REPORTING FORM 2024

Please return completed form to imber@ecnu.edu.cn **by 20th July**

REPORTING PERIOD: WHAT YOU HAVE DONE since the annual report submitted for the SSC meeting held in Paris in April 2023 (Link to past annual reports)

and **PLANNED ACTIVITIES** over the next year (and beyond if details available)

N.B. The form focuses reporting on the research objectives (2022-2025) of the Grand Challenges (in order to align with how we are addressing IMBeR's commitments defined in the 5-year review process to SCOR and Future Earth).

Thank you.

Ecosystem Studies of the Subarctic and Arctic Seas (ESSAS)

Franz Mueter

1. Ongoing activities, in line with the IMBeR Grand and Innovation Challenges

(Among other uses, information will be used to update the IMBeR Annual Report to SCOR)

1.a. Grand Challenge I

Understanding and quantifying the state and variability of marine ecosystems - with focus on Research Objectives 1 to 3:

***Research Objective 1**. Evaluate and predict the cumulative effect of multiple stressors*
***Research Objective 2**. Integration of climate change and climate variability*
***Research Objective 3**. Impacts on society – preparation for a changed future*

ESSAS supported the following activity to address Grand Challenge I:

- To address **objective 1**, a session at the ESSAS Annual Science meeting focused on "***Natural disasters, multiple stressors and cumulative impacts along sub-arctic and arctic coasts***" with presentations ranging from modelling the effect of oil spills, assessing the recovery of coastal ecosystems and communities from a mega-tsunami, conducting a cumulative impacts assessments for communities in the Barents Sea that experience a range of anthropogenic stressors, to threats from the invasion of alien species into Arctic waters.
- Several activities addressed **objective 2**, including a session on "***Cod and climate change at the coastal interface***" and a Workshop entitled "***Using natural analogues to investigate the effects of climate change on northern ecosystems; moving from gradient to mosaic approaches***". Presentations and discussions focused on the impacts of climate change on early life stages of cod in coastal areas and improving our understanding of how marine

species and systems cope with natural gradients and variability in environmental conditions, including ocean acidification and warming.

- Finally, ESSAS addressed **objective 3** by organizing a session on "***Cooperative studies of coastal ecosystems engaging local communities in the sub-Arctic and Arctic***" that focused on collaborative studies with high-latitude coastal communities, including Indigenous communities, to understand and prepare for impacts of climate change on these communities. The session included presentations on risk assessment and scenario planning, as well as examples of community engagement and co-production of knowledge.

1.b. Grand Challenge II

Improving scenarios, predictions and projections of future ocean-human systems at multiple scales - with focus on Research Objectives 4 to 6:

Research Objective 4*. Development of integrated data systems and approaches for predictions and projections*
Research Objective 5*. Development of predictive models and projections for use at regional scales*
Research Objective 6*. Development of alternative scenarios to bridge the gap between physical climate sciences and humanities*

While ESSAS did not focus specifically on Grand Challenge II over the reporting period, work presented at the Annual Science Meeting included case studies on data sovereignty and how to better integrate Indigenous knowledge and data into existing dataases (related to **objective 4**), projections of future egg survival of two cod species in the Arctic (**Ojective 5**), and developing scenarios for a desirable future through a participatory approach (in support of **Ojective 6**).

In addition, ESSAS chairs and steering committee members are involved in multiple regional efforts to further GC II.

1.c. Grand Challenge III

Improving and achieving sustainable ocean governance - with focus on Research Objectives 7 to 9:

Research Objective 7*. Develop knowledge on best practices for multilevel governance approaches to ocean climate adaptation and mitigation*
Research Objective 8*. Develop understanding on key ingredients for transformation towards more sustainable, equitable and inclusive governance approaches to fisheries and aquaculture*
Research Objective 9*. Support implementation of post-2020 biodiversity targets for marine spatial planning and marine protected areas*

ESSAS did not organize specific activities focused on GC III, but SSC members continued to participate in international working groups such as the 'Protection of the Arctic Marine Environment' ICES/PAME group and the Working Group on an Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA). In addition, SSC members continued to participate in the

development of Integrated Ecosystem Assessments for the Central Arctic Ocean (S.-I. Saitoh, N. Harada), the Chukchi Sea (F. Mueter), and the Barents and Norwegian seas (B. Planque).

1.d. Innovation Challenge 3

To advance understanding of ecological feedbacks in the Earth System

No recent ESSAS activities have address IC 3

1.e. Innovation Challenge 4

To advance and improve the use of social science data for ocean management, decision making and policy development

The ESSAS session "***Cooperative studies of coastal ecosystems engaging local communities in the sub-Arctic and Arctic***" at the 2023 Annual Science Meeting, included several case studies that used social science approaches in a collaborative context to support local decision making and adaptation, such as "*Stewardship, advocacy, and knowledge exchange in coastal resource management: Case studies from Alaska*" (Beaudreau et al.), "*Stewarding Sugpiaq (Alutiiq) Fisheries through the Millennia: Braiding Knowledge for a Sustainable and Equitable Future*" (Fitzhugh et al) and "*Another role of coastal marine science for making the hope in a local community: a case of sub-Arctic area in Japan*" (Minegishi).

1.f. Innovation Challenge 5

Interventions to change the course of climate impacts

ESSAS contributed to IC 5 and IC 6 by organizing a collaborative session at the 2023 ESSAS Annual Science Meeting with Nina Bednarsek (co-lead of IC 5) focused on "***Blue Carbon, mariculture and climate change mitigation and adaptation in the Subarctic and Arctic***", which has contributed to a better alignment between ESSAS activities and IMBER goals.

1.g. Innovation Challenge 6

Sustainable management of Blue Carbon ecosystems

See 1.f

2. Selected highlights

2.a. Selected scientific highlights since last report (1-5)

Last report was submitted to SSC meeting, April 2023

Impacts of warming and marine heatwave events on Pacific cod stocks in the Northeast Pacific

Pacific cod (*Gadus macrocephalus*) support major commercial fisheries in the Gulf of Alaska and Bering Sea. Marine heatwave (MHW) events in 2014-2016 and 2019 led to a dramatic decline in abundance of

Pacific cod and subsequent fisheries closures, with severe economic impacts on coastal communities (Barbeaux *et al.*, 2020). More frequent and intense heatwaves are predicted in the future (Frölicher *et al.*, 2018) and these can directly impact the phenology and growth of fish such as Pacific cod, and their subsequent survival (Almeida *et al.*, 2024; Thalmann *et al.*, 2024).

Hatching occurred earlier during and between MHWs than before the first heat wave (Figure 1). Size at age at younger ages (90 days) was similar before, during and between MHWs, but size at older ages diverged with larger sizes during and between heatwaves (Figure 2). These differences in size could not be explained by temperature-related differences in diets or growth alone (Almeida *et al.*, 2024; Thalmann *et al.*, 2024). The large observed sizes in late summer were likely a consequence of strong, size-selective mortality, suggesting that the available nursery habitats were unable to protect young of year Pacific cod from high predation rates during MHWs (Thalmann *et al.*, 2024).

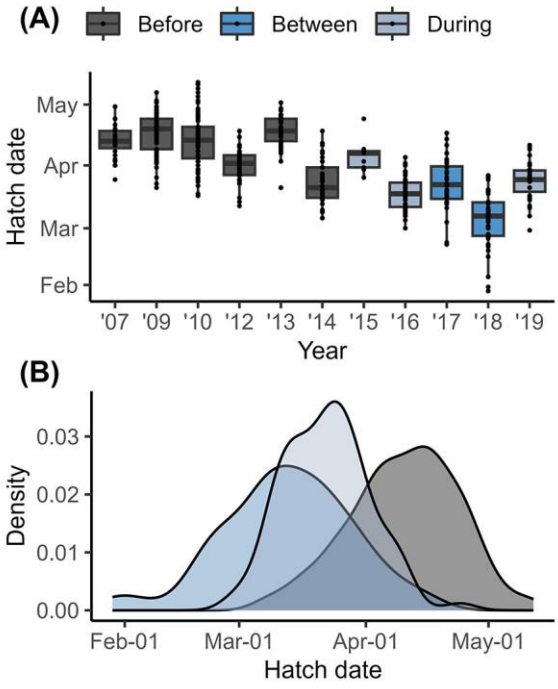

Figure 1 (left): Hatch phenology of age-0 Pacific cod in the Gulf of Alaska before, during, and between marine heatwaves. (A) Individual hatch dates presented as box-and-whisker plots, where points are raw data, the box is the interquartile range, the horizontal line is the median, the vertical "whiskers" indicate the 95% confidence interval, and box colors indicate if years were before (dark gray), during (light blue), or between (blue) marine heatwaves (MHWs). (B) Density plot indicating the hatch dates before (dark gray), during (light blue), and between (blue) MHWs. **From** Almeida et al. (2024)**.**

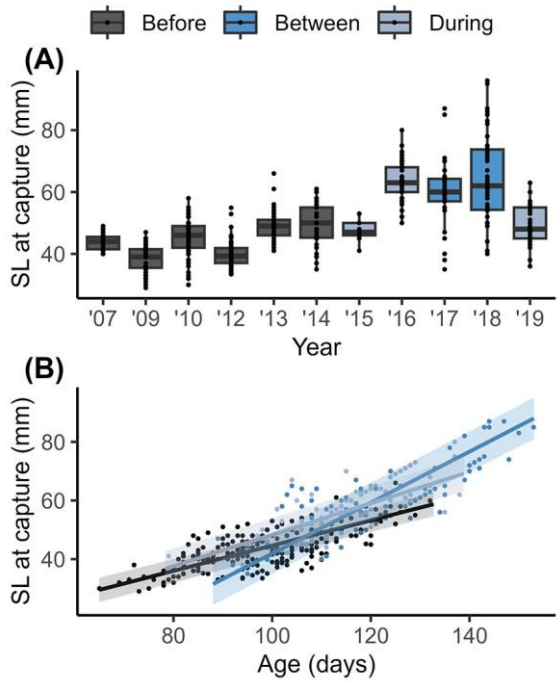

Figure 2 (right): Standard length of age-0 Pacific cod in the Gulf of Alaska before, during, and between marine heatwaves. (A) Individual standard length (SL, mm) at capture presented as box-and-whisker plots (see Fig. 1) (B) The predicted relationship from a linear mixed model between age and SL at capture within the periods before (black), during (light blue), and between (blue) MHWs. Points are raw data, and shaded regions are 95% confidence intervals. **From** Almeida et al. (2024)**.**

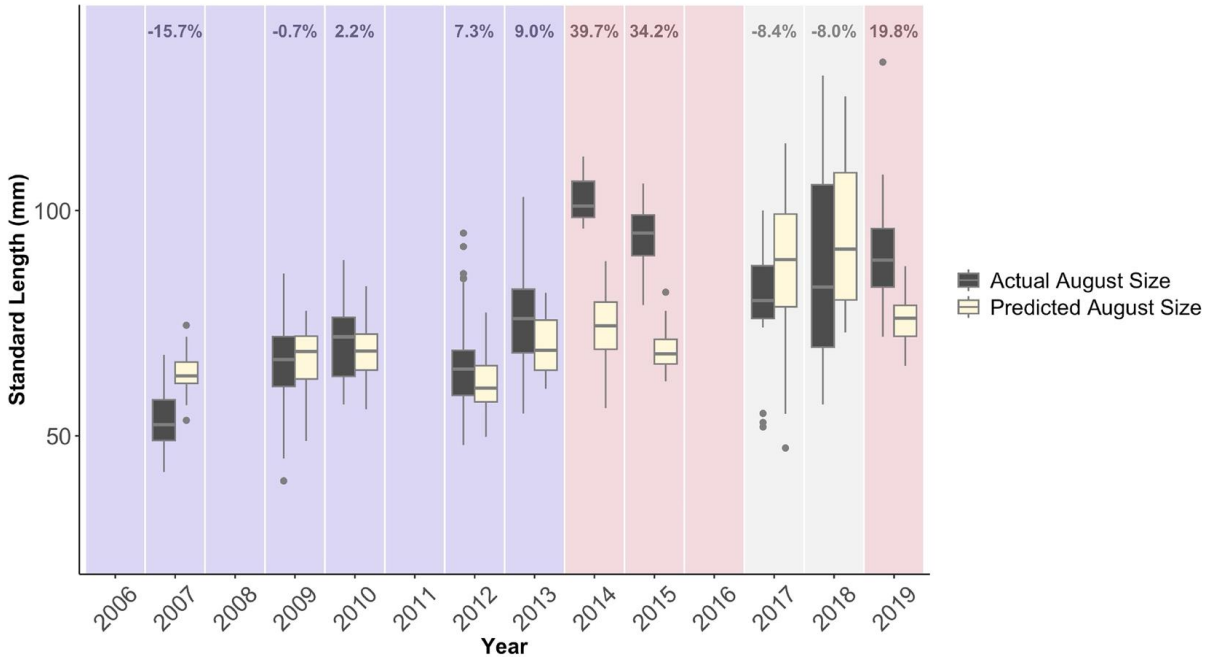

Figure 3: August size during MHWs could not be predicted from growth rates alone. Predicted August sizes were based on July growth rates and calculated by summing mean July growth rates for that year over the number of days between July and August sampling in that year. Percentages represent the mean percent increase between predicted August growth and actual August growth for each year. Dark-grey plots represent actual August sizes and beige-colored plots represent predicted August sizes. Plots are shaded based on their heatwave class, with blue representing years before the MHWs, red representing years during MHWs, and grey representing years between MHWs. Boxplots extend from the first to the third quartiles of the data, with whiskers that extend to the largest values no further than the 1.5 × IQR. Individually plotted points represent outliers beyond the 1.5 × IQR range. From Thalmann et al. (2024).

Findings from these studies were compared with laboratory and field studies from the Atlantic on juvenile Atlantic cod off Canada (Slesinger *et al.*, 2024) and off Iceland (Nickel *et al.*, 2024)during workshops (2023, 2024) of the ESSAS working group on Bioenergetics of Subarctic and Arctic Fishes.

Classification of optical water groups using satellite-derived light absorption spectra

A recent study conducted as part of the Japanese project 'Arctic Challenge for Sustainability (ArCS and ArCS II), with funding from other projects, successfully developed an algorithm to distinguish optical water mass groups using the characteristics of chromophoric dissolved organic matter or CDOM (Oida *et al.*, 2024, Fig. 4). Water masses in the Pacific Arctic region were identified with high accuracy using data from an ocean color satellite (Fig. 5).

Abstract: The characteristics of the water masses that contribute to high biological production in the subarctic Pacific and adjacent seas (SPA) could change because of recent climate change. This study

reports on a method to classify water in the SPA into distinct optical water groups using the light absorption coefficient of chromophoric dissolved organic matter (CDOM), aCDOM(λ), captured using an ocean color satellite. In situ samples obtained from ship surveys between 2006 and 2021 were classified into five optical group numbers (OGN1–OGN5) based on aCDOM parameters in the ultraviolet (UV) region: aCDOM(λ) at 350 nm (aCDOM(350)) and the spectral slopes at 275–295 nm (S275–295) and at 350–400 nm (S350–400). We were also able to identify OGN with a new method using machine learning technique developed in this study that adopted satellite-derived aCDOM(λ) in the visible (VIS) region. The distribution and characteristics of OGN classified using the in situ aCDOM parameters in the UV region supplement the interpretation of the origin and mixing of the water masses classified by temperature and salinity. Relative to in situ samples, the accuracy of the OGN estimation from the ocean color satellites was 83.3%. The satellite-derived OGN were able to distinguish high chlorophyll-a areas where high phytoplankton productivity is expected. In addition, identifying the distribution of OGN from satellites supports improved understanding of the bloom process. This method has potential to help to understand the impact of phenomena from accelerating ocean warming (e.g., sea ice decline, enhancement of stratification and increase in riverine input) on water masses structure and the consequent changes in the phytoplankton productivity in the SPA.

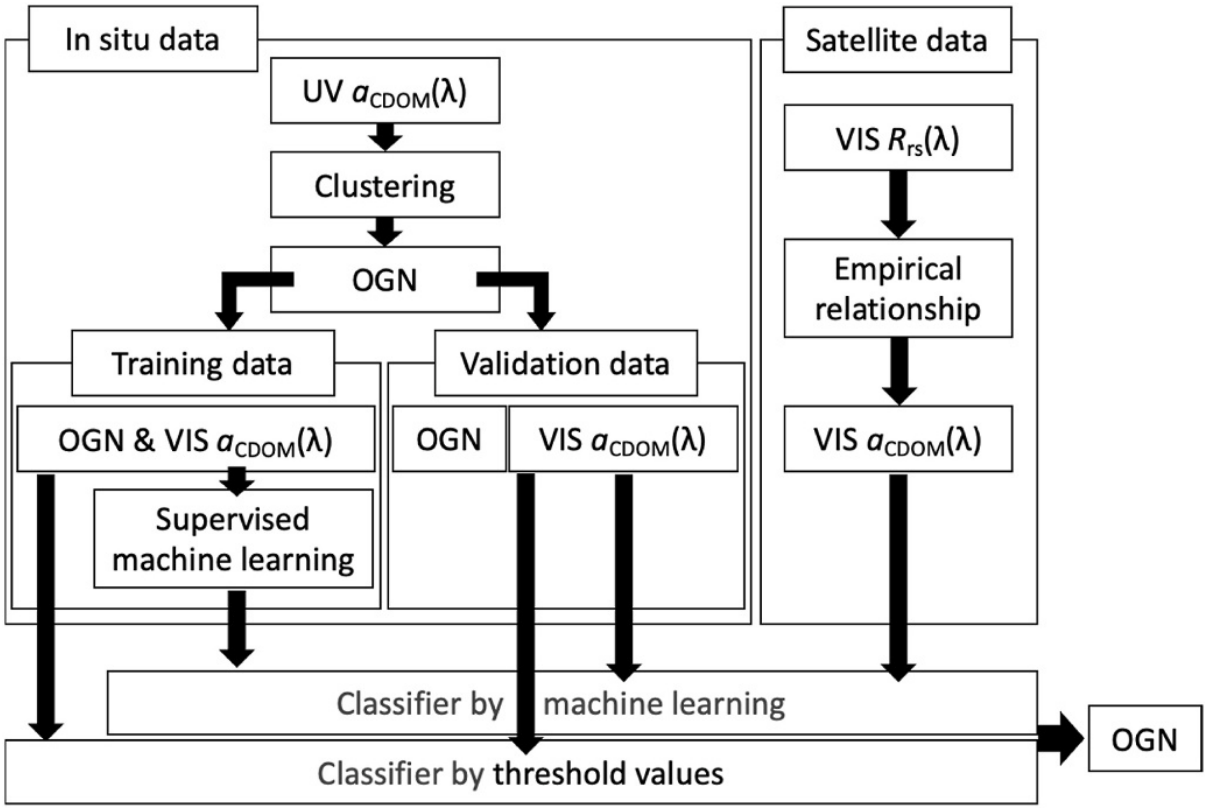

Figure 4: Flowchart of our empirical and supervised machine learning algorithms estimating optical group number (OGN). The empirical relationship represents the aCDOM(λ) algorithm of Aurin et al. (2018) and its correction equation. **From Oida et al. (2024).**

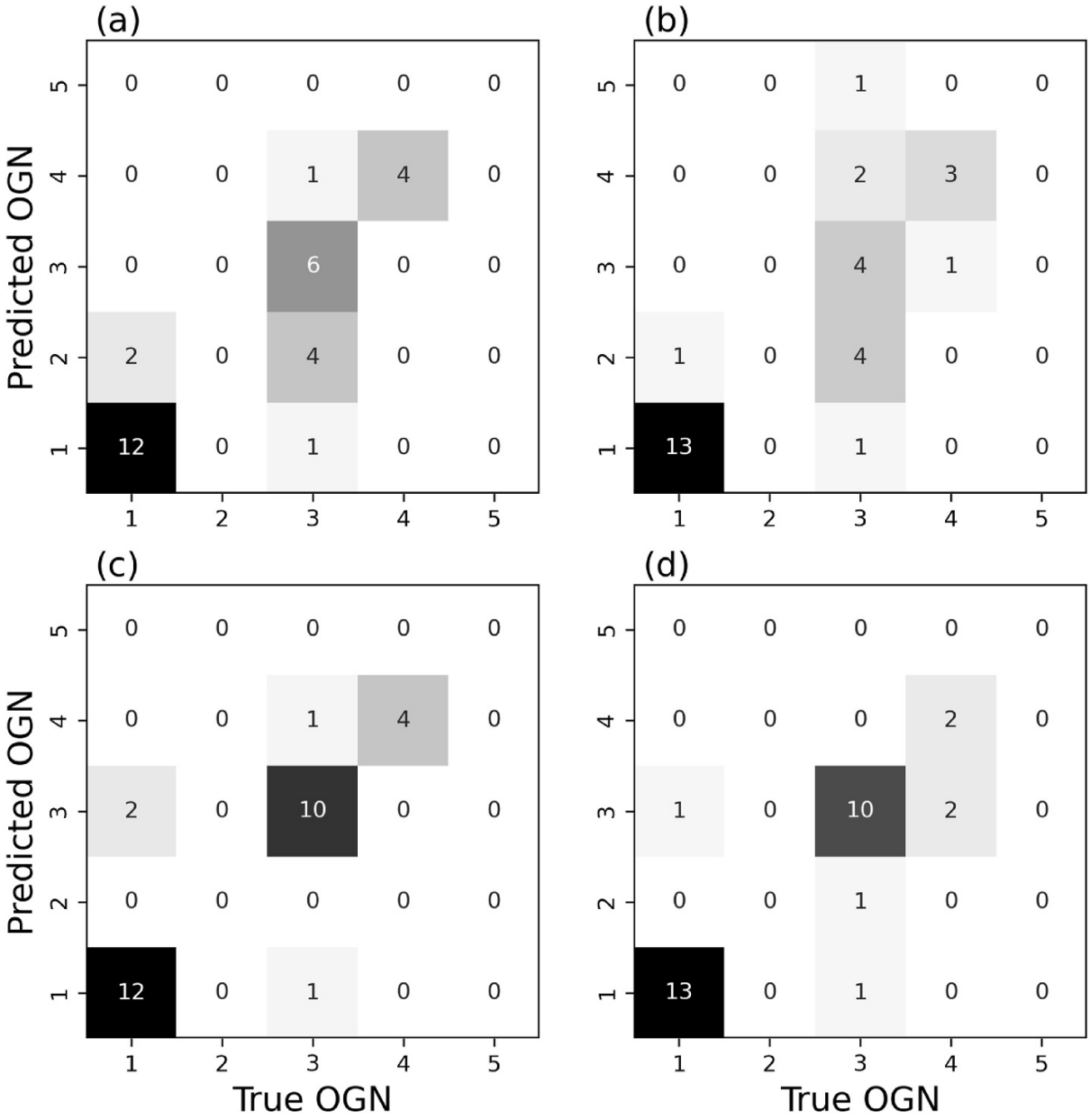

Figure 5: Error matrix showing the accuracy of OGN classification using (a) threshold values and in situ validation data; (b) threshold values and aCDOM(λ) derived from satellite data; (c) supervised machine learning and in situ validation data; and (d) supervised machine learning and satellite-derived aCDOM(λ) data. The numbers in the boxes indicate the numbers of datapoints; darker colors indicate larger numbers of datapoints. **From Oida et al. (2024).**

Almeida, L. Z., Laurel, B. J., Thalmann, H. L., and Miller, J. A. 2024. Warmer, earlier, faster: Cumulative effects of Gulf of Alaska heatwaves on the early life history of Pacific cod. Elementa: Science of the Anthropocene, 12: 50. https://doi.org/10.1525/elementa.2023.00050.

Aurin, D., Mannino, A., and Lary, D. J. 2018. Remote Sensing of CDOM, CDOM Spectral Slope, and Dissolved Organic Carbon in the Global Ocean. Applied Sciences, 8: 2687.

Barbeaux, S. J., Holsman, K., and Zador, S. 2020. Marine Heatwave Stress Test of Ecosystem-Based Fisheries Management in the Gulf of Alaska Pacific Cod Fishery. Frontiers in Marine Science, 7: 703. https://www.frontiersin.org/article/10.3389/fmars.2020.00703.

Frölicher, T. L., Fischer, E. M., and Gruber, N. 2018. Marine heatwaves under global warming. Nature, 560: 360–364. https://doi.org/10.1038/s41586-018-0383-9.

Nickel, A. K., Campana, S. E., and Ólafsdóttir, G. Á. 2024. Temperature and body size affect movement of juvenile Atlantic cod (Gadus morhua) and saithe (Pollachius virens) at nearshore nurseries. Journal of Fish Biology, n/a. John Wiley & Sons, Ltd. https://doi.org/10.1111/jfb.15850.

Oida, J., Hirawake, T., Yamashita, Y., Abe, H., Nishioka, J., Waga, H., Nomura, D., *et al.* 2024. Classification of optical water groups in the subarctic pacific and adjacent seas using satellite-derived light absorption spectra of chromophoric dissolved organic matter. Deep Sea Research Part I: Oceanographic Research Papers, 208: 104313. https://www.sciencedirect.com/science/article/pii/S0967063724000839.

Slesinger, E., Mundorff, S., Laurel, B. J., and Hurst, T. P. 2024. The combined effects of ocean warming and ocean acidification on Pacific cod (Gadus macrocephalus) early life stages. Marine Biology, 171: 121. https://doi.org/10.1007/s00227-024-04439-w.

Thalmann, H. L., Laurel, B. J., Almeida, L. Z., Osborne, K. E., Marshall, K., and Miller, J. A. 2024. Marine heatwaves alter the nursery function of coastal habitats for juvenile Gulf of Alaska Pacific cod. Scientific Reports, 14: 14018. https://doi.org/10.1038/s41598-024-63897-w.

2.b. Publications since last report

Please add all publications since last report to the table below (see notes for details on "Class" and "Activity" fields).

***Publication** with DOI*	***Class 1, 2, 3***	***Activity****
Alabia, I. D., García Molinos, J., Hirata, T., Mueter, F. J., & David, C. L. (2023). Pan-Arctic marine biodiversity and species co-occurrence patterns under recent climate. *Scientific Reports*, *13*(1), 4076. https://doi.org/10.1038/s41598-023-30943-y	*1*	*ESSAS project RACArctic & ESSAS Annual Science Meeting*
Almeida, L. Z., Laurel, B. J., Thalmann, H. L., & Miller, J. A. (2024). Warmer, earlier, faster: Cumulative effects of Gulf of Alaska heatwaves on the early life history of Pacific cod. *Elementa: Science of the Anthropocene*, *12*(1), 50. https://doi.org/10.1525/elementa.2023.00050	*1*	*ESSAS Annual Science Meeting*

Bank, M. S., Ho, Q. T., Kutti, T., Kögel, T., Rodushkin, I., van der Meeren, T., Wiech, M., & Rastrick, S. (2024). Multi-isotopic composition of brown crab (*Cancer pagurus*) and seafloor sediment from a mine tailing sea disposal impacted fjord ecosystem. *Journal of Hazardous Materials*, *471*, 134406. https://doi.org/10.1016/j.jhazmat.2024.134406	*2*	*Presented / discussed at ESSAS ASM*
Bednaršek, N., Pelletier, G., Beck, M. W., Feely, R. A., Siegrist, Z., Kiefer, D., Davis, J., & Peabody, B. (2024). Predictable patterns within the kelp forest can indirectly create temporary refugia from ocean acidification. *Science of The Total Environment*, *945*, 174065. https://doi.org/10.1016/j.scitotenv.2024.174065	*2*	*Presented / discussed at ESSAS ASM*
Cadman, R., Snook, J., Goudie, J., Watts, K., Broomfield, T., Johnson, R., Winters, J., & Bailey, M. (2024). "We don't have a lot of trees, but by God, do we have a lot of fish": imagining postcolonial futures for the Nunatsiavut fishing industry. *AlterNative: An International Journal of Indigenous Peoples*, 11771801241249920. https://doi.org/10.1177/11771801241249920	*2*	*Presented / discussed at ESSAS ASM*
Correa, G. M., Hurst, T. P., Stockhausen, W. T., Ciannelli, L., Kristiansen, T., & Pilcher, D. J. (2024). Modelling the multiple action pathways of projected climate change on the Pacific cod (*Gadus macrocephalus*) early life stages. *Progress in Oceanography*, *227*, 103313. https://doi.org/10.1016/j.pocean.2024.103313	*2*	*Presented / discussed at ESSAS ASM*
Cote, D., McClenaghan, B., Desforges, J., Fahner, N. A., Hajibabaei, M., Chawarski, J., Roul, S., Singer, G., Aubry, C., & Geoffroy, M. (2023). Comparing eDNA metabarcoding and conventional pelagic netting to inform biodiversity monitoring in deep ocean environments. *ICES Journal of Marine Science*, *80*(10), 2545–2562. https://doi.org/10.1093/icesjms/fsad169	*2*	*Presented / discussed at ESSAS ASM*
Decker, M. B., Brodeur, R. D., Ciannelli, L., Britt, L. L., Bond, N. A., DiFiore, B. P., & Hunt, G. L. (2023). Cyclic variability of eastern Bering Sea jellyfish relates to regional physical conditions. *Progress in Oceanography*, *210*, 102923. https://doi.org/10.1016/j.pocean.2022.102923	*2*	*Presented / discussed at ESSAS ASM*
Emelin, P. O., Maznikova, O. A., Benzik, A. N., Sheibak, A. Yu., Trofimova, A. O., & Orlov, A. M. (2022). Invader's portrait: Biological characteristics of walleye pollock *Gadus chalcogrammus* in the western Chukchi Sea. *Deep Sea Research Part II: Topical Studies in Oceanography*, *206*, 105211. https://doi.org/10.1016/j.dsr2.2022.105211	*2*	*Presented / discussed at ESSAS ASM*
Ferreira, A. S. A., Langangen, Ø., Yaragina, N. A., Prokopchuk, I. P., & Durant, J. M. (2024). How the spatio-temporal overlap of cod, haddock, and capelin larvae affects their recruitment in the Norwegian-Barents Sea system. *Marine*	*2*	*Presented / discussed at ESSAS ASM*

Ecology Progress Series, *734*, 79–90. https://doi.org/10.3354/meps14564		
Fujii, M., Hamanoue, R., Bernardo, L. P. C., Ono, T., Dazai, A., Oomoto, S., Wakita, M., & Tanaka, T. (2023). Assessing impacts of coastal warming, acidification, and deoxygenation on Pacific oyster (*Crassostrea gigas*) farming: a case study in the Hinase area, Okayama Prefecture, and Shizugawa Bay, Miyagi Prefecture, Japan. *Biogeosciences*, *20*(22), 4527–4549. https://doi.org/10.5194/bg-20-4527-2023	2	*Presented / discussed at ESSAS ASM*
Green, J. M., Schornagel, D., Nguyen, K. Q., Pennell, C., & Morris, C. J. (2023). Field observations of the movements of locally adapted Atlantic cod (*Gadus morhua*) living in zero and sub-zero centigrade temperatures for half the year. *Canadian Journal of Zoology*, *102*(3), 253–263. https://doi.org/10.1139/cjz-2023-0067	2	*Presented / discussed at ESSAS ASM*
Laurel, B. J., Abookire, A., Barbeaux, S. J., Almeida, L. Z., Copeman, L. A., Duffy-Anderson, J., Hurst, T. P., Litzow, M. A., Kristiansen, T., Miller, J. A., Palsson, W., Rooney, S., Thalmann, H. L., & Rogers, L. A. (2023). Pacific cod in the Anthropocene: An early life history perspective under changing thermal habitats. *Fish and Fisheries*, *n/a*(n/a). https://doi.org/10.1111/faf.12779	2	*Presented / discussed at ESSAS ASM*
Mikkelsen, N., Planque, B., Arneberg, P., Skern-Mauritzen, M., Hansen, C., Fauchald, P., Holsman, K. K., Haynie, A. C., & Ottersen, G. (2023). Multiple stakeholders' perspectives of marine social ecological systems, a case study on the Barents Sea. *Ocean & Coastal Management*, *242*, 106724. https://doi.org/10.1016/j.ocecoaman.2023.106724	2	*Presented / discussed at ESSAS ASM*
Nickel, A. K., Campana, S. E., & Ólafsdóttir, G. Á. (2024). Temperature and body size affect movement of juvenile Atlantic cod (*Gadus morhua*) and saithe (Pollachius virens) at nearshore nurseries. *Journal of Fish Biology*, *n/a*(n/a). https://doi.org/10.1111/jfb.15850	2	*Presented / discussed at ESSAS ASM*
Oida, J., Hirawake, T., Yamashita, Y., Abe, H., Nishioka, J., Waga, H., Nomura, D., & Kakehi, S. (2024). Classification of optical water groups in the subarctic pacific and adjacent seas using satellite-derived light absorption spectra of chromophoric dissolved organic matter. *Deep Sea Research Part I: Oceanographic Research Papers*, *208*, 104313. https://doi.org/10.1016/j.dsr.2024.104313	2	*Presented / discussed at ESSAS ASM*
Slesinger, E., Mundorff, S., Laurel, B. J., & Hurst, T. P. (2024). The combined effects of ocean warming and ocean acidification on Pacific cod (*Gadus macrocephalus*) early life stages. *Marine Biology*, *171*(6), 121. https://doi.org/10.1007/s00227-024-04439-w	2	*Presented / discussed at ESSAS ASM*

Thalmann, H. L., Laurel, B. J., Almeida, L. Z., Osborne, K. E., Marshall, K., & Miller, J. A. (2024). Marine heatwaves alter the nursery function of coastal habitats for juvenile Gulf of Alaska Pacific cod. *Scientific Reports*, *14*(1), 14018. https://doi.org/10.1038/s41598-024-63897-w	*2*	*Presented / discussed at ESSAS ASM*

**If appropriate, please list the IMBeR activity through / by / from / during which the publication arose*

*******Notes on publications********

Publications are logged in the IMBeR Zotero library which is publicly accessible online –

Publications since 2016 | Publications prior to 2016

Publications are categorised by "Class" and linked to "Activities":

Class 1 publications are specifically generated through/by/from/during ***IMBeR activities*** - for example, arising from IMBIZOs and IMBeR conferences such as the IMBeR open science meeting and the IMBeR West Pacific symposia and from the activities of the working groups, regional programmes and the SPIS scoping teams.

Class 2 publications are on topics relevant to the IMBeR Science Plan that benefitted from some interaction with IMBeR or ***IMBeR activities***, for example by IMBeR symposium attendees, past and present SSC members, working group, regional programme and endorsed project members, or national contacts.

Class 3 publications are on topics relevant to the IMBeR Science Plan but for which there is no direct link to or benefit from an IMBeR activity. These might include publications by SSC members, working group, regional programme or endorsed project members or members of the IMBeR international community that were written as part of the normal scientific activity of the authors and would have occurred irrespective of IMBeR's existence. You can report Class 3 publications, but they will no longer be logged in the IMBeR database.

[See "What is an IMBeR publication?" for further information]

Why list 'Class' and 'Activity'? This helps us to declare authentically which publications IMBeR has helped to generate, and it makes it easier for us to demonstrate the value of the Regional Programmes, the Working Groups, and IMBeR in general, and it helps us to justify support for IMBeR activities when we can list tangible outputs.

2.c. Events, Meetings, and Workshops

List all international and national events, meetings and workshops. Describe the level of participation: e.g. chairing session/workshop, organising meeting. Include Endorsed Projects committee meetings and workshops.

2023 ESSAS Annual Science Meeting "Ecological, social, and economic dynamics of high-latitude coastal systems" June 19-23, 2023, Seattle, Washington, USA.

The meeting included a workshop and 4 session ranging from a half day to a full day. There were a total of 51 presentation and about 60 participants.

Workshop – AnalogueART: Using natural analogues to investigate the effects of climate change on northern ecosystems; moving from gradient to mosaic approaches.

Session 1: Cooperative studies of coastal ecosystems engaging local communities in the sub-Arctic and Arctic

Session 2: Natural disasters, multiple stressors and cumulative impacts along sub-arctic and arctic coasts

Session 3: Blue Carbon, mariculture and climate change mitigation and adaptation in the Subarctic and Arctic

Session 4: Cod and climate change at the coastal interface

2024 ESSAS Annual Science Meeting "Exploring the dynamic interface of human and marine life in high-latitude coastal zones", June 18-21, 2024, St. John's, Newfoundland, Canada

The annual science meeting consisted of 5 sessions over 3 days, followed by an informal workshop on day 4. There were a total of 39 oral presentations and 11 posters during the main meeting with approximately 70 participants overall. The half-day workshop on day 4 featured another 10 presentations and extensive discussions, including remote participants from Norway and the US. In addition, a project meeting was held for a Norwegian-US collaboration on "Arctic ecosystem impact assessment of oil in ice under climate change (ACTION).

Session 1: Conservation and Sustainable Use of Species and Habitats in Changing Arctic and Subarctic Ecosystems

Session 2: Benthic communities, resources, and processes in high-latitude coastal zones: current knowledge and impacts

Session 3: Effects of Climate Change on Spawning and Recruitment Success of Arctic Marine Species

Session 4: High-Latitude Fjords, Estuaries, and Coastal Zones in Transition

Session 5: Understanding and Managing Human-Marine Mammal Interactions in High-Latitude Regions

Workshop: Coastal Cod

3. International collaboration and links

ESSAS works across the circumpolar north and has members from all Arctic countries, as well as Japan and Korea. ESSAS fosters collaborations among scientists from these countries.

One example of a recent international collaboration was the ACTION project noted above, a collaboration among scientists in Norway and the US. In addition, SSC members are involved in international collaborations such as ICES and PICES working groups.

The ESSAS Decade Action entitled "No.71.2 - Ecosystem Studies of Subarctic and Arctic Seas" was endorsed as a contribution to the UN Decade of Ocean Science for Sustainable Development.

4. Input to management, policy and SOCIETY* over the last year

Add anything that is not covered under "1.c. Grand Challenge III"

**As previous reporting forms requested 'input to management and policy' only, please add any 'input to society' not captured in previous reports*

ESSAS members serve on national and international scientific advisory bodies and in other roles to provide input on management and policy issues that are directly or indirectly informed by ESSAS activities.

- In the US, Franz Mueter served as co-chair of the Scientific and Statistical Committee of the North Pacific Fishery Management Council, which provides direct advice to fishery managers, including the determination of acceptable biological catch limits.
- B. Planque served in the ICES working groups for the integrated ecosystem assessments of the Norwegian and Barents Sea. These groups prepare the advice formally provided by ICES on ecosystem overviews for these two oceans.
- Other SSC members were engaged in national management and policy forums relating to climate policy (e.g. K. Azetsu-Scott, Canada, DFO, N. Harada, JAMSTEC, Japan) and fisheries management (e.g. Caroline Bouchard, Greenland; Gudbjorg Olafsdottir in Iceland) in Arctic waters.

5. Education, outreach and Capacity Development

ESSAS did not engage in dedicated education or outreach activities, but contributes to capacity building by sponsoring the participation of early career scientists, including local students, in Annual Science Meetings. ESSAS also has a dedicated seat on the SSC for an early career researcher (Dr. Bia Diaz) and students help out with preparing and running the Annual Science Meeting.

6. Planned activities

6.a. Activities and Outreach and how they link to the Challenges (including, but not limited to convening sessions, meetings, summer schools, workshops, etc)

ESSAS is currently preparing for its next Open Science Meeting in Japan. Open Science Meetings are considerably larger than our typical Annual Science Meeting and we are expecting approximately 200 participants. The theme for the Open Science Meeting is "**Past, Present and Future of Marine**

Biodiversity and Ecosystems" and will be held on 24-26 June 2025 at the National Institute of Polar Research, Tachikawa, Tokyo, Japan.

6.b. Upcoming papers (Community-Position-Review-etc)

None

7. Funding

7.a. Funding from external sources

We received considerable support from the following sponsors for the Annual Science Meetings in Bergen in 2023 and in St. John's in 2024.

Institute of Marine Research, Norway: Financial support plus in-kind support for registration and abstract submission, as well as meeting facilities and IT support for the meeting.

Nunatsiavut Government: Substantial financial support for meeting facilities and catering, plus in-kind support for helping with local organization.

Fisheries and Oceans Canada: In-kind support to help with local organization.

Memorial University: Financial support for socials plus in-kind support to help with local organization.

7.b. Funding proposals in progress or planned

Currently, no funding proposals specific to ESSAS are planned.

7.c. Funding requested from IMBeR for 2024-2025

Include a brief budget and justify requests

Travel support: US $7,500

We are seeking full travel support for the early career scientists ESSAS SSC member ($ 3,000), partial travel support for two SSC members from Canada and Norway ($1,500 each) and partial support for one invited keynote speaker (early career) to participate in the Open Science Meeting in Tokyo, Japan, in 2025. This request in in line with recent IMBeR support. Any additional funds would go towards supporting Early Career Scientists to participate in the OSM.

8. Changes to Organisational Structure (e.g. SSC) of Regional Programme

None

9. Images / Figures

*****It is always good to have some recent photos / figures / infographics to create more exposure for the Regional Programmes, Working Groups, etc. These can range from those suitable for a very scientific*

audience, to those that would engage the general public. IMBeR would use these, on the website (e.g. http://www.imber.info/ and http://www.imber.info/en/news), in tweets (@imber_ipo), in presentations, etc. In addition, Future Earth (one of our sponsors) regularly asks us to provide high quality images for their glossy reports. These can highlight the activities of IMBeR and their other Global Research Projects (see pdfs of past Future Earth reports here https://futureearth.org/publications/annual-reports/)

*So, please provide any images that you might think are useful. These can be pasted in this document or emailed as an attachment to imber@ecnu.edu.cn.*****

Participants in the 2024 Annual Science Meeting in St. John's, Newfoundland and Labrador, Canada.

10. Anything not covered above

Add text…

11. How to improve this form

Please give suggestions on how to improve this form and make it better next time.

Add text…

12. Appendices

Add appropriate meeting / workshop reports and include URLs (this helps to track where online content is missing)

Appendix 1: Schedule of presentations at the 2023 Annual Science Meeting in Bergen, Norway

Ecological, social, and economic dynamics of high-latitude coastal systems

Overview and Schedule

The meeting will be held at the Institute of Marine Research (IMR), meeting room *Pynten*, in Bergen, Norway. For details, registration, and accommodations see the ESSAS website. Abstracts are listed by session below.

Monday, June 19

Day: Workshop – AnalogueART: Using natural analogues to investigate the effects of climate change on northern ecosystems; moving from gradient to mosaic approachesers

Eveninng: Reception

Tuesday, June 20

Morning: Session 1: Cooperative studies of coastal ecosystems engaging local communities in the sub-Arctic and Arctic

Afternoon: Session 2: Natural disasters, multiple stressors and cumulative impacts along sub-arctic and arctic coasts

Wednesday, June 21 (morning only)

Morning: Session 3: Blue Carbon, mariculture and climate change mitigation and adaptation in the Subarctic and Arctic

Afternoon: Excursion, possibly followed by group dinner

Thursday, June 22

Day: Session 4: Cod and climate change at the coastal interface

Friday, June 23

ESSAS business meeting

Monday, June 19, 2023

<u>Workshop:</u> Using natural analogues to investigate the effects of climate change on northern ecosystems; moving from gradient to mosaic approaches

Time	*Presenter*	*Abstract title*
9:00	Samuel Rastrick	Workshop Introduction.
9:30	Kumiko Azetsu-Scott	A Tale of Two Fjords, with marine-terminated and land-terminated glaciers
9:45	Agneta Fransson	Western Svalbard fjords as climate change proxies for a changing Arctic: focus on ocean acidification and climate drivers
10:00	Jonaotaro Onodera	Decadal condition changes in material transportation in the southwestern Canada Basin, 2020-2021
10:15	Nina Bednaršek	Natural ocean acidification analogues in the subpolar and polar Northern regions: a synthesis study
10:30	Susen Fitzer (r)	Impacts of climate change on mollusc biomineralisation
10:45	Michael Bank	Using stable isotopes as tracers of pollution in heterogeneous environments
11:00	**Break**	
11:15	Jason Hall-Spencer	An overview of CO2 seep studies and the International CO2 Natural Analogues Network
11:30	Ben Harvey	The simplification of marine ecosystems under ocean acidification – insights from CO2 seeps
11:45	Richard Bellerby	Climate-Smart kelp restoration opportunities for coastal Norway
12:00	Jorge Corrales-Guerrero	Using natural analogues to evaluate the resilience of cold-water coral reefs to changes in environmental conditions
12:15	Antonio Agüera	Seasonal variability of Mytilus spp metabolic rate
12:30	Talia Mullen-Humphreys	Assessing vulnerability to future environmental change based on current habitat preferences along salinity gradients within Kongsfjorden: a case study on marine gammarid amphipods
13:00	**Lunch**	
14:00	Jorge Corrales-Guerrero	Knowledge gaps and future directions; results of a meta-analysis of natural gradient and mosaic studies.
14:15	Samuel Rastrick	Introduction to the group writing activity (5 min)
14:20	All	Group writing activity, split up for group discussions in to Chemistry, Biology, Statistics/experimental design.
15:15	**Break**	

Time	*Presenter*	*Abstract title*
15:30	All	Group writing (cont'd)
17:00	Wrap-up	
18:00	**Reception**	(At venue)

Tuesday, June 20, 2023

<u>Session 1</u>: Cooperative studies of coastal ecosystems engaging local communities in the sub-Arctic and Arctic

Time	*Presenter*	*Abstract title*
9:00	ESSAS co-chairs / Session chairs	Welcome & Introduction
9:10	Malgorzata Smieszek	Understanding risk in ecosystem impact assessments in the Arctic
9:30	Kate Ortenzi	Southern scientists, your data debt's come due.
9:50	Anne Beaudreau	Stewardship, advocacy, and knowledge exchange in coastal resource management: Case studies from Alaska
10:10	Rachael Cadman	Participatory Scenario Planning for Inuit-led Fish Futures
10:30	**Break**	
11:00	David Cote	Integrative and multidisciplinary approach leads to discovery of deep ocean biodiversity hotspot off Labrador, Canada
11:20	Yuki Minegishi	Another role of coastal marine science for making the hope in a local community: a case of sub-Arctic area in Japan
11:40	Caroline Bouchard (r)	Polar cod (Boreogadus saida) in fjord and glacial habitats: a collaborative study with Uummannaq fishers
12:00	Ben Fitzhugh (r)	Stewarding Sugpiaq (Alutiiq) Fisheries through the Millennia: Braiding Knowledge for a Sustainable and Equitable Future
12:20	***Discussion***	
13:00	**Lunch**	

Session 2: Natural disasters, multiple stressors and cumulative impacts along sub-arctic and arctic coasts

Time	*Presenter*	*Abstract title*
14:00	Hideki Fukuda	Recovery process of coastal ecosystem and local communities from the disturbance induced by mega tsunami following the 2011 Tohoku Earthquake off the Pacific coast, northeastern Japan
14:20	Raymond Nepstad	Oil spill modelling for preparedness and potential impacts in the Barents Sea region
14:40	Melina Kourantidou (r)	Arctic waters and coasts at stake from invasive alien species threats
15:00	Toru Hirawake	Water mass distribution in the northern Bering and southern Chukchi seas using light absorption of chromophoric dissolved organic matter
15:20	Johanna Myrseth Aarflot	Cumulative impact assessment of four coastal, sub-Arctic regions with contrasting scope of human a`ctivities
15:40	**Break**	
16:00	James Overland (r)	Catastrophic ecological and human impacts from climate change and diminished sea ice in the northern Bering Sea

Session 3: Blue Carbon, mariculture and climate change mitigation and adaptation

Time	*Presenter*	*Abstract title*
16:20	Session chairs	Introduction
16:40	Øivind Strand Pia Kupka Hansen (r)	Perspectives on Mariculture Planning facing climate change
17:00	Navya Vikraman Nair	Linking Blue Carbon Ecosystems And Water Quality In Coastal Wetlands For Viable Small-Scale Fisheries
17:20	Wrap-up	

Appendix 2: Schedule of presentations at the 2024 Annual Science Meeting in St. John's, Canada

Exploring the dynamic interface of human and marine life in high-latitude coastal zones

CONFERENCE PROGRAM

Table of Contents

Schedule at a glance

Monday, June 17	Tuesday, June 18	Wednesday June 19	Thursday June 20	Friday June 21
	8:00 Registration & breakfast	**8:00 Breakfast**	**8:00 Breakfast**	
	"	"	"	
	"	"	8:55 Introduction	
9:00 ACTION	9:00 Introduction	9:00 Introduction	**9:00 Pepin (Keynote 2)**	**9:00 SSC meeting**
workshop	**9:20 Laing (Keynote 1)**	9:10 Farnole	"	(closed)
(closed)	"	9:30 West	9:40 Vilgrain	
	10:00 Graham	9:50 Planque	10:00 Valliant	
	10:20 Warren	10:10 Mueter	**10:20 Morning Break**	
	10:40 Morning Break	**10:30 Morning Break**	10:50 Laurel	
	11:10 Cadman	11:00 Ma	11:10 Miller	
	11:30 Weinstein	11:20 Rastrick	11:30 Abookire	
	11:50 Ruiz Diaz	11:40 Soares	11:50 Thalmann	
12:00 Lunch on your own	12:10	12:00 Poster speed talks	12:10 Opdal	**12:00 Lunch on your own**
	12:30 Lunch provided	**12:30 Lunch provided**	**12:30 Lunch provided**	**13:00 Coastal Cod workshop**
ACTION	13:30 King	13:30 Poster session	13:30 Geoffroy	
workshop	13:50 McAllister	"	13:50 Arimitsu	
(con'd)	14:10 Oates	"	14:10 Birnir	
	14:30 Ofosu	14:00 Boat excursion	14:30 Kjesbu	
	14:50 Ólafsdóttir		14:50 Fitzhugh	
	15:10 Afternoon break		**15:10 Afternoon break**	
	15:40 Hamisch		15:40 Folkvord	
	16:00 Wolvin		16:00 Copeman	
	16:20 de Moura Neves		16:20 Salant	
	16:40 Evans		16:40 Johansen	
20:00 Jack Axes (8-10pm)	Evening Dinner on your own	**19:00 Quidi Vidi**	Evening Dinner on your own	**Evening Indigenous Peoples Day** activities)

Exploring the dynamic interface of human and marine life in high-latitude coastal zones

Session descriptions

Session 1: Conservation and Sustainable Use of Species and Habitats in Changing Arctic and SubArctic Ecosystems

International commitments to preserve global biodiversity target the protection of 30% of marine habitats by 2030. Many of these new protected areas are being placed in the Arctic in collaboration with Indigenous communities who rely heavily on these areas for subsistence, cultural, and economic purposes. In this session we invite presentations that highlight 1) science and knowledge co-production methods used to identify habitats of high conservation value in areas with sparse scientific data, and 2) approaches that can be used to address conservation of these habitats while allowing for sustainable use by rights holders and other local people.

Session Co-chairs:

Rodd Laing (Nunatsiavut Government), rodd.laing@nunatsiavut.com
Bia Dias (University of Alaska Fairbanks), bdossantosdias@alaska.edu
Jon Fisher (Memorial University), jonathan.fisher@mi.mun.ca

Session 2: Benthic communities, resources, and processes in high-latitude coastal zones: current knowledge and impacts

This session will focus on benthic studies in high-latitude coastal environments. From SCUBA-diving depths to deep-water environments, including fjords and bays, benthic environments in high-latitude coastal zones can host an array of diverse habitats and processes. These areas are intrinsically important to indigenous and other coastal communities, and support human-related activities including fishing, aquaculture, and shipping. Yet, these areas are often understudied, and impacts are not well understood. In this session, we invite studies that address social, biological, or geological aspects of high-latitude coastal environments. Presentations may include, but are not limited to, the effect of climate change and industry on benthic resources and processes, from physiological responses to benthic diversity and ecosystem function, including endofauna, epifauna, and megafauna, local use of benthic communities, impacts and conservation.

Session Co-chairs:

Barbara de Moura Neves (Fisheries and Oceans, Canada); barbaradm.neves@gmail.com
Sam Rastrick (Institute of Marine Research, Norway); samuel.rastrick@hi.no

Session 3: Effects of Climate Change on Spawning and Recruitment Success of Arctic Marine Species

Climate-driven changes in sea ice and water temperature are extending growing seasons for Arctic marine species through shorter winters, increasing light, and earlier primary productivity. Such changes are impacting spawn timing, size-at-age, and energetic status of marine organisms, all of which can shift mortality and maturity schedules for these species. This session is focused on seasonal processes in the Arctic that are important to 1st year of life survival and population replenishment for all types of marine organisms, with an emphasis on gadid and crab populations that have undergone recent population declines and distributional shifts. We encourage talks focused on changes in spring spawning and match-mismatch dynamics, summer growth and distribution, fall maturity and energetics, and winter survival.

Session Co-Chairs:

Ben Laurel (NOAA Alaska Fisheries Science Center, USA); ben.laurel@noaa.gov
Maxime Geoffroy (Memorial University, Canada); Maxime.Geoffroy@mi.mun.ca
Frode Vikebø (Institute of Marine Research, Norway); frode.vikeboe@hi.no

Session 4: High-Latitude Fjords, Estuaries, and Coastal Zones in Transition

Climate change disproportionately affects coastal areas at high latitudes. The decreasing spatial extent, duration and thickness of sea ice leads to higher waves, exacerbating coastal erosion and hazardous conditions for navigation. Increasing river runoff and glacier melting in fjords alter stratification and circulation patterns, affecting terrestrial nutrient and carbon supply, biogeochemical cycling, and ocean acidification. Thawing permafrost releases more organic carbon and methane into coastal regions. Biological processes are strongly influenced by these physical and chemical changes, thereby impacting coastal ecosystems and the livelihoods of coastal inhabitants. This session welcomes presentations on physical and biogeochemical studies in changing coastal environments in high latitudes, encompassing observations from both instrumental and local knowledge sources, laboratory experiments, theoretical studies, and modeling approaches.

Session Co-chairs:

Kumiko Azetsu-Scott (Bedford institute of Oceanography, Fisheries and Oceans, Canada); Kumiko.Azetsu-Scott@dfo-mpo.gc.ca
Naomi Harada (University of Tokyo, Japan); naomi.harada@aori.u-tokyo.ac.jp

Session 5: Understanding and Managing Human-Marine Mammal Interactions in High-Latitude Regions

High-latitude marine ecosystems are highly productive regions that attract and sustain a large variety of organisms across all trophic levels. Marine mammals, generally occupying the upper trophic levels, are widely present in these regions. Some are year-round residents,

while others migrate to high latitudes during intense summer feeding seasons – but regardless of their residency pattern they play a crucial ecological role. As key top predators, marine mammals rely on the structure and resilience of high-latitude ecosystems to perturbation, including from human activities such as fishing, marine traffic, and offshore energy production. In the coming years, activities and developments in the marine sector are expected to increase substantially. As this is happening against the backdrop of rapid climate warming that disproportionately affects higher latitudes, the expansion of human activities carries serious implications for marine mammals in the north. Despite the potential for human activities to adversely impact marine mammals, and by extension, the entire marine ecosystems of which they are part, human-marine mammal interactions are often not well understood. In this session, we invite presentations on this general topic, including human-marine mammal interactions, monitoring and management frameworks.

Session Co-chairs:

André Moan (Institute of Marine Research, Norway); Andre.Moan@hi.no
Charmain Hamilton (Fisheries and Oceans, Canada); Charmain.Hamilton@dfo-mpo.gc.ca

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Coastal Cod workshop

Beyond growth: Ocean warming and size-shifts in 0-group gadid populations

This workshop is for the Coastal Cod Working Group, a collaboration initiated in 2012 by scientists from NMFS, DFO, and IMR (Norway). The collaboration now falls under the Bioenergetics of Subarctic Fishes, a working group supported by the Ecosystem Studies of Sub-Arctic Seas (ESSAS) Program.

The historical working group comprised researchers involved with collecting and analyzing beach seine data used in nearshore monitoring of early life stages of gadids. These data form the core time-series, which include long-running beach-seine surveys from sub-Arctic coastal areas along Kodiak Island, Alaska (20 yrs and 5+ yrs 1000 km coastline expansion), Bonavista Bay, Newfoundland (25+ yrs), and the Skagerrak coastline, Norway (105+ yrs). These surveys provide estimates of age-0 abundance that may serve as early warning indicators of climate driven changes in cod and other commercially harvested species across all regions. The working group has since expanded under ESSAS to include analyses and process studies from other regions, as well as the offshore, as there is mutual interest in linking life history processes with broader population dynamics within and across regions.

Particular research areas include:

- connectivity between offshore spawning and inshore nurseries
- methods to integrate non-traditional datasets across political boundaries (e.g., state-federal, provincial-federal)
- identifying overlooked datasets and determining their relevance for stock assessment
- improving recruitment forecasting using direct measures of age-0 abundance
- capturing climate-driven demographic shifts and carry-over impacts in the population
- improving survey design for age-0 gadids in assessment

• using cross-regional and cross-species analyses to refine mechanistic understanding of climate impacts on growth, survival, habitat use, and recruitment.

Workshop Abstract:

The temperature-size rule (TSR) predicts that warmer temperatures will lead to faster growth, earlier maturity and smaller maximum body size in fish (Atkinson, 1994). However, cod populations are responding differently to warming among populations, species and regions. The goal of this workshop is to bring together different perspectives and time-series data, with a particular focus on both mechanisms and ecological implications of size-shifts beginning at an early age. Specifically, we will discuss: 1) where size shifts have been documented, 2) the role of growth vs age vs selection in determining size, 3) whether these size-shifts carry over into subsequent years e.g. 'cohort effects' and 4) potential year-class, population and ecosystems impacts of changing size.

Detailed Schedule

Monday, June 17, 2024

Time	*Event*	
9:00	ACTION workshop (closed)	
12:00	**Lunch on your own**	
13:00	ACTION workshop (con'd)	
20:00	**Jack Axes (8-10pm)**	95 Merrymeeting Rd.

Tuesday, June 18, 2024

Time	*Presenter*	*Abstract title*
8:00	**Registration & breakfast**	
9:00	Local Committee / ESSAS	Welcome & Introduction
9:20	Rodd Laing (Keynote 1)	Imappivut Marine Plan - Inuit Self-Determination in Marine Planning
10:00	Myrah Graham	Making maps together: Collaborative seafloor mapping for sustainable marine conservation in Arctic Canada
10:20	Margaret Warren	Exploring the utility of current scientific indicators for monitoring marine conservation areas in Newfoundland and Labrador, Canada.
10:40	**Break**	
11:10	Rachael Cadman & Michelle Saunders	Imappivut Knowledge Study: Documenting Labrador Inuit Knowledge and priorities for marine conservation
11:30	Spencer Weinstein	Genomics, morphometrics, and community knowledge inform char (*Salvelinus* spp.) conservation in the central Canadian Arctic
11:50	Raquel Ruiz Diaz	Sensitivity of the projections of fish species distribution to underlying climate models: a test case from the Northwest Atlantic
12:10		
12:30	**Lunch provided**	
13:30	Benjamin King	Using baited cameras and acoustic telemetry to investigate coastal demersal fish communities in northern Labrador, Canada
13:50	Amy McAllister	Resolving Food Webs in the Labrador Sub-Arctic Deep Sea
14:10	Ashley Oates	Identifying the main drivers of shrimp dynamics in the eastern Canadian Arctic

14:30	Caroline Ofosu	How may Nunatsiavut Arctic char populations adapt to the changing marine environment? A spatial and temporal investigation
14:50	Guðbjörg Ásta Ólafsdóttir	Fisheries legislation in Iceland as a tool for biodiversity conservation
15:10	**Break**	
15:40	Stephan Hamisch	Ecosystem functioning in (sub-)Arctic Fjords: Impact of biodiversity on benthic nutrient remineralization on a north to south gradient
16:00	Sophie Wolvin	Rock bottom: colonization of dropstones in the low and high Arctic
16:20	Bárbara de Moura Neves	Deep-water corals in coastal Newfoundland (eastern Canada): state of knowledge and future directions
16:40	Rebecca J. Evans	Influence of Across-Shelf Food Sources on Subarctic Benthic Functioning and Biodiversity
Evening	**Dinner on your own**	

Wednesday, June 19, 2024

Time	*Presenter*	*Abstract title*
8:00	**Breakfast**	
9:00	Local Cmt	Introduction / Announcement
9:10	Patrick Farnole	Estimating the evolution of ringed seals and bearded seals preferred habitats in the Canadian Arctic, from the preindustrial period to the end of the century
9:30	Hannah West	Investigating the Influence of Harp Seals and Commercial Fisheries on Shared Target Species in Newfoundland and Labrador
9:50	Benjamin Planque	Quantifying direct and indirect interactions between marine mammals, fish, and fisheries in the Norwegian and Barents Seas
10:10	Franz Mueter	Managing Human – Cetacean Interactions in Alaska
10:30	**Break**	
11:00	Kevin Ma	Distribution and population structure of the northern sea cucumber within and around a nursery habitat in the Canadian Arctic
11:20	Sam Rastrick	Ocean acidification may increase the biological impact of metal pollution on commercial bivalves, a case study from mine waste deposits in Arctic Norway
11:40	Michael Soares	Using body condition to explain the impacts of environmental change on the Newfoundland and Labrador fish community

12:00	Speed talks (Posters)	
12:30	**Lunch provided**	
13:30	Poster session	
15:00	Boat excursion	
19:00	**Quidi Vidi Brewery**	

Thursday, June 20, 2024

Time	*Presenter*	*Abstract title*
8:00	**Breakfast**	
8:55		Welcome & Introduction
9:00	Pierre Pepin (Keynote 2)	Lessons learned from Canadian efforts to move toward an ecosystem approach to fisheries management – implications for resource management approaches in Polar Oceans
9:40	Laure Vilgrain	Assessing inshore-offshore connectivity of mesozooplankton across the Labrador Current front by combining nets, acoustics and eDNA data
10:00	Michelle Valliant	Distribution and movement of juvenile Atlantic cod (*Gadus morhua*) ecotypes in nearshore water
10:20	**Break**	
10:50	Ben Laurel	The rise and fall of saffron cod in the Gulf of Alaska: a thermal habitat perspective
11:10	Jessica Miller	The potential role of enhanced selective mortality during marine heatwaves
11:30	Alisa Abookire	Indications of changing recruitment control for Gulf of Alaska Pacific cod following extreme marine heatwaves
11:50	Hillary Thalmann	Can metabolic rate be predicted by water temperature or otolith carbon isotopes for age-1 Pacific Cod?
12:10	Anders Frugård Opdal	Seasonal dynamics in ocean temperatures can give false impression of thermal bottleneck for spawning fish.
12:30	**Lunch provided**	
13:30	Maxime Geofroy	Demersal spawning of capelin in Northern Labrador
13:50	Mayumi Arimitsu	Capelin response to thermal habitat and large-scale circulation in the Northwest Atlantic and North Pacific Oceans
14:10	Bjorn Birnir	The Use of Measurements to Calibrate Simulations, and Understand the Effects of Changing Currents on the Icelandic Capelin

14:30	Olav Sigurd Kjesbu	Flexibility in the reproductive cycle in Northeast Arctic cod under climate fluctuations
14:50	Ben Fitzhugh	The Little Ice Age in the Gulf of Alaska: Implications and Uncertainties in the Relationship between Climate Change, Fisheries Ecology, and Resilient Indigenous Economies
15:10	**Break**	
15:40	Arild Folkvord	Liver condition of 0 and 1-group cod (*Gadus morhua*) in the Barents Sea
16:00	Louise Copeman	Decreased juvenile snow crab nutritional condition during recent warming events in the Bering Sea
16:20	Carlissa Salant	Spatial variation in energetic status of juvenile Arctic cod (*Boreogadus saida*) from the western and eastern Canadian Arctic
16:40	Malou Platou Johansen	Marine fish diversity in Northeast Greenland
Evening	**Dinner on your own**	

Friday, June 21, 2024

Time	***Event***	
9:00	ESSAS SSC meeting	
12:00	**Lunch on your own**	
13:00	Coastal Cod workshop (1-4pm)	Beyond growth: Ocean warming and size-shifts in 0-group gadid populations
Evening	**National Indigenous Peoples Day**	(Optional activities)