

information

Keywords

Seabirds, pollution, Arctic, Stress

Project title

Multi-stress relationships in seabird populations: interactions between natural stressors and environmental contaminants

Year

2016

Project leader

Jan Ove Bustnes, NINA and Geir Wing Gabrielsen, NPI

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

78.55N, 11.56E

Participants

Participant: Børge Moe, NINA

Participant: Bård Jørgen Bårdsen, NINA

Participant: Sveinn Are Hanssen, NINA

Participant: Dorte Herzke, NILU

Participant: Kjetil Sagerup, APN

Participant: Olivier Chastel, Chizé, France

Flagship

Hazardous Substances

Funding Source

Flagship and NRC

Summary of Results

Highlights:

1. Ecological effects of low levels of POPs demonstrated in seabirds suffering from multiple stressors such as food shortage
2. DNA damage of POPs through shortening of telomeres shown in kittiwakes
3. Arctic skuas wintering in the Southern Ocean are carriers of persistent pollutants to the Arctic

Seabirds are among the species most vulnerable to bio-magnifying environmental contaminants, and the main objective of this project is to document concentrations, distributions and effects of different environmental contaminants in northern seabird populations. Special focus is on how environmental contaminants may function in concert with other natural and anthropogenic stressors; i.e. a multi-stress perspective.

The project project studies different seabird species at Kongsfjorden, Svalbard. Prime species of interest are the common

eider, the kittiwake, the glaucous gull, and skuas (great skua and arctic skua). These species represent different food chains (benthic, pelagic and scavenging). In 2016 new data have been collected for kittiwake, eiders and glaucous gulls and arctic skuas from Kongsfjorden in Svalbard. The project is linked to the **NFR project AVITOX** which has received funding in 2014-2016.

For **kittiwakes** data have been collected from a study colony in Kongsfjord; in 2016 for the 10'th year in a row. All blood samples from kittiwakes collected between 2007 and 2011 (5 years) have been analyzed and the variation in concentrations of POPs in live kittiwakes over time, and thus the potential effects of POPs, is studied. Great annual variation in legacy POPs in kittiwakes was demonstrated. One paper has been published online in 2016 (Bustnes et al. in 2016). Within the multistress seabird project, a cooperation with the Olivier Chastel Group has resulted in 2 papers published in 2016. Among these studies, we will particularly mention the finding that shortening of telomeres was most profound in birds with high concentrations of oxychlordan, a very toxic metabolite of chlordan (Blevin et al. 2016). In 2016, Olivier Chastel's group has continued research on kittiwakes in Kongsfjorden, focusing especially on potential effects of POPs on sperm quality. The material collected are now being analysed, both with regard to effects of POPs by the PhD student Pierre Blevin who will work in Tromsø in the fall 2016 to complete POP analyses. Moreover, a paper has been published showing that the preen gland is an important excretion route for POPs in kittiwakes (Solheim et al. 2016).

For the **great skua**, the Flagship funding has enabled continuous work using data from the NFR funded SKUA project. Two papers are now being prepared for publication; one on the effect of remoteness and cold condensation on legacy contaminants in great skua across the Northeast Atlantic (Leat et al. in prep a), and one on the effect of diet on the accumulation of POPs (Leat et al. in prep b).

The master student on **arctic skuas** (Elise Skottene) finished her thesis in spring 2015. The thesis was about wintering areas and heavy metals in blood and feathers. In addition, blood samples have been taken from a large number of arctic skuas that have been equipped with GLS loggers. The POP analyses of these birds are almost completed. Preliminary results indicates that these birds carry contaminants from their wintering grounds in the southern Ocean to the Arctic (Hanssen et al. in prep).

The studies of **common eiders** has progressed and Anette Fenstad, with whom Mutistress/AVITOX has cooperated closely, defended her PhD in June 2016 (J.O. Bustnes has been a supervisor for her thesis). In 2016, papers have been published/accepted for publication (Fenstad et al. 2016, in press a, b, c). Eiders in the Baltic Sea had up to 26 times higher blood concentrations of some POPs compared to eiders from Svalbard. In addition, individuals with high levels of POPs/metals are more prone to suffer higher oxidative stress (OS) (Fenstad et al. 2016). Moreover, paper on the impact of PCB/Hg on DNA double strand-breaks is being prepared (Fenstad et al. in press b). Finally, a paper on migration strategies of common eiders have been accepted (Hanssen et al. in press).

Modelling exercises have been carried out for common eiders by Bård-Jørgen Bårdsen, which has the aim to understand the potential impact that POPs have in causing ecological effects in this species. A paper is now being prepared for submission in 2017 (Bårdsen et al. in prep).

Finally, Ane Haarr defended her MSc thesis on gentox in several arctic seabird species and is now at the stage of writing up the thesis to a publication.

Master and PhD-students involved in the project

1 PhD student, 3 MSc students

For the Management

Environmental contaminants have been of concern for management for many decades, and this project adds knowledge to how such pollutants can have adverse effects even as concentrations are declining.

Published Results/Planned Publications

1. Tartu, S., Bustamante, P., Angelier, F., Lendvai, A.Z., Moe, B., Blévin, P., Bech, C., Gabrielsen, G.W., Bustnes, J.O. & Chastel, O.S. 2016. Mercury exposure, stress and prolactin secretion in an Arctic seabird. *Functional Ecology* 30: 596-604.
 2. Blévin, P., Angelier, F., Tartu, S., Ruault, S., Bustamante, P., Herzke, D., Moe, B., Bech, C., Gabrielsen, G.W., Bustnes, J.O. & Chastel, O. 2016. Exposure to oxychlordan is associated with shorter telomeres in arctic breeding kittiwakes. *Science of the Total Environment* 563-564: 125-130.
 3. Fenstad, A.A., Moody, J., Öst, M., Jaatinen, K., Bustnes, J.O., Moe, B., Hanssen, S.A., Gabrielsen, K.M., Herzke, D., Lierhagen, S., Jenssen, B.M. & Krøkje, Å. 2016. Antioxidant responses in relation to persistent organic pollutants and metals in a low- and a high-exposure population of seabirds. *Environmental Science & Technology* 50: 4817-4825.
 4. Solheim, S.A., Sagerup, K., Huber, S., Byrkjedal, I., Gabrielsen, G.W., 2016. The black-legged kittiwake preen gland - an overlooked organ for depuration of fat-soluble contaminants? *Polar Research* 35, 29651, <http://dx.doi.org/10.3402/polar.v35.29651>.
- In press**
5. Fenstad, A.A., Jenssen, B.M., Gabrielsen, K.M., Öst, M., Jaatinen, K., Bustnes, J.O., Hanssen, S.A., Moe, B., Herzke, D. & Krøkje, Å. In press a. Does proximity to pollutant source matter? Levels of POPs in Baltic and Svalbard breeding common eiders. *Environmental Toxicology & Chemistry*

6. Hanssen, S.A., Gabrielsen, G.W., Bustnes, J.O., Bråthen V.S., Skottene, E., Fenstad, A., Strøm, H., Bakken, V., Phillips, R.A., Moe, B. 2016. Migration strategies of common eiders from Svalbard: Implications for bilateral conservation management. *Polar Biology*.

7. Bustnes, J. O., Bårdsen, B.J., Moe, B., Herzke, D., Hanssen S.A., Sagerup, K., Beck, C., Nordstad, T., Chastel, O., Tartu, S. & Gabrielsen, G.W. Temporal variation in circulating concentrations of organochlorine pollutants in a pelagic seabird breeding in the High Arctic. *Environmental Toxicology & Chemistry*

8. Fenstad, A.A., Jenssen, B.M., Bingham, C., Moody, J, Öst, M., Jaatinen, K., Moe, B., Hanssen, S.A., Moody, A.J., Gabrielsen, K.M., Herzke, D., Lierhagen, S., Bustnes, J. O., & Krøkje, Å. In press b. DNA double-strand breaks in relation to environmental exposure to pollutants in Baltic and Arctic breeding common eiders (*Somateria*

mollissima). *Environmental Research*

9. Fenstad, A.A., Bustnes, J. O., Lierhagen, S., Gabrielsen, K.M., Öst, M., Jaatinen, K., Hanssen, S.A., Moe, B., Jenssen, B.M., & Krøkje, Å. In press c. Blood and feather concentrations of toxic elements in a Baltic and an Arctic seabird population. *Marine Pollution Bulletin*

Submitted

10. Leat, E.H.K, Bourgeon, S., Hanssen, S.A., Petersen, A., Strøm, H., Bjørn, T.H., Gabrielsen, G.W., Bustnes, J.O., Furness, R.W. & Borgå, K. Effect of remoteness and cold condensation on legacy contaminants in great skua across the Northeast Atlantic.

Manuscripts

11. Leat, E.H.K, Bourgeon, S., Magnúsdóttir, E., Gabrielsen, G.W., Grecian, J., Hanssen, S.A., Olafsdóttir, K., Petersen, A., Phillips, R.A., Strøm, H., Ellis, S., Fisk, A.T., Bustnes, J.O., Furness, R.W. & Borgå, K. Variation in persistent organic pollutants in plasma of great skuas with measures of diet.

12. Bårdsen, B.-J., Hanssen, S.A., Bustnes, J.O. et al. Potential impact of pollution on demography and population dynamics: a model study of a benthic seabird.

Communicated Results

A workshop was held in May 2016 in Chizé, France

Interdisciplinary Cooperation

Ecology, physiology, chemistry

Budget in accordance to results

- It has been essential for continuing the research on seabirds in at Svalbard and northern Norway, which is especially important for the continuity of the multi-stress perspective.

Could results from the project be subject for any commercial utilization

No

Conclusions

- a. Understanding variation and impacts of POPs in the vulnerable ecosystems of the north is a long-term endeavor. In this respect this project is important because it allows us to have a long horizon on our research. The project is now starting to generate new results, both with regard to trends and effects of POPs that is novel to ecotoxicology.