

Project information

Keywords

Integrated Ecosystem Assessment (IEA), Svalbard, northern Barents Sea, Ecosystem Functioning, Vulnerability, Fish and Benthos, Climate, Trait-based Methods, Food Web Analyses

Project title

Assessment of ecosystem vulnerability and functioning in ice-affected waters (ICEEVA)

Year

2019

Project leader

Lis L. Jørgensen, Raul Primicerio

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)

76°N – 84°N and 05°E – 35°E

Participants

Project leaders: Lis Lindal Jørgensen (Institute of Marine Research) and Raul Primicerio (University of Tromsø)

Project participants/institutions:

- Institute of Marine Research, Lis L. Jørgensen lis.lindal.joergensen@imr.no (co-PL and benthos), Maria Fosheim (demersal fish), Harald Gjøsæter (demersal and pelagic fish), Randi Ingvaldsen (oceanography, lead SI_Arctic), Kirsteen McKenzie (stable isotope analyses)
- University of Tromsø, Raul Primicerio raul.primicerio@uit.no (co-PL and synthesis method), Bodil Bluhm (benthos), master student (stable isotope analyses)
- UNIS & Akvaplan-NIVA: Øystein Varpe oystein.varpe@unis.no (pelagic fish)
Administrative responsible for lead institution: Frode Vikebø frode.vikeboe@imr.no (Head of Research Program, IMR) and Terje Aspen, terje.aspen@uit.no (Head of Department, UoT)

Flagship

Arctic Ocean

Funding Source

	2017	2018	2019
<i>Arctic Ocean Flagship</i>	500	500	500
Other Flagships	1000		
SI_Arctic 201418 (NRC SIP)	4820	4820	

Summary of Results

The project aims to provide an integrated assessment of the functioning and vulnerability of the southern reaches of the Arctic ocean ecosystem under climate change. The main objectives are: 1) characterize ecosystem functioning along depth gradients crossing Arctic and Atlantic water masses; 2) assess temporal changes in ecosystem functioning driven by climate warming; 3) investigate spatio-temporal variation in ecosystem vulnerability.

2017 activities and results

In 2017 we addressed objective 1, and presented preliminary ICEEVA traits-based results on ecosystem functioning at the WGIBAR ICES working group meeting (Murmansk/Russia march 2017).

We had three workshops addressing: 1) data availability (sampled compartments, traits data, diet data) and knowledge gaps; 2) quantitative methods, including trait analyses; and 3) production of preliminary maps of taxonomic characterization (fig 1) for benthos (left) and fish (right) communities.

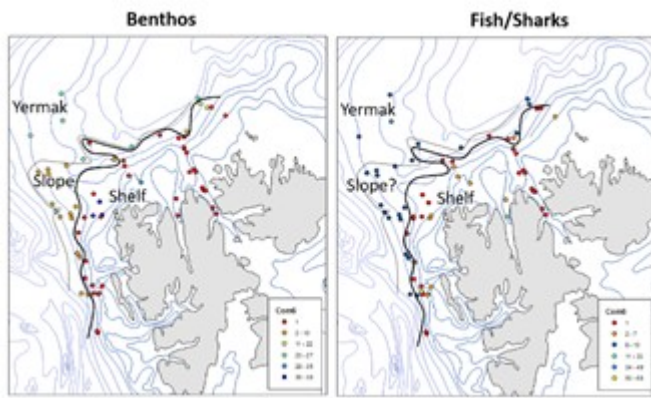


Fig 1. Taxonomic characterization (color coded classification) of bottom communities.

The traits, isotope and diet databases were compiled, updated and extended to allow for the ICEEVA trait-based and food-web analyses planned for 2017 and following two years.

2018 activities and results

In 2018 we addressed ICEEVA objectives 1 and 3, and presented ICEEVA results to various institutions and organizations, including the United Nations (Jørgensen, Malta 08.18; Primicerio, UN Headquarter New York 09.18) and ICES working group WGIBAR (Primicerio, Tromsø 03.18), and conferences, including the ICES annual scientific conference (Primicerio, Hamburg 09.18). Results from ICEEVA published in 2018 concerned functional characterization and redundancy of fish communities (Aune et al. 2018).

Based on the demersal fish presence-absence and functional traits data, maps of taxonomic characterization, species richness and functional diversity were produced (fig 2). Fish species richness and functional diversity declined with increasing depth.

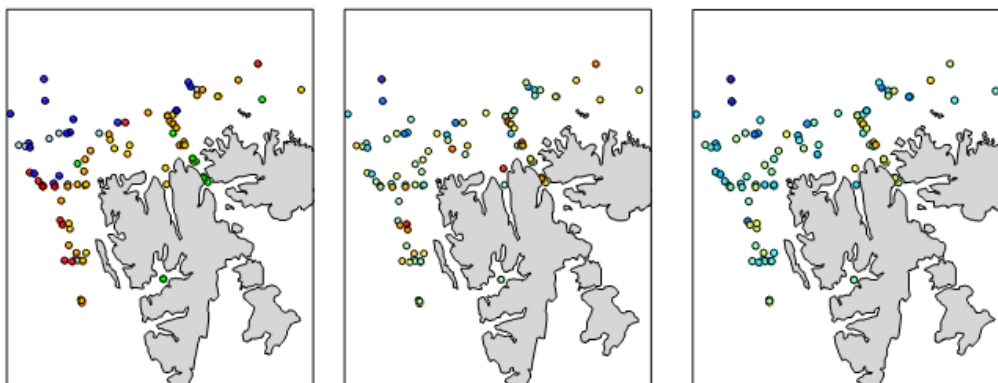


Fig 2. Demersal fish taxonomic characterization (left panel, color coded classification), species richness (mid panel, blue to red codes for low to high SR), functional diversity (right panel, blue to red codes for low to high FD).

Demersal fish diet data were used to compile a metaweb dataset. The metaweb (fig 3) allows for analyses of spatial variation in food web structure.

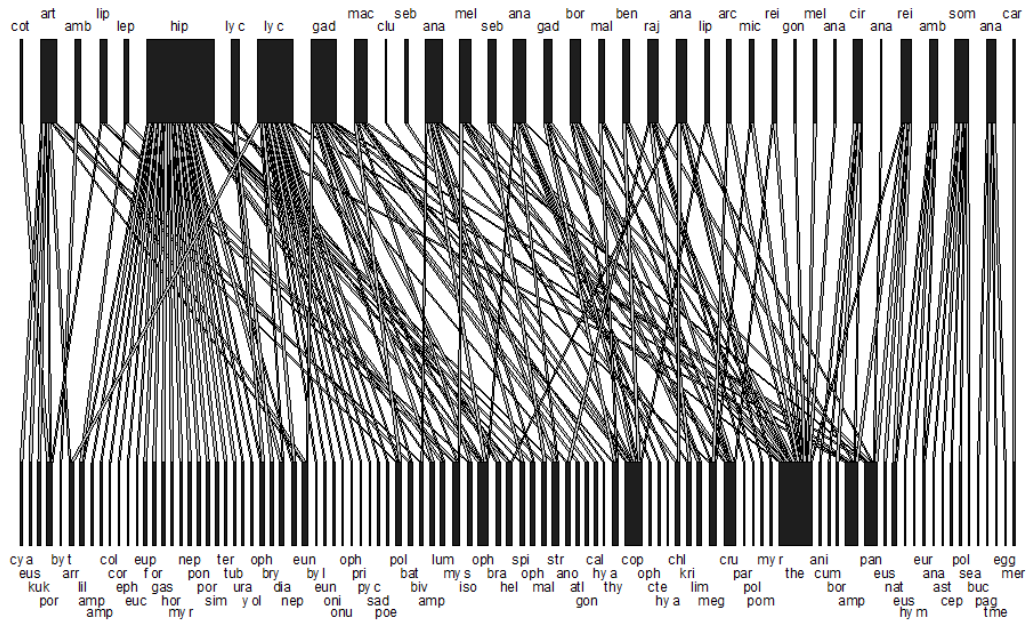


Fig 3. Bipartite food web with fish predators (top nodes) and their prey (bottom nodes). The breadth of the black rectangles indicates the degree of the respective nodes (broader rectangles correspond to species with more prey or predators)

2019 activities and results

In 2019 we addressed ICEEVA objectives 1, 2 and 3, and initiated the synthesis work for an ecosystem vulnerability assessment in the study area, to be summarized in the final project report. Results from ICEEVA were presented to various institutions and organizations, including AWI (Germany) and ICES working groups WGIBAR and WGICA, and conferences, including the IMBER Future Oceans conference (Primicerio, Brest, France) and the International Science and Policy Conference on Implementation of the Ecosystem Approach to Management in the Arctic (Jørgensen, Bergen, Norway). Results from ICEEVA published in 2019 concerned vulnerability of benthos (Jørgensen et al. 2019), spatial variability in food web structure and ecosystem vulnerability (Kortsch et al. 2019), role of sea mammals in the marine food web (Blanchet et al. 2019), and climate driven change in Arctic fish communities (Thorson et al. 2019).

Based on analyses of survey and research data for benthos, zooplankton, fish, seabirds and sea mammals, we subdivided the fauna around Svalbard into coastal, shelf and offshore assemblages. To compile foodwebs for the three assemblages, feeding relationships among species members of each assemblage were reconstructed based on literature and survey data relevant to project ICEEVA. Further, functional traits and environmental affinities data were compiled for all species in the assemblages to allow the integration of traits and food web analyses needed for the ecosystem vulnerability assessment and evaluation of ecosystem functioning.

Master and PhD-students involved in the project

Ella Weissenberg (master student with Øystein Varpe, UNIS, and Tor Knutsen, IMR)

Ann Mikaela Tillman (master student with Bodil Bluhm, UiT, and Lis L. Jørgensen, IMR)

Amalia Keck (master student with Bodil Bluhm and Raul Primicerio, UiT)

Laurene Merillet (visiting PhD student, Raul Primicerio, UiT - spring 2019)

For the Management

The project addresses ecosystem functioning and vulnerability empirically, combining trait-based methods with food web analyses and stable isotope analyses of main energy pathways using ecosystem data from the southern Arctic Ocean and bordering Arctic reaches of

the Barents Sea. The main findings will be summarized in maps visualizing areal specific ecosystem vulnerability indicators, suitable to inform areal management (e.g. Norwegian management of the Barents Sea), and international working groups within ICES and the Arctic Council.

Our project will contribute to an Integrated Ecosystem Assessment (IEA) of the marine areas north and west of Svalbard and the northern Barents Sea, by evaluating ecosystem functioning and the vulnerability of ecosystem components (fish and benthos) affected by climate change. The findings are communicated to the ICES (institution responsible for inter-governmental management of marine resources) by the project participants via dedicated working groups (integrated ecosystem assessment of Barents Sea WGIBAR, Arctic Ocean WGICA). The integrative approach to ecosystem assessment developed in this project can be further used to address other ecosystem components (e.g. marine mammals and seabirds), other stressors and areas (e.g. the entire Arctic Ocean) of interest for international working groups within the Arctic Council (see publication list). This project will thus contribute to the knowledge base necessary to develop an IEA for the entire Arctic Ocean.

Published Results/Planned Publications

Jørgensen LL. 2017. Trawl and temperature pressure on Barents benthos. Feature Article – ICES, 11 July 2017.

Jørgensen LL, Archambault P, Blicher M, Denisenko N, Guðmundsson G, Iken K, Roy V, Sørensen J, Anisimova N, Behe C, Bluhm BA, Denisenko S, Denisenko N, Metcalf V, Olafsdóttir S, Schiøtte T, Tendal O, Ravelo AM, Kędra M, Piepenburg D. 2017. Benthos. In: CAFF. State of the Arctic Marine Biodiversity Report. Conservation of Arctic Flora and Fauna, Akureyri Iceland.

Aune M, Aschan M, Greenacre M, Dolgov A, Fossheim M, Primicerio R. 2018. Functional roles and redundancy of demersal Barents Sea fish: ecological implications of environmental change. *PLoS One* 13(1) e0207451

Kortsch S, Primicerio R, Dolgov A, Aschan M, Planque B. 2019. Food-web structure varies along environmental gradients in a high-latitude marine ecosystem. *Ecography* 42: 295-308.

Jørgensen LL, Primicerio R, Ingvaldsen RB, Fossheim M, Strelkova N, Thangstad TH, Manushin I, Zakharov D. 2019. Impact of multiple stressors on sea bed fauna in a warming Arctic. *Marine Ecology Progress Series* 608: 1-12.

De Lucia V, Primicerio R, Prip C, Kraabel KD. 2019. Arctic protection can't wait for global treaty. *Nature* 565. doi: 10.1038/d41586-019-00021-3.

Blanchet M-A, Primicerio R, Fraimer S, Korstch S, Mauritzen M, Dolgov A, Aschan M. 2019. Marine sea mammals role in the Barents Sea food web. *ICES J. Mar. Sci.* doi: 10.1093/icesjms/fsz136

Thorson JT, Fossheim M, Mueter FJ, Olsen E, Lauth B, Primicerio R, Husson B, Marsh J, Dolgov A, Zador SG. 2019. Comparison of near-bottom fish densities show rapid community and population shifts in Bering and Barents Seas. *Arctic Report Card* In Press

Communicated Results

Jørgensen LL et al (2017) Effects of multiple stressors on the benthic ecosystem in the Barents Sea. ECRA General Assembly, 7-8 March 2017, Brussel. Climate Change and Vulnerable Regions (oral presentation).

Jørgensen LL et al (2017) Effects of multiple stressors on the benthic ecosystem in the Barents Sea. ESSAS conference, Tromsø, 11-15 June – Multiple stressors (oral presentation)

Jørgensen LL (2017) Bunndyr i Barentshavet. Fiskebåt, Ålesund, 04 April (oral presentasjon).

Jørgensen LL et al (2017) Effekt fra mange stressors samtidig på bunndyr i Barentshavet. CAFF – orientering om og oppfølging av arktisk marinbiologisk overvåking, Ons 13.sep. Miljødirektoratet Oslo (oral presentation).

Jørgensen LL og Bakke (2017) Sårbare bunndyr i nordlige Barentshavet, pågående arbeid siden 2007. Møte i Referansegruppen for ressursforskning, September, HI, Bergen (oral presentation).

Jørgensen LL., Primicerio R (UiTø), Fossheim M (IMR), T. Thangstad, R. Ingvaldsen (IMR), N. Anisimova, D. Zakarov, O. Manuchin (PINRO, Russia). (2017). Effects of multiple stressors on the benthic ecosystem in the Barents Sea. European Climate Research Alliance General Assembly, 7-8 March 2017, Brussels, Belgium (Oral presentation).

Fossheim M (2017) Fisk på flyttefot; forventet utvikling i Barentshavet. Torskfiskkonferansen, Tromsø, Norge, Oktober 2017.

Fossheim M (2017) Open-ended Informal Consultative Process on Oceans and the Law of the Sea, 18th Meeting, Panel “The effects of climate change on oceans”: Ecosystem effects of climate change in polar waters, United Nations, New York, USA, May 2017 (Oral presentation)

Primicerio R (2018) Arctic Ocean BBNJ: Conservation and management of Arctic marine ecosystems, United Nations, New York, USA, September 2018 (Oral presentation)

Jørgensen LL, Snelgrove P, Birchenough SNA, Deidun A, Yasuhara M, de Jesus ACM, Barón PJ, Arvanitidis C, Clark MC, Przeslawski R, O'Connor N, Rise J, Wenqian C (2018) Marine invertebrates. World Ocean Assessment Report 2. UN workshop, Malta, August 2018 (oral presentation)

Jørgensen LL, Logerwell L, Blicher M, Hammeken N, Roy V, Ólafsdóttir SH, Strelkova N, Sørensen J, Christiansen JS, Bluhm B, Fredriksen R (2018) Detecting drivers and stressors causing changes in the Arctic Benthic Ecosystem. Arctic Biodiversity Congress. Roveremi, Finland, October 2018 (oral presentation)

Jørgensen LL, Logerwell L, Strelkova N, Mier K, McConnaughey B, Rand K, Lauth B, Cooper D (2018) Arctic benthic species and community distributions, sensitive ecosystems and biodiversity in the Atlantic and Pacific Gateways. Arctic Biodiversity Congress. Roveremi, Finland, October 2018 (oral presentation)

Jørgensen LL, Roy V (2018) The state of the arctic marine biodiversity report Benthos. Arctic Biodiversity Congress. Roveremi, Finland. 09-12 October 2018 (oral presentation)

Jørgensen LL, Strelkova N, Zakarov D, Manushin I, MacKenzie K (2018) Benthic distribution and production. The 18th Russian-Norwegian Symposium, Murmansk, Russia, June 2018 (oral presentation)

Blanchet MA, Primicerio R, Fossheim M, Jørgensen LL et al (2018) Role of marine mammals in the Barents Sea food web. The 18th Russian-Norwegian Symposium, Murmansk, Russia, June 2018 (oral presentation)

Jørgensen LL, Strelkova N, Zakarov D, Manushin I, McKenzie K (2018) Benthic distribution and production. The 18th Russian-Norwegian Symposium, Murmansk, Russia, June 2018 (oral presentation)

Zakharov D, Strelkova N, Manushin I, Jørgensen LL (2018) Potential taxon's indicators of the «Vulnerable Marine Ecosystem» in the Barents Sea. The 18th Russian-Norwegian Symposium, Murmansk, Russia, June 2018 (oral presentation)

Jørgensen LL, Logerwell L, Cooper D, McConnaughey B, Lauth B, Rand K (2018). Pan-Arctic benthic monitoring in a rapidly changing environment. Invited keynote speech to the Alaska Marine Science Symposium, Anchorage, January 2018 (oral presentation)

MacKenzie K, Jørgensen LL, Tillman M (2018) Functional groupings and connectivity in the Barents Sea ecosystem determined by stable isotope analysis. The 18th Russian-Norwegian Symposium, June 2018 (oral presentation)

Frainer A, Primicerio R, Fossheim M, et al (2018) Shifts in functional trait distribution and ecosystem functioning in the Barents Sea marine fish communities affected by climate change. The 18th Russian-Norwegian Symposium, June 2018 (oral presentation)

Blanchet MA, Primicerio R, Fossheim M, Jørgensen LL et al (2018) Role of marine mammals in the Barents Sea food web. The 18th Russian-Norwegian Symposium, June 2018 (oral presentation)

Tillman M, Bluhm B, MacKenzie K, Renaud P, Jørgensen L. Food web structure in the Barents Sea: insights from carbon and nitrogen stable isotope data. Arctic Frontiers Conference, Tromsø, January 2018 (poster)

Jørgensen L.L., Hoel A.H., Bakke G. (2019) Vulnerable areas and Ecosystem-based fishery management in the Barents Sea. Second International Science and Policy Conference on Implementation of the Ecosystem Approach to Management in the Arctic. 25-27 June 2019, Bergen, Norway (oral presentation).

Primicerio R, Aschan M, Aune M, Blanchet M-A, Dalpadado P, Dolgov A, Eriksen E, Fossheim M, Frainer A, Jørgensen LL, Kortsch S, Lindstrøm U, Skern-Mauritzen M, Pecuchet L, Renaud P, Varpe Ø. (2019) Climate change impact on Barents Sea ecosystem functioning and vulnerability. IMBER Future Oceans, June 2019, Brest, France (oral presentation)

Frainer A, Primicerio R, et al (2019) Climate change impact on Barents Sea fish functional diversity. June 2019, IMBER Future Oceans (oral presentation)

Interdisciplinary Cooperation

The ICEEVA project collaborated closely with the Polhavet flagship project on Arctic marine governance, ARCTIC-BBNJ, to ensure that the insights from integrated ecosystem assessment could be related to present laws and regulation for management and conservation

practice, and to help inform a future Arctic governance focused on conservation and sustainable co-management of marine ecosystems.

Budget in accordance to results

Budget in accordance to results

Could results from the project be subject for any commercial utilization

No

Conclusions

The synthesis and conclusions of this project will be provided in the final report.