Project information

Keywords
Multiple stressors, Pollution, Raptor, Birds of prey, Ecology, Terrestrial
Project title
Effects of pollutants and other stress factors on northern raptors: RAPTOR
Year
2018
Project leader
Jan Ove Bustnes
Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)
Tromsø 69°39′N 18°57′E; Trondheim: 63° 25’ N 010° 23’E
Participants

Participant: Dorte Herzke, NILU
Participant: Bård Jørgen Bårdsen, NINA
Participant: Igor Eulaers, University of Århus
Participant: Adrian Covaci, University of Antwerpen
Participant: Sophie Bourgeon, UiT

Participant : Nikolaus Huber, Veterinärmedizinische Universität, Wien

Flagship
Hazardous Substances
Funding Source

NFR

FRAM

Summary of Results

Highlights:

1. L

1. Summary of results, including 2-3 highlights from the project (max 1 A4 page, figures can be attached separately):

Highlights:

Landscape features have a significant influence on the trophic transfer of toxic elements in a terrestrial top predator.

In bird species that alternate between marine and freshwater habitats, it has been found that input of fluorinated compounds in their eggs has a marine origin.

There was no covariance in the annual occurrence of organohalogenated compounds in top predators in adjacent freshwater and terrestrial ecosystems, suggesting that different drivers of exposure.

Bird species at the top of the food chain are vulnerable to bio-accumulating contaminants, notably persistent organic pollutants (POPs) and toxic elements such as mercury. Hence, birds

of prey are valuable sentinels for research on the impacts of biomagnifying contaminants in nature. However, wildlife faces a multitude of natural and other anthropogenic stressors and this has been suggested to have far reaching impacts on the health of individuals and populations. Nevertheless, a major challenge is to document such effects in nature and be able to link natural and anthropogenic stress. The RAPTOR project is a continuation of NFR projects, and have received Flagship funding over several years including 2020. The project has also cooperated with the NFR project NewRaptor (2014-2016) led by NTNU and contributed to several publications, notably form 2 PhD students (Mari Løseth, and Nathalie Briels) from this project.

The RAPTOR project has been instrumental in securing funding from NRF to the EcoStress project (*Ecological consequences of environmentally persistent pollutants in a marine sentinel species: A multi-stressor approach*). *EcoStress* (2016-2018) was a continuation of the sea eagle work in Tromsø, and expanded the research internationally. RAPTOR has been contributing to fieldwork and analyses in EcoStress. The PhD student Jiachen Sun was included in the EcoStress project in 2017 and defended her thesis in October 2019 at University of Antwerp, and has published 3 papers (Sun et al. 2019a,b, 2020). By using archived feathers from white-tailed eagles from Sweden (Baltic), the Norwegian Coast and Greenland she has documented contrasting spatial and temporal trends for mercury (Hg), organochlorines and perfluorinated compounds in northern eagle populations.
In 2020, data collection on white-tailed eagles in Troms, as a part of a long-term monitoring of concentrations and effects, continued. Blood samples and ecological data were collected from 11 eagle chicks. Effect parameters are measured over several years, such as oxidative stress, immunology and blood parameters. In 2019, a MSc student (Elisabeth Hansen) completed her MSc thesis on the impacts of POPs on the immune system of sea eaglets, using novel approaches (Leucocyte coping capacity: LCC) to examine new biomarkers of stress. This is in cooperation with University of Veterinary Medicine, Vienna. A paper from this work has been published in 2020 (Hansen et al. 2020).

The RAPTOR project is also supporting the EnviStress project: *Environmental stress processes: the role of anthropogenic pollution in a rapidly changing environment (EnviStress).* This project was funded by NFR from 2017 to 2020, but due to the Covid situation the project will be prolonged into 2021.

EnviStress studies tawny owls and the Goldeneye duck in Trøndelag. Data collection on tawny owls has been carried out since 1986 (by Georg Bangjord), and up until in 2019, the data series reaching 33 years. The project has access to data on measurements of different elements in tawny owl feathers from 1986-2005, and element analysis of feathers collected in the period 2006-2019 has now been completed. This allows testing of the hypothesis that heavy metal accumulation in terrestrial raptors is influenced by environmental conditions, as have been done in other works on POPs by our group. Our cooperation with Clementine Fritsch at the CNRS, France, has resulted in the completion of a MSc thesis by Quentin Devalloir on how landscape features influence the profile of element exposure in tawny owls (Devalloir in prep.). Furthermore, central issues raised by the EnviStress project are to assess the potential of pollution to modulate stress pathways, and thus capacity of such top predators to adapt to a rapidly changing environment. Stress is measured by CORT (a stress hormone) in feathers collected from tawny owls between 1986 and 2018. CORT analysis in these feathers (~1180) were carried out in 2019. Finally, eggs of tawny owl (2010-2019) and goldeneye duck (1999-2019) have been analysed for PFAS and POPs at NILU. These data are now being analysed and the writing of 3 papers has started. Interesting results have been found, showing that PFAS in eggs of goldeneyes have a predominantly marine origin. Secondly, an annual comparison between tawny owl and goldeneye have found little or covariance in OHCs in their eggs, suggesting there are different drivers of the exposure in adjacent terrestrial and aquatic ecosystems.

Master and PhD-students involved in the project

Elisabeth Hansen, MSc UiT

For the Management

Pollution is a ubiquitous phenomenon of great interest for the society and the public. This project is a supplement for managers in different fields (nature and pollution); i.e. understanding the impact of pollution have on seabird populations. It could also potentially

contribute to improve criteria for selecting POPs in the Stockholm Convention.

Published Results/Planned Publications

Sun, J., Bustnes, J.O., Bårdsen, B.J., Dietz, R., Helander, B., Jaspers, V.L.B., Lepoint, G., Søndergaard, J., Sonne, C., Thorup, K., Tøttrup, A.P., Zubrod, J., Eens, M. & Eulaers, I. 2020. Temporal trends of legacy organochlorines in different white-tailed eagle (*Haliaeetus albicilla*) subpopulations. *Environmental International* 138: 105618

Hansen, E., Huber, N., Bustnes, J.O., Herzke, D., Bårdsen, B-.J., Eulaers, I., Johnsen, T.V., & Bourgeon, S. Leukocyte coping capacity- a new tool to assess immunotoxicity of organohalogenated contaminants in avian wildlife. *Environmental International* 142: 105861.

Jouanneau, W., Bårdsen, B.-J., Herzke, D., Johnsen, T.V., Eulaers, I. & Bustnes, J.O. 2020. Spatial and temporal analysis of PFASs in White-tailed eagle (*Haliaeetus albicilla)* nestlings of Northern Norway – a ten-year study. *Environmental Science & Technology* 9B06818.

Lee, M. M., Jaspers, V.L.B., Løseth, M.E., Briels, N.E., Nygård, T., Bustnes, J.O., & Waugh, C.A. 2019. No evidence of avian influenza antibodies in two species of raptor nestlings inhabiting Norway. *BMC Veterinary Research* 15: 1-5.

In Press

Briels, N., Ciesielski, T.M., Havnsøe Krogh, A.K., Herzke, D., Poma, G., Malarvannan, G., Covaci, A., Eulaers, I., Nygård, T., Bustnes, J.O., Jaspers, V.E.L. & Sonne, C. Blood biochemistry and organohalogenated contaminants in Norwegian northern goshawk (*Accipiter gentilis*) nestlings. *Chemosphere*

Manuscripts

Devalloir, Q, Bårdsen, B.-J., Bangjord, G., Eulaers, I., Bustnes, J.O. & Fritsch, C. Disentangling the spatial and temporal trends of exposure to toxic (As, Cd, Hg, Pb) and (Al, B, Co, Cu, Mn, Se) metallic elements in the tawny owl (*Strix aluco*).

Communicated Results

A workshop on effects of POPs and multistress was planned in March in Tromsø with national and international participants as part of the EnviStress/Raptor projects. Due to the Covid situation, the workshop was cancelled, but will be held 23 November.

Interdisciplinary Cooperation

Ecology, physiology, chemistry

Budget in accordance to results

Yes

The funding from the Flagship has been essential for continuing the research on raptors, which is especially important for the continuity of the multi-stress perspective.

Could results from the project be subject for any commercial utilization

No

If Yes

No

Conclusions

The project increases our understanding of variation in accumulation and effects of POPs and different elements in northern food chains, both terrestrial and marine. This will be important in future work on unraveling the potential effects of different contaminants in northern ecosystems.