

Project information

Project title

Freshwater and marine bivalves as indicators of pollution and climate variation

Year

2013/2014

Project leader

Michael Carroll, ApN

Participants

Collaborating Fram Centre Institutes: Akvaplan-niva (project leader), Bioforsk, NINA

International Partners: Woods Hole Oceanographic Institute (USA), Bates College (USA), Metsähallitus Natural Heritage Services Lapland (Finland), University of Jyväskylä (Finland), Metsähallitus Natural Heritage Services Ostrabothnia (Finland), Lapland Centre for Economic Development (Finland), Transport and the Environment County Administrative Board of Norrbotten (Sweden), Institute of North Industrial Ecology Problems (INEP KSC) (Russia)

Flagship

Hazardous substances, Theme: The impact of climate change on transport and fate of contaminants in the Arctic

Funding Source

Fram Centre, InterReg - "Restoration of the freshwater pearl mussel populations with new methods" (2011 – 2014), KolArctic (EU Cross border cooperation) - Trilateral Cooperation on Environmental Challenges in the Joint Border Area ("TEC 2012-2014")

Summary of Results

The long lived freshwater pearl mussel has been analysed in order to reveal variation in growth and content of heavy metals in space and time. Thirty freshwater pearl mussels (*Margaritifera margaritifera*) were collected in the from 2 locations in Karpelva. The shell of the mussels have been processed at Bates College in USA and analysed at Wood Hole Oceanographic institution USA. Individuals ranged in age from approximately 60 to 220 years. Heavy metals in s in the outer shell material varied among individuals and sites. Finer scale metal concentrations measured with a laser also showed heavy mental concentration varying among years. There remains work to harmonize and calibrate the annual growth chronology and relate growth differences among years to local climate and large scale climate indices. Results so far have been very interesting and successful.

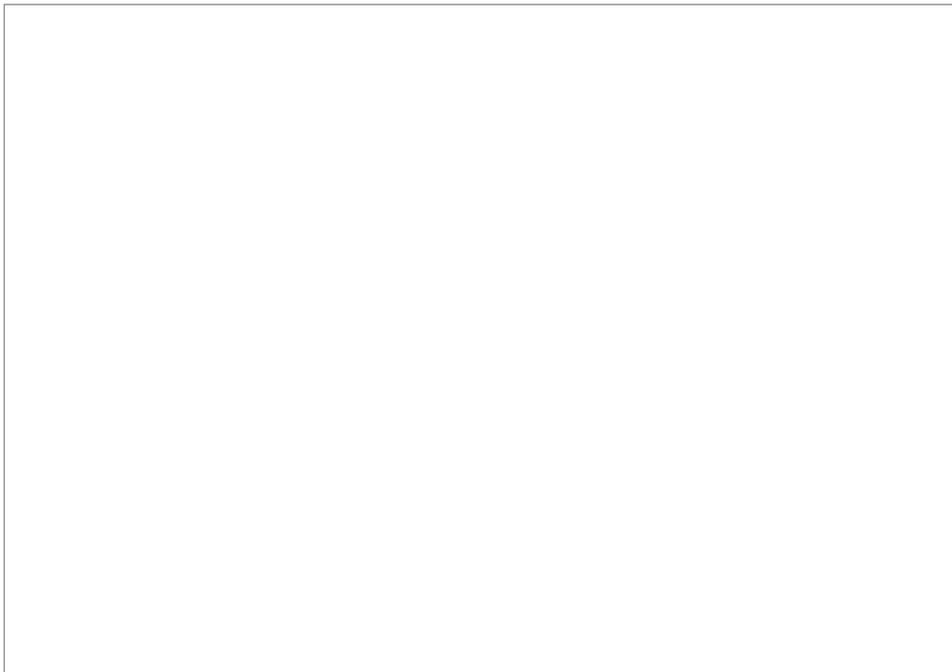


Figure 1. Image showing the growth increments of the *M. margaritifera*, which we presume to be produced with an annual cycle. These increments form the temporal basis of the chronology (see below).

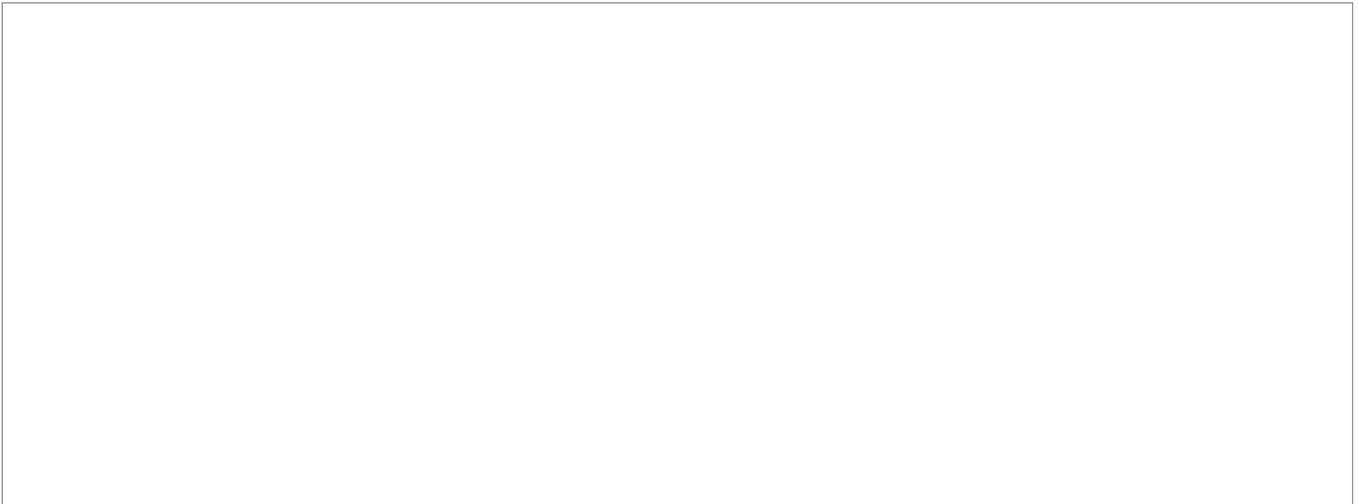


Figure 2. Growth chronology of the freshwater mussels from the collection point in 2012 back to 1860, spanning some 150 years. Oscillatory periods of higher and lower growth are evident. We are investigating the environmental factors controlling the growth patterns.



Figure 3. Image showing locations of samples for shell metals analysis. The whitish spots are the sites where the laser ablation linked to ICP-MS has operated. The spots are double (two in each year).

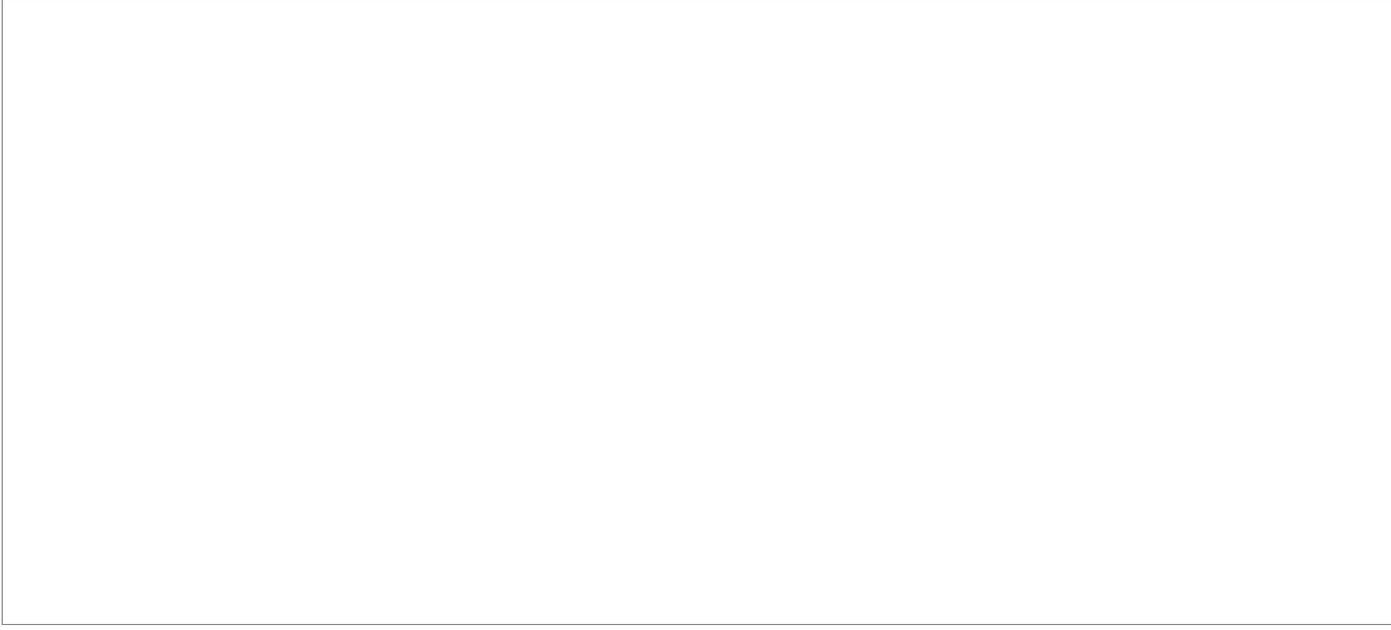


Figure 4. Concentration of various metals in the *M. margaritifera* shells, separated in periods before and after the beginning of operation of the Nickel plant in Russia in 1946. Iron and Manganese particularly have trends of increased concentrations in during the plant

operation compared to before.

For the Management

Freshwater pearl mussels are an IUCN critically endangered species, with long lifespans and low recruitment. They are sensitive to environmental disturbances and are threatened from habitat destruction, environmental pollution, and contaminants. By developing growth chronologies, understanding the factors that regulate growth patterns, and how they incorporate environmental pollutants in their tissues and shells, the work carried out here provides new knowledge that has extremely high relevance for management of the habitat and species.

Published Results/Planned Publications

1. Existing Products:

- Ambrose WG, Carroll ML, Locke W, LaRosa S, Aspholm PE, Christensen G, and Larsen, M (2013) Growth variability and shell mineralogy of the Freshwater Pearl Mussel (*Margaritifera margaritifera*) from Finnmark, Norway. 3rd International Sclerochronology Conference, Bangor, Wales, UK. May 18-23, 2013.
- LaRosa, S (2013) Growth Variability and Mineralogy of *M. margaritifera* from Karpelva, Norway. Senior Thesis. Bates College. 38 p.
- LaRosa, S and WG Ambrose (2013) Growth variability and heavy metal concentrations in *Margaritifera margaritifera* from Karpelva fjord Norway. New England Estuarine Research Society Spring 2013 Meeting, Portland, Maine, USA. April 11-13, 2013.

2. Planned publications:

- Chronology development and environmental regulation. Winter 2013/14
- Temporal pattern of metal concentration in shells. Spring 2014
- Comparison of contaminants in different environmental compartments (shell, tissue, sediments, water). Late 2014

Communicated Results

- St. Petersburg, Dec 2012: presentation; "Age reading to understand growth and contaminants in *Margaritifera*"
- Svanhovd Jan. 2013: seminar talk; "Various works on *Margaritifera*"
- Belfast, Feb 2013: roundtable talk "Aging and contaminant in *Margaritifera* in the north"
- Letterkenny (Ireland), Feb 2013; Mini workshop "Sclerochronology, cohorts and contaminants in *Margaritifera*"
- Konnevesi (Finland) April 2013; Interreg project meeting "Sclerochronology and contaminants in *Margaritifera* from Karpelva"
- Svanhovd May 2013; presentation for representatives from The Norwegian Ministry of Agriculture; "Work on *Margaritifera*; restoration, age and contaminants"
- The project was one of the anchor elements in presentations during the roadtrip Forskningsdagene; "Forskerne kommer" 23.-25. September. About 20 presentations was made of "Elvemusling – indikator og nøkkelart"
- During various presentations for visiting groups at Bioforsk Svanhovd, our project has been one of the elements in the presentations.
- During the shooting of the background filming for the new NRK nature series "Norske naturperler" we talked about our project. It still remains to see how the cut will be like.
- The project was one of the object during interview by one Russian tv-team, and our project has been told to some writing journalists.

Interdisciplinary Cooperation

Akvaplan-niva, Bioforsk, NINA. This project combines many different disciplines and national and international partners. We would like to include social science in phase 2 (2015 +). That work would involve ecologists, chemists, managers, social scientists and cultural heritage experts. The river mussel has been utilized for many centuries for its valuable pearls. In the Pasvik area, local people (Sami and others) harvested freshwater pearl mussel for generations. There are old settlements along the Pasvik River where large quantities of mussel shells indicate regular harvests by Karelian, Finnish and Norwegian pearl fishers. These sites are historically interesting. But mussels from these sites will also be used for analysis of contaminants and growth (climate parameters) and a longer chronology than is possible with live mussels.

Budget in accordance to results

The Fram Center funding has provided a critical element of the funding of this project, which has been linked to other programs from the EU (Interreg, KolArctic) to provide synergy in both activities and funding. Without the Fram Centre funding this study would not have been possible.

If Yes

Results could assist in monitoring pollution and climate for environmental agencies and authorities.

Conclusions

a) Indicate future research and/or perspectives which the project results have led to

The results from Kapelve need to be extended to other river systems. And there is still more work that needs to be accomplished before these results can be published.

b) List and describe new methods or techniques that have been developed during the project or that the project has revealed a need for

A multi-centaury chronology has not been developed for any freshwater animal and heavy metals are rarely measured in bivalve shells and never in freshwater bivalves. So, the research is yielding novel results. There is a need for unequivocally determining the growth lines are annual; we have plans to mark and recover individuals after 1 and 2 years.