

Project information

Project title

Physiological responses to petroleum-related compounds in the Arctic key species polar cod (*Boreogadus saida*), with focus on energy related processes

Year

2012/2013

Project leader

Jasmine Nahrgang, UiT

Participants

- Jasmine Nahrgang (University of Tromsø)
- Sonnich Meier (Institute of Marine research)
- Marianne Frantzen (Akvaplan-niva)
- Ingar Wasbotten (Unilab analyse AS)
- Jørgen Berge (University of Tromsø/University Centre In Svalbard)
- Jørgen Schou Christiansen (University of Tromsø)
- Larisa Karamushko (Murmansk Marine Biological Institute)

Flagship

Hazardous substances, Theme: Petroleum pollution

Funding Source

Fram Centre, EWMA (UiT)

Summary of Results

The objective of the study was to determine effects of ingested crude oil in post-spawning polar cod (*Boreogadus saida*) and in particular on growth, metabolism and lipid composition in tissues.

Following 2-month acclimation, polar cod were exposed weekly and for 8 weeks to 3 doses of crude oil (0.1, 1 and 5 mg crude oil per g food), corresponding to 0.1 to 2.6 ug of polycyclic aromatic hydrocarbons (PAHs) per g fish per week. Control fishes received uncontaminated food. The exposure was followed by 2 week of recovery, where fish were fed clean food. Polar cod were sampled at time 0 (14 control fishes) and week 2, 8 and 10 (n=12 fish per treatment).

The study shows a significant reduction in growth both in length and somatic weight in female fishes, while no significant changes were observed in exposed males compared to controls.

In parallel, all exposed females increased their oxygen consumption compared to controls, while only males from the medium crude oil treatment increased their respiration compared to the controls. All the observed effects were maintained during the recovery period, showing that 2 weeks of recovery are too short to see physiological responses return to normal levels.

The analysis of lipid composition is still undergoing. The results seem to show some differences between gender here as well. Furthermore, some interesting changes in neutral lipids fatty acid profile were observed in livers of males. There was a reduced proportion of fatty acids of type 22:6 (n-3) in males from the medium and high doses compared to the control and low doses, and higher levels of unsaturated FA (16.0 and 18.0). The analysis of the lipid composition is undergoing and need thus considered carefully.

In general, the study shows strong gender differences in responses to the exposure. However, the small sample size when analyzing gender separately may pose a problem to observe statistically significant differences between the groups.

The highlights of the projects are that exposure to very low doses of crude oil showed effects on growth and respiration of female polar cod.

Gender had a significant impact on the responses of polar cod to ingested crude oil. Females and males were in a different physiological state at the beginning of the experiment (different gonad and maturation status), which influenced their responses.

The observed effects could have important implications for a population exposed to contaminated food in a season where they already are energetically weakened by spawning activities.

Published Results/Planned Publications

We plan to publish at least one, maybe two publications in international peer-reviewed publications.

Abstract to the following conferences are attached:

- Poster at the 28th Congress ESCPB in Bilbao, September 2012
- Talk at the Norwegian Environmental Toxicology Symposium (NETS), Tromsø, October 2012

- NPI seminar, Tromsø, October 2012

Planned: poster by Alexandra Mackee (Master student on the project) and talk at the next SETAC conference in Glasgow, May 2012.

Communicated Results

- Poster at the 28th Congress ESCPB in Bilbao, September 2012
- Talk Norwegian Environmental Toxicology Symposium (NETS), Tromsø, October 2012
- Talk NPI seminar, Tromsø, October 2012
- Talk at a Kingsbay seminar, September 2012
- Talk during the "System ecology group meeting" (University of Tromsø), Skibotn, November 2012.

Interdisciplinary Cooperation

The project combined ecotoxicology, ecology, physiology and chemistry. There are no negative comments on this aspect.

Budget in accordance to results

The original budget was cut by half. The 200 kNOK from the Fram Centre covered the chemical analyses of lipid profiles in tissues (only one sampling point) by the Institute of Marine Research (Sonnich Meier) and the polycyclic aromatic hydrocarbon analysis in the food and muscle of polar cod by Unilab analyse AS (Ingar Wasbotten) and some chemicals for the biochemical analysis performed by the Master student A. Mackee (UiT/Univ. Southampton).

The Fram Centre acted definitively as a boost for completing the project. But many samples could not be analysed and the overall value of the study is decreased due to the important budget cut. Gene, histology and some additional chemistry analyses could not be performed as planned in the original project description. This implies also the loss of some partners such as NIVA, the University of Bergen and the Karelian research institute (Russia).

Could results from the project be subject for any commercial utilization

No

Conclusions

The project can be considered as a pilot for the POLARISATION project (FRIMEDBIO/UiT) financed in 2012, for a period of 4 years. The Fram project has implemented new methods not used previously in the species that will be used during Polarisation and in future projects. The analysis of lipid composition changes in tissues of polar cod is an additional parameter that was not considered within Polarisation and gives a new dimension to the study of lipid metabolism under pollutant exposure.

- Force feeding of polar cod using 1ml syringes has never been reported before. Previous work fed a group of fish as a whole and lead to variability in doses received due to competition within the group. Another study trained the fish to feed individually. This later method is only possible on small groups and takes several weeks or months of training.
- Respiration of 8 individual fish simultaneously during 3 hours using intermittent flow respirometry (a first time in our Tromsø ecotox community). Intermittent flow through respirometry was only used by physiologist and in one polar cod at a time. Measuring respiration in 8 fish simultaneously allows to study many more fishes and increase statistical significance of the generated data.