

## Project information

### Project title

Impact of thermal stress and toxicant exposure in polar cod investigated by in vitro techniques and genome-wide transcriptome analyses

### Year

2013/2014

### Project leader

Øivind Andersen, Nofima

### Participants

Project leader/institution: Øivind Andersen (Nofima)

Project participants/institutions:

Lionel Camus (ApN)

Perrine Geraudie (ApN)

Aleksei Krasnov (Nofima),

Cinzia Verde (CNR)

### Flagship

Hazardous substances, Theme: Pollution from petroleum activities and shipping in the north - effects on Arctic ecosystems and communities

### Funding Source

Fram Centre, NRC

### Summary of Results

Expansion of petroleum-related activities into the Barents Sea will potentially expose Arctic marine organisms to oil spills from operational or accidental discharges. Polar cod is a circumpolar gadoid fish playing a key role in the Arctic marine ecosystem as a crucial food web-anchoring species. We investigated the effect of crude oil on the liver transcriptome by exposing fish to contamination for 2 days at 4°C and 11°C.

A number of genes involved in detoxification was induced, including several CYP, other biotransformation enzymes and transporters of xenobiotics. In parallel, a mild response to oxidative and protein stress was observed. The gene expression changes were slightly stronger at higher temperature. The number of upregulated genes markedly decreased after 11 days and witnessed recovery from the impact of pollution.

#### Highlights

1. **This study is the first genome-wide analysis of polar cod.**
2. The transcriptome analyses of polar cod suggested rapid responses to crude oil.

**The study revealed known and novel biomarkers to assess the impact of anthropogenic threats from pollution on polar organisms.**

### For the Management

This study is applied to management and monitoring of coastal areas and brackish environments both at temperate and polar latitudes, impact assessment of off-shore gas and oil production, dredging and disposal activities, environmental management of highly polluted areas, remediation of industrial areas, potential transfer of pollutants and risk to human health, sustainable aquaculture and animal welfare, toxicity risk of electromagnetic fields and urban pollution.

### Published Results/Planned Publications

- Øivind Andersen, Marte Rosland, Marianne Frantzen, Adrijana Skugor, Lionel Camus, Aleksei Krasnov. Effect of exposure to oil pollution on the hepatic transcriptome of polar cod (*Boreogadus saida*). In manus.
- Marte Rosland, Aleksei Krasnov, Marianne Franzen, Øivind Andersen. Liver transcriptome response of polar cod exposed to oil pollution. Norwegian Biochemical Society Winter Meeting, Røros, 2014.
- Marte Rosland. Genome-wide transcriptome analysis of the polar cod exposed to crude oil. Master Thesis, UMB, 2014.

### Communicated Results

Most of the results will be obtained in the further couple of weeks and will be presented in national and international conferences (NETS

conference, PRIMO, SETAC), next year.

#### Interdisciplinary Cooperation

Good inter-disciplinary cooperation was developed to validate and develop a new *in vitro* assay method as fish biology and physiology competence, ecotoxicology and tools are needed.

#### Budget in accordance to results

Funding from Fram Centre was essential for this pilot study, and will likely proceed with further analyses with industrial funding.

#### If Yes

*In vitro* tools, especially the liver explant culture is a cheap, easy, rapid and robust test to assess toxicity of a large range of environmental compounds alone or in complex mixture with low biological material needed (more than 240 explants with one fish).

#### Conclusions

1. This pilot study has investigated effects of oil exposure on liver detoxifying enzymes. Other effects to be examined include changes in gill morphology and respiration and long term effects on brain function. Early developmental stages should be included in a follow up study.
2. Genome-wide transcriptome analysis of the polar cod was for the first time performed in polar cod. The microarray has been established at Nofima and is based on the genomic sequences of Atlantic cod. Availability of polar cod larvae is needed for addressing effects of oil pollution on these fragile and vulnerable stages.