Project information

Project title

Climate-mediated increases in organic matter export to Arctic coastal waters: Effects on lower food web structure and contaminant bioaccumulation

Year

2016

Project leader

Amanda Poste

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

69.089 and 18.612; 69.301 and 18.533; 69.328 and 18.515; 69.342 and 18.517; 69.362 and 18.528

Participants

NIVA: Amanda Poste, Anders Ruus

Akvaplan-niva: Guttorm Christensen, Eva Leu

UiT: Lena Seuthe, Marit Reigstad

NPI: Maria Granberg

SALT: salt.nu

Flagship

Hazardous Substances

Funding Source

The project was planned as a 2-year project, and began in 2015, funded by the Fram Centre Flagship for Hazardous Substances

Summary of Results

The following milestones have been achieved:

- MSc student successfully carried out a 6-month research internship, co- supervised by Poste (NIVA) and Seuthe (UiT))
- Six rounds of field work in Målselv/Målselvfjord (August 2015, and seasonal work (5 occasions) in 2016)
- All water chemistry analyses completed (general chemistry, mercury)
- Mercury and dietary marker analysis of the plankton samples will be completed by the end of November 2016
- Data from 2015 has been analysed, analysis of 2016 data is ongoing.
- We have made two detailed outlines of planned manuscripts based on the work carried out in this project.
- Presented research at an international conference (ECSA 56)
- Outreach work with Bardufoss ungdomskole (outreach visit in 2015, ongoing student research (sampling) in 2016, with planned wrap up in January 2017 (salt.nu will arrange a workshop in Tromsø for the students)

Our preliminary data analysis has shown that Målselv-Målselvfjord is a highly dynamic system, with rapidly shifting and highly seasonally variable freshwater, organic matter, nutrient and contaminant inputs to the coast. We found that conservative mixing of fresh and marine water masses was the strongest driver of physicochemical conditions in the river-fjord system, with most chemical parameters closely correlated with salinity. River hydrology and discharge was the main determinant of the extent of freshwater influence on the fjord, although the freshwater plume extended all the way to the outer fjord, even during low-flow conditions. In particular, the river was an important source of terrestrial organic matter, silicate, mercury and inorganic particles to the fjord.

Using stable carbon isotopic data from 2015, we estimated the reliance of zooplankton along the study gradients on terrestrial energy sources (this will also be carried out with 2016 data once it is available). Briefly, we used a simple isotope mixing model with two end members (riverine POM as an indicator of the terrestiral carbon signal, and marine POM as an indicator of the marine carbon signal), to estimate the proportion of terrestrial vs. marine carbon utilized by the zooplankton. We found that zooplankton relied to a substantial degree on terrestrial inputs as a food source, with decreasing importance of terrestrial energy sources along the freshwater to marine gradient.

For all six study dates, we found that mercury concentrations in water were highest in the inner fjord and gradually decreased along the study transects, highlighting that the freshwater river inputs were indeed a source of mercury to the fjord. For the 2015 data, we also found that mercury concentrations in zooplankton decreased from the inner to outer fjord. Furthermore, bioaccumulation factors were also higher in the inner fjord, suggesting that higher mercury concentrations in inner fjord zooplankton were not only attributable to elevated concentrations in water, but that the mercury may actually be accumulated more efficiently at sites with higher freshwater influence.

These preliminary results demonstrate that terrestrial inputs can have strong impacts on coastal biogeochemistry, ecology, and contaminant dynamics.

Master and PhD-students involved in the project

Sebastiaan Koppelle (University of Amsterdam) carried out a 6-month research internship as a requirement for his MSc (supervised by Poste and Seuthe).

Report title: Riverine inputs to a sub-Arctic Norwegian fjord: Effects of coastal water chemistry and lower food web structure (finished February 2016)

For the Management

Contaminants in aquatic food webs and climate change are both key topics of concern for the general public, as well as for policy makers and managers, particularly considering the potential for these stressors to exert wide-ranging environmental, economic, health and social effects. Given current trends and future projected increases in terrestrial organic carbon export to the arctic aquatic environment, this project contributes essential and timely information about how these changes are likely to affect contaminant concentrations in aquatic food webs.

Our preliminary results demonstrate that terrestrial inputs can have strong impacts on coastal ecosystems, highlighting the need to consider the potential effects of terrestrial inputs when exploring how climate change will affect coastal ecosystems (e.g. effects of food webs and biological productivity, effects on contaminant concentrations in coastal organisms, and subsequent risks to human and ecosystem health).

Published Results/Planned Publications

We have prepared manuscript outlines for two manuscripts based on this work, which we intend to finalize and submit in 2017:

Manuscript 1:

Title: *Physicochemical conditions and pelagic community structure along a freshwater-marine gradient in a sub-Arctic river-fjord system (Målselv-Målselvfjord)*

Target journal: Limnology and Oceanography

Manuscript 2:

Title: *Riverine inputs to Norwegian fjords: Effects on pelagic food web structure and mercury bioaccumulation*

Target journal: Environmental Science and Technology

Note: This manuscript combines and contrasts data from Målselv-Målselvfjord with data from a parallel project (funded by NIVA's Strategic Institute Initiative for Land-Ocean Interactions) in southern Norway (Storelva-Sandnesfjord)

Communicated Results

Oral presentation at an international scientific conference:

ECSA 56 (Estuarine and Coastal Science Association)

Location: Bremen, Germany

Presentation title: "Riverine inputs to Norwegian fjords: Effects on lower food web structure and contaminant bioaccumulation")

Outreach with Bardufoss ungdomskole

In this project, we have partnered with SALT (salt.nu) to involve students from Bardufoss ungdomskole in collection of river water samples and to learn about the project as a whole. In 2015, we held an interactive one-day introduction facilitated by SALT, where students discussed the ideas and initial results of the project, learned about scientific methods, met the project leader, and made plans for further project involvement. In 2016, there was another visit to the students with an update on the project, and students were shown how to collect water samples for sending to NIVA for analysis (which they have done on a few occasions throughout 2016). We

are planning a wrap up workshop with the students in January 2017.

Interdisciplinary Cooperation

This is a highly interdisciplinary and integrative project, which links climate change effects on terrestrial biogeochemistry and C export to effects on coastal lower food web structure and contaminant transport, bioaccumulation and trophic transfer. As such, this project has involved a broad range of scien@sts with expertise including catchment biogeochemistry, marine ecology, analytical chemistry, and ecotoxicology.

Budget in accordance to results

The budget and outputs for 2016 are in agreement with the timeline and budget of the project as outlined in the proposal, with the exception of the final analyses and manuscript submission. Since we decided to carry out seasonal sampling in 2016, we carried out our final autumn sampling only a few weeks ago, and as such, we are currently in the process of carrying out these final analyses, after which we will be able to carry out the final data analysis and work more closely with the planned manuscripts.

Could results from the project be subject for any commercial utilization

No

Conclusions

In the Målselv-Målselvfjord system, we observed that physicochemical conditions were strongly driven by conservative mixing between the fresh and marine water masses. The extent of the freshwater influence was closely related to riverine discharge and recent rainfall, highlighting the potential importance of future climate-change driven shifts in precipitation patterns (total precipitation volume, and occurrence of large rainfall events) for physical and chemical conditions in coastal waters.

Our preliminary results suggest that zooplankton in Målselvfjord were able to utilize terrestrial energy sources, with decreasing importance of terrestrial energy sources (and increasing importance of marine phytoplankton as an energy source) along the freshwater-marine gradient.

Finally, we found that Målselv is a source of mercury to the fjord across all seasons, with elevated mercury concentrations in the innerfjord and freshwater plume compared to the deeper marine waters. Based on data from 2015, we found that a combination of increased mercury exposure (i.e. higher aqueous concentrations) and enhance bioaccumulation of mercury by zooplankton (possibly as a result of increased reliance on lower-quality terrestrially-derived food sources) could lead to increased contamination of biota in the freshwater-influenced coastal waters of Målselvfjord. When paired with the seasonal data from 2016, these results will provide important insight into the potential for riverine inputs (and potential changes in these inputs) to drive changes in contaminant dynamics in affected coastal waters.