

Project information

Project title

Introductions and transfer of marine alien species by ballast water and hull fouling over the Polar Sea Routes

Year

2013/2014

Project leader

Anders Jelmert, IMR

Participants

Project leader:

- Anders Jelmert, Institute of Marine Research, Flødevigen Research Station, Nye Flødevigvn 20, 4817 His, Norway

Participants:

- Chris Ware, University of Tromsø
- Jørgen Berge, University of Tromsø
- Jan H. Sundet, IMR, TRomsø
- Stephan Gollasch, Go-Consult, Hamburg, Germany
- Lijun Wang, Marine Environmental Monitoring Centre, Dalian China,
- Stephanie Delacroix, Niva, Norway

Flagship

Arctic ocean, Theme: Environmental impact of shipping

Funding Source

Fram Centre

Summary of Results

Facilitating a finalization of the Dr. dissertation for Chris Ware:

A large proportion of the funding has (after recommendation from the funder) been allocated to finalize the Dr thesis for the dissertation of Chris Ware.

The funding for 2013 has contributed to one accepted and two soon-to be submitted papers to relevant peer reviewed journals, and to the submittal of his thesis expected by the end of March, 2014.

Exploring the use of DNA barcoding for the analysis of Meroplankton in ballast water.

The work (Paper II) outlines improvements to existing DNA barcoding methods, which when employed, can be used to substantially improve identification rates and coverage over traditional microscopy. Nonetheless, we found the time required to sort samples prior to molecular analyses, the number of primers required for successful PCR of different taxa, and sample contamination from ballast water tanks, suggests that to become truly efficient as a management tool, metabarcoding and next-generation sequencing techniques should be developed.

Disentangling propagule pressure and environmental factors for activities in the near polar areas:

During the project period, it has been uncovered that unpublished scientific reports from the “Melkøya” terminal can shed light on the modeled and anticipated risks derived from related studies accomplished in the area and elsewhere. Baseline-studies before activity commenced (1998-1999) showed no alien marine species in the Melkøya stations. Later studies in 2005 and 2010 did not detect new species (soft-bottom, mobile meio- and macrofauna and algae. While the studies don't have adequate sampling gear to detect the red king crab present, other well-known methods like plates for fouling communities have been deployed and analyzed. The low numbers of alien species but concomitant considerable traffic to the harbor yields important insight to the relative importance of environmental factors versus propagule pressure, at least for the period studied. (Of course the study may uncover established aliens when their number have increased). The results does not imply that the polar areas should be regarded as immune to invasions, but a further analysis of traffic pattern (ballast origin and last port of call) for the ships to Melkøya should contribute to a better understanding of the risks involved.

Difficulties in recruiting sampling objects.

During the project period it has been experienced that the access to sampling is a much larger challenge than anticipated. Several companies have not replied to our inquiries, and it has not been possible to find a commercial company that are willing to have scientists following a PSR passage. Also singular sampling (hull fouling or ballast water) have been difficult to accomplish. The decisions to use the PSR are rather opportunistic and hence planning and mobilizing people for sampling have been difficult.

For the Management

- 1) The current use of DNA methods is not developed to a level where it may replace traditional taxonomic work, and can be used as a cost effective monitoring tool.
- 2) Based on the data obtained through the precursor to the project, analysis in the project has shown that there is a propagule pressure of alien (temperate species) into the high arctic.
- 3) Exploring the grey literature, the results from on-going scientific studies (targeting alien species in an export harbor ("Melkøya, Hammerfest)) have during two surveys the last 10 years, not discovered alien species in the study area. These results warrant further examination (and analyses of traffic patterns). While later studies (planned 2015) may discover aliens, the preliminary results indicate that environmental factors may play a more important role than anticipated (compared to propagule pressure). These results does not imply that the polar ecosystems are immune to invasions (as demonstrated by the snow crab), and does not clarify the risks for temperate species transported through the PSR and released further to the south.
- 4) If the findings (2) can be confirmed as robust, the results may have implications for management of risk, e.g. ballast water treatment exemption. This will however require a) A more thorough analysis of traffic patterns, and b) Examination of the Melkøya data at least for one more 5 year period, and c) Evaluating eventual further change in temperature regime in the region.

Published Results/Planned Publications

Scientific publications:

Ware, C., Berge, J., Sundet, J.H., Kirkpatrick, J.B., Coutts, A.D.M., **Jelmert, A.**, Olsen, S.M., Floerl, O. and Alsos, I.G. 2013. Climate change, non-indigenous species and shipping: assessing the risk of species introduction to a high-Arctic archipelago. *Diversity and Distributions*, (*Diversity Distrib.*) (2013) 1–10 DOI: 10.1111/ddi.12117, <http://wileyonlinelibrary.com/journal/ddi>

Oral presentations

[The potential for high-latitude species invasions via an Arctic shipping network](#), 2013

Chris Ware, Inger Greve Alsos, Jamie B Kirkpatrick, Jørgen Berge, Jan H Sundet, Anders Jelmert, Ashley DM Coutts. *Arctic Frontiers*, 2013.

Minchin D., Matej D., Gollasch S., Jelmert A., Olenin S. 213 The cold route: Alien biota spread via Arctic seas. Oral presentation, plenary session, *IV INTERNATIONAL SYMPOSIUM "INVASION OF ALIEN SPECIES IN HOLARTIC" (BOROK-4) 22.09.2013 - 28.09.2013, Russia* http://www.sevin.ru/news/borok-4/PROGR_ABSTRACTS_Borok4.pdf

Ware C., Alsos I.G., Kirkpatrick J.B., Berge J., Sundet J.H., Jelmert A., Coutts A.D.M. 2013. Measuring and managing invasive species threats in high arctic Svalbard. Oral presentation, Marine session, *IV INTERNATIONAL SYMPOSIUM "INVASION OF ALIEN SPECIES IN HOLARTIC" (BOROK-4) 22.09.2013 - 28.09.2013, Russia* http://www.sevin.ru/news/borok-4/PROGR_ABSTRACTS_Borok4.pdf

Planned publications:

Ware et al.2014, Tentative title: "Applicability of universal primers for identifying zooplankton in ship ballast water," To be submitted March, 2014

Ware et al. 2014, Tentative title: "Further exploration of the role of ballast water in transporting non-indigenous species to Svalbard, and the potential for these to establish under future climate scenarios. To be submitted March, 2014

Jelmert et al, 2014. Tentative title: "Norway, -the way to the north: What roles do environmental factors and shipping activities (propagule pressure) play in the prevalence of marine alien species along the Norwegian coast?"

Minchin et al. 2014, Tentative title: The cold route: Alien species spread via Arctic seas. Manuscript based on the Borok presentation under development.

Communicated Results

Ware, C., 2013, Heed past lessons to save Arctic from invasive species. *The Conversation*, 20 November 2013 <https://theconversation.com/heed-past-lessons-to-save-arctic-from-invasive-species-20181>

Jelmert, A. 2013. Shipping activities in the Arctic and the northern sea routes, new pathways for alien species? *Mini-symposium, IMR (Flødevigen) and GRID (Marine Divisioin)* Arendal 15. Nov. 2013.

Interdisciplinary Cooperation

Genomics and modeling: The models for risks depends on quantifiable numbers for viable organisms and traffic patterns.

Genomics and taxonomy: The rapid developing DNA bar-coding methods have still a lot of necessary validation work with respect to classical taxonomy.

Budget in accordance to results

The contribution from the Fram Centre has been crucial in order to develop the last papers to finalise the Dr. dissertation of Chirs Ware.

The Fram Centre has been very useful to liaison with the “incentive” funds for Norwegian Chinese cooperation, thereby facilitating the cooperation with Dr. Lijun Wang at the First Marine environmental Monitoring Centre, Dalian. A cooperation we hope may develop further, despite some politically motivated backlashes.

The Fram Centre have been very useful to liaison with the Norwegian-Russian Environmental cooperation in the Arctic. A cooperations which is under development, and hopefuller will materialize in more scientific cooperation in the future.

Could results from the project be subject for any commercial utilization

No

Conclusions

Future development of DNA barcoding:

This details the testing of standard DNA barcoding methods to complete the challenging task of identifying meroplankton present in ballast water tanks. The work outlines improvements to existing DNA barcoding methods, which when employed, can be used to substantially improve identification rates and coverage over traditional microscopy. Nonetheless, we found the time required to sort samples prior to molecular analyses, the number of primers required for successful PCR of different taxa, and sample contamination from ballast water tanks, suggests that to become truly efficient as a management tool, metabarcoding and next-generation sequencing techniques should be developed. This point is emphasized in manuscript II.

Additionally, there are unresolved questions with regards the DNA sampled: does it come from an intact viable organism (with ability to potentially colonize)?, or does it come from a more or less intact, but moribund organisms (representing low/zero risk)

Disentangling the relative importance of propagule pressure and environmental factors in northern ecosystems.

The scientific work in the project and the comparison to other studies, elucidates how northern ecosystems have responded to the traffic patterns so far. These results does not clarify how the ecosystems may respond to a) the climate change scenarios with significant warming, b) large increase in traffic amount (and from other ports and ecoregions), and how more temperate species transported over the Polar Sea Routes will survive this transport.