAME-2-2019	The progress of the project is presented for PAME
PAME-1-2020	The first thematic factsheet draft is presented for PAME
PAME-2-2020	The first thematic factsheet (MPA) will be presented for PAME for decision, and the second thematic factsheet draft if presented for PAME
PAME-1-2021	The second thematic factsheet (Indigenous Peoples Life impacted by a Changing Climate) will be presented for PAME for decision

Budget and Operations

Finland has applied for financial resources to cover project consultant, meeting(s), and printing costs. Other financial contributions and in-kind support are under development.

Project Team Structure/Lead Countries

The leads for the initial work package are: Finland, USA.

Each working group and Permanent Participants' organization will be invited to appoint a project team member, preferably in spring 2019, but may also join the project later.

Observers and External Partners

Observers and external partners are also invited to participate in the project.

PAME-1-2019 gave its support for the project plan and the project can begin its work. The indicated co-chairs and partners should confirm their participation in the project at their earliest convenience. A participation in the preparation of only one of the thematic factsheets is also possible.



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