

Project information

Keywords

ocean acidification, *Limacina helicina*, biogeochemical processes, sea ice, glacial water, freshwater, Arctic, Svalbard fjords

Project title

Pteropod shell thickness and composition in different regimes - OAprteropods ECOAN WP2-OA7

Year

2017

Project leader

Agneta Fransson (NPI) and Melissa Chierici (IMR)

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

70°N-90°N; 20°W to 35°E, Arctic Ocean/Nansen Basin, Svalbard fjords, Fram Strait, East Greenland Current, Barents Sea.

Participants

Collaborators:

Naomi Harada and Katsunori Kimoto (JAMSTEC)

Tine Rasmussen and Kasia Zamelyszak (UiT)

Flagship

Ocean Acidification

Funding Source

Fram Centre Ocean Acidification Flagship

Collaboration with OAstare and OAdrivers and Fram Centre incentive project (Tine Rasmussen and Kasia Zamelyszak, UiT)

Summary of Results

- Collection of pteropod *Limacina helicina* from numerous places in the Fram Strait (September), North of Svalbard (September) and Kongsfjorden (July) and the Barents Sea, including samples of both adults and juveniles (in collaboration with incentive forum and pteropod project)
- We found large abundance in area North of Svalbard especially of juvenile pteropods (*L. helicina*). Pteropod are mainly small (juvenile stages) and their shells are fragile. However, adults were found in NE Greenland waters and in some places north of Svalbard and reached in some cases up to 10 mm in size.

- We found that the *L.helicina* was more abundant and less patchy than previous experience. This is probably mainly due to methodology improvements.
- Kongsfjorden carbonate chemistry shows aragonite saturation (Ω) of 1.5, which is close to the 1.4 level when damage on the shells has been observed in other regions (California and Antarctica).
- Wintertime particularly low Ω , when mostly vulnerable juveniles reside and there is less food availability.
- Increased freshening due to glacial melt water have the potential to lower the Ω to detrimental levels in Kongsfjorden.
- Encouraging results from Micro X-ray Tomography (MXCT) scan analyses of aragonite shells of the pteropod *L. helicina* (in collaboration with JAMSTEC, Japan) will be compared to carbonate chemistry gradients. Promising method under development.

The results obtained are used for the planning of future field studies and will be at least partly included into a PhD-study, and other researchers at IMR, NPI, and UiT. The data collected during this project (from natural sites) will be compared to previously collected pteropods in this project and also with other pteropod data sets from the world ocean. This comparison has a great potential to assess the possible scenarios under stronger impact of ocean chemistry changes on planktonic calcifiers.

Master and PhD-students involved in the project

Several master and PhD students are involved in the project, mainly during field activities. M. Chierici and A. Fransson are involved in the UNIS master/PhD course "Chemical oceanography".

For the Management

- Competence and expertise for pteropod studies and ocean acidification have rapidly advanced at the Fram Centre. Contribute with knowledge transfer to other science fields.
- Sampling of shelled pteropods in polar waters along large chemical and physical gradients reveals that polar waters are suitable to use as natural analogues for ocean acidification effects on the ecosystem.
- Increased knowledge on the seasonal variability of pteropod abundance and life cycle and distribution in the water column in different water regimes (temperature, salinity, calcite saturation) which provides insight to the extent of ocean acidification effects on calcifiers.
- Active part in giving advice on biological effect indicators in several meetings and workshops.

Published Results/Planned Publications

Publications in peer-reviewed journals in 2017

Manno C. (M. Chierici, A. Fransson) et al., Shelled pteropods in peril: assessing vulnerability in a high CO₂ ocean (2017). *Earth Science Review*, doi: 10.1016/j.earscirev.2017.04.005.

Fransson A., M. Chierici, H. Findlay, H. Hop, S. Kristiansen, A. Wold. Seasonal of change ocean acidification state in Kongsfjorden, with implications for calcifying organisms. *Polar Biol.* , 1-17, DOI:10.1007/s00300-016-1955-5 special issue on Kongsfjorden.

Fransson A. M. Chierici, N. Harada, K. Katsunori, T. Rasmussen, K. Zemelyak. Pteropod *Limacina helicina* shell conditions related to aragonite saturation levels in the Arctic Ocean and fjords. To be submitted.

Related publications in 2017

Iglikowska, A., Bełdowski, J., Chełchowski, M. Chierici, M., Kędra, M., Przytarska, J., Sowa, A., and P. Kukliński (2017)., Chemical composition of two mineralogically contrasting Arctic bivalves' shells and their relationships to environmental variables, in press, Marine Pollution Bulletin, MPB-D-16-00973R1

Assmy P. M. Fernandez-Mendez, P. Duarte, A. Meyer, M. Chierici, A. Fransson, M. Granskog et al. (2017). Leads in Arctic pack ice enable early phytoplankton blooms below snow covered sea ice. Scientific Report, 7:40850, DOI: 10.1038/srep40850.

Charrieau, L.M., H.L.Filipsson., K. Ljung., M. Chierici., K. L. Knudsen & E. Kritzberg., The effects of multiple stressors on the distribution of coastal benthic foraminifera: a case study from the Skagerrak-Baltic Sea region, Limnology and Oceanography (LO-16-0464).

Opstad, I., P. Dalpadado., A. Mangor Jensen, E. Speerfeldt., A. Fransson., M. Chierici Effects of elevated pCO₂ on northern krill species *Thysanoessa inermis*: survival, moulting, growth, grazing and respiration. Submitted to Journal of Plankton Research, 2017

Thor P., A. Bailey, C. Halsband, E. Guscelli, E. Gorokhov, A. Fransson (2016) Seawater pH predicted for the year 2100 affects the metabolic response to feeding in copepodites of the Arctic copepod *Calanus Glacialis*. PLoS ONE 11(12): e0168735. doi:10.1371/journal.pone.0168735.

Reports (related)

Chierici, M., I. Skjelvan., R. Bellerby., M.Norli., L. Lunde Fonnes., H. Lødemel Hodal., K.Y. Børsheim., K. S. Lauvset., T. Johannessen., K. Sørensen., E. Yakushev. 2017. Overvåking av havforsuring i norske farvann I 2017, Rapport, Miljødirektoratet

Renner A., P. Dodd, A. Fransson. MOSJ status report: Assessment of the marine climate system around

Svalbard and Jan Mayen, in review, 2017

Public report

Pteropod research presented in Forskning.no Havforsuring påvirker skallet til vingesneglen, (Fransson NPI/Chierici IMR)

Fransson A., P. Thor, A. Bailey, M. Chierici (2016) Ocean acidification in Kongsfjorden, Fram Forum, 2016

Planned publications/in preparation:

Data obtained within the project has a potential to be included into at least 2 publications on ocean acidification effects on pteropods.

Conferences abstracts/workshops 2017:

OA flagship meetings, 2017, NPI, IMR, NIVA, Akvaplan-Niva, UiT, NINA, NORUT.

Fransson A. M. Chierici, H. Hop, S. Kristiansen, A. Wold. Seasonal variability of the carbonate chemistry and ocean acidification state in Kongsfjorden: Implications for calcifying organisms. Abstract accepted for the Svalbard Science Forum, Oslo, Norway 2018

Assmy P, et al. (A. Fransson) Emerging physical and biological properties in a new Arctic ice regime. Abstract submitted to the Ocean Science Meeting, Portland, USA, 2018.

Assmy P, et al. (A. Fransson) Emerging physical and biological properties in a new Arctic ice regime. Abstract submitted to the Arctic Frontier Conference, Tromsø, Norway 2018.

Chierici Melissa., Agneta Fransson, Ylva Ericsson, Eva Falck, Svein Kristiansen. Influence of glacial water on carbonate chemistry and biogeochemical processes in Svalbard fjords with different characteristics. Abstract submitted to the Arctic Frontier Conference, Tromsø, Norway 2018.

Fransson A. M. Chierici, D. Nomura, M. A. Granskog, S. Kristiansen, T. Martma, G.

Nehrke. Effect of glacial drainage water on the CO₂ system and ocean acidification state in an Arctic tidewater-glacier fjord during two contrasting years. Arctic Frontiers, Tromsø, 2017

Chierici Melissa., Agneta Fransson, Ylva Ericsson, Eva Falck, Svein Kristiansen. Influence of glacial water on carbonate chemistry and biogeochemical processes in Svalbard fjords with different characteristics. Abstract submitted to the Ocean Science Meeting, Portland, USA, 2018.

Fransson A. Sea-ice carbonate chemistry and influence of biogeochemical processes and glacial water in Spitsbergen fjords. ESSAS conference, Tromsø, Norway, 2017, oral, invited

Fransson A. and M. Chierici. Ocean acidification and effect indicators for OA - pteropods, Oral presentation. Fagdag om havforsuring, Miljødirektoratet, Oslo, 2017

Fransson A. M. Chierici, H. Hop, S. Kristiansen, A. Wold. Seasonal variability of the carbonate chemistry and ocean acidification state in Kongsfjorden: Implications for calcifying organisms. Abstract to ESSAS, Tromsø, Norway 2017.

Chierici M. Fransson A., H. Hop, S. Kristiansen, A. Wold. Late-winter to summer change of the

carbonate chemistry and ocean acidification state in Kongsfjorden: Implications for calcifying organisms. Abstract to the Gordon Ocean Research Conference, Ventura, USA, May, 2017.

Fransson A., M. Chierici., H. Hop., A. Wold., H. Findlay., Seasonal variability of ocean acidification state and implications for calcifiers in Kongsfjorden, poster, Gordon Research Conference, Marine science, Ventura, USA, May 2017

Chierici, M., Fransson, et al., Advancement of OA monitoring in AO and Norwegian waters, (poster at Gordon Research Conference, Marine Science, Ventura, USA, 2017)

Assmy, P., A. Fransson., M. Chierici., A. Wold., H. Hop., et al., Phytoplankton spring bloom beneath heavily snow-covered arctic sea ice during the N-ICE2015. 2017. Abstract accepted in Session CR5.4/OS1.24 Marginal ice zone processes, EGU2016-17254

Meetings regularly with all members from UiT, HI and NPI.

Open section meeting presentation on Kongsfjorden and pteropods (A. Fransson), NPI, Tromsø, 2017

Advice

“Biological effect indicators for OA - pteropods”, Fagdag om havforsuring, Miljødirektoratet, Oslo, 2017

Marine Protected Areas (MPA) workshop in Helsinki, Finland, 2017 (advice OA, A. Fransson)

Arctic Ocean Assessment-AMAP vs 2

Conferences/workshops 2017, see also above meetings and abstracts

Fransson A. M. Chierici, H. Hop, S. Kristiansen, A. Wold. Seasonal variability of the carbonate chemistry and ocean acidification state in Kongsfjorden: Implications for calcifying organisms. Abstract accepted for the Svalbard Science Forum, Oslo, Norway 2018

Assmy P, et al. (A. Fransson) Emerging physical and biological properties in a new Arctic ice regime. Abstract submitted to the Ocean Science Meeting, Portland, USA, 2018.

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Nehrke. Effect of glacial drainage water on the CO₂ system and ocean acidification state in an Arctic tidewater-glacier fjord during two contrasting years. Arctic Frontiers, Tromsø, 2017

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Fransson A. Sea-ice carbonate chemistry and influence of biogeochemical processes and glacial water in Spitsbergen fjords. ESSAS conference, Tromsø, Norway, 2017, oral, invited

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Fransson A. M. Chierici, H. Hop, S. Kristiansen, A. Wold. Seasonal variability of the carbonate chemistry and ocean acidification state in Kongsfjorden: Implications for calcifying organisms. Abstract to ESSAS, Tromsø, Norway 2017.

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Fransson A., M. Chierici., H. Hop., A. Wold., H. Findlay., Seasonal variability of ocean acidification state and implications for calcifiers in Kongsfjorden, poster, Gordon Research Conference, Marine science, Ventura, USA, May 2017

Chierici, M., Fransson, et al., Advancement of OA monitoring in AO and Norwegian waters, (poster at Gordon Research Conference, Marine Science, Ventura, USA, 2017)

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Interdisciplinary Cooperation

The project has had great benefit of the large collaboration between the natural science disciplines. In particular, inter-disciplinary cooperation between marine geologist/paleo oceanographers and chemical, biological and physical oceanographers offers a wide range of knowledge and contribution to the project. Only positive aspects.

Collaboration on the thickness and density of aragonite shells with Japanese scientists at JAMSTEC as well as with American expert in pteropod research is rewarding.

Budget in accordance to results

The project funding is shared with WP1 and has a very low budget which only partly covers the field work. The project relies on infrastructure and funding from other projects such as in-kind SI_ARCTIC (IMR), MOSJ (NPI) and Fram Strait (NPI). It supports the costs associated with Arctic field work using research vessels and equipment, and extensive water and pteropod sample collection.

Could results from the project be subject for any commercial utilization

No

Conclusions

- a) Need for more investigation of seasonal variability of carbonate chemistry and planktonic calcifiers (pteropods and planktonic foraminifera) life cycle and special distribution in the arctic waters (e.g. adult, juvenile).
- b) The project lead to modification/improvement of pteropod sample treatment after recovery. Due to severe fragility of the shells (not observed before), more gentle procedures had to applied. In addition, the buffer used for maintaining shell in good state of preservation while storing the sampled had to be adjusted to the fragility of the shells.

Continue with the method development using new techniques for shell density and shell thickness and relation to CaCO₃ saturation state.