

## Project information

### Keywords

ecotoxicology, marine, food chain, diesel, PAH, alkylated PAH, sediment, Amphipod, Kongsfjord, Svalbard

### Project title

Trophic transfer and genotoxicity of PAHs, their alkylated homologues and metabolites along Arctic and sub-arctic marine food chains

### Year

2015

### Project leader

Maria Granberg

### Participants

- **Senior Adviser Kjetil Sagerup** ([kjetil.sagerup@akvaplan.niva.no](mailto:kjetil.sagerup@akvaplan.niva.no)) Akvaplan-NIVA- Ecotoxicology of marine organisms and Arctic birds
- **Senior Research Scientist Sveinn Are Hanssen** ([sveinn.a.hanssen@nina.no](mailto:sveinn.a.hanssen@nina.no)) Norwegian Institute for Nature Research- Ecology of Arctic birds
- **Senior Research Scientist, Head of Section Geir Wing Gabrielsen** ([gabrielsen@npolar.no](mailto:gabrielsen@npolar.no)) Norwegian Polar Institute- Ecotoxicology of Arctic birds
- **Associate Prof. Jasmine Nahrgang** ([jasmine.nahrgang@uit.no](mailto:jasmine.nahrgang@uit.no)) University of Tromsø- Arctic Ecotoxicology and biomarker responses
- **Associate Prof. Åse Krøkje** ([ase.krokje@ntnu.no](mailto:ase.krokje@ntnu.no)) Norwegian University of Science and Technology- Genotoxicity
- **Associate Prof. Jan Christensen** ([jch@plen.ku.dk](mailto:jch@plen.ku.dk)) & **Post doc. Linus MV Malmquist** ([linus@plen.ku.dk](mailto:linus@plen.ku.dk)) University of Copenhagen, Dept. of Plant and Environmental Sciences- Analytical platform for PAHs and PAH metabolomics.

During the course of the project two other partners joined the project.

- **Professor. Ketil Hylland** ([ketil.hylland@ibv.uio.no](mailto:ketil.hylland@ibv.uio.no)) University of Oslo, Section for Aquatic Biology and Toxicology- Marine ecotoxicology and zoophysiology.
- **Technical Expert/Professor. Gerard Cornelissen** ([gerard.cornelissen@ngi.no](mailto:gerard.cornelissen@ngi.no)) Norwegian Geotechnical Institute/Norwegian University of Life Science. Environmental biogeochemistry of organic contaminants.

### Flagship

Hazardous Substances

### Funding Source

FRAM center Hazardous substances Flagship.

### Summary of Results

The project budget was reduced from 600 to 300 kNOK and the tasks were therefore modified accordingly. The main modification included focusing on Svalbard only and thus excluding Tromsø as a study site. The refined project then consisted of two tasks.

#### **Task1**

*Field sampling in Ny Ålesund.* Samples representing different trophic levels of a benthic marine food chain were collected at three sites with increasing distance from Ny Ålesund and the coal contaminated old coal harbor at Thiisbukta (Fig1). The trophic levels included sediments, sediment dwelling invertebrates, common eider (*Somateria mollissima*) blood and eggs and glaucous gull (*Larus hyperboreus*) blood and eggs. All samples were then, and are still being, analyzed for PAH compounds, including parent PAHs/alkylated PAH homologues and PAH metabolites, in order to determine background concentrations, bioaccumulation and biomagnification capacities. Genotoxicity is being analyzed as DNA strand breaks in blood, eggs and invertebrates. Invertebrates will also be analyzed for

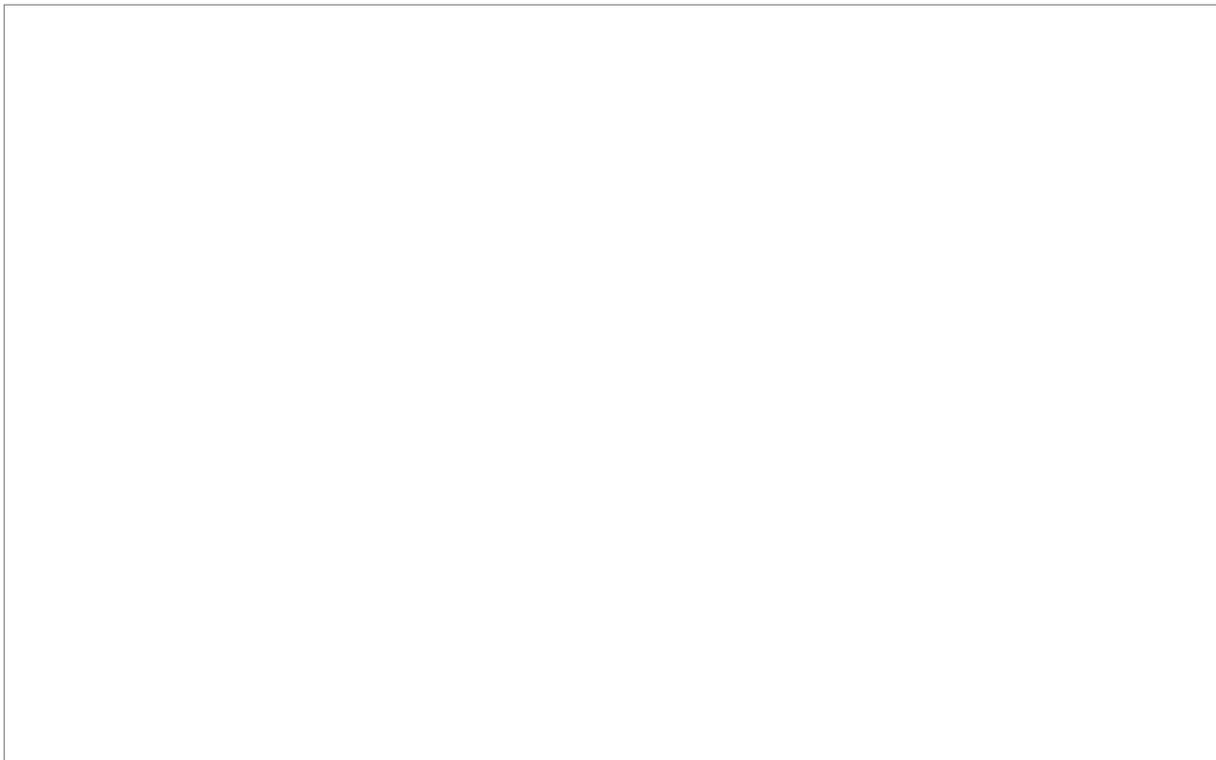
the PAH biomarker response in lipid peroxidation. Toxicity endpoints will be evaluated against concentrations of individual and classes of PAHs accumulated.

- H1*: Alkylated PAHs accumulate from sediment to sediment dwelling organisms, and biomagnify along food chains contrary to their parent homologues.
- H2*: Glaucous gulls will have higher concentrations of alkylated PAHs than Eider ducks.
- H3*: PAH compounds, alkylated PAHs in particular, are transferred from female to egg.
- H4*: Concentrations of alkylated PAHs and PAH metabolites correlate with genotoxic signals in all matrixes.



**Figure 1.** Sampling sites in Kongsfjorden, Svalbard. Svalbard 3: Prins Heinrich Øya, Svalbard 2: Lovénøyane, Svalbard 1: Breøyane

Most of the chemical and biological analyses are still being made. Results have, however, arrived for sediments collected at the three field stations in Kongsfjorden (Fig 2). Svalbard 3 is closest to Ny Ålesund and Svalbard 1 is farthest away. Concentrations of all PAHs and alkylated PAHs are highest closest to Ny Ålesund and decreasing with distance from the town. The PAH signature shows a clear dominance of alkylated homologues (bell-shaped PAH group patterns). This is indicative of a strong petrogenic PAH source most likely related land based coal deposits leaking coal dust and PAHs into the coastal marine environment. Levels of the traditional 16 EPA PAHs parent compounds are low. Measuring the 16 EPA PAHs only, as is the current national standard, will severely underestimate the potential PAH exposure and risk in these marine areas.



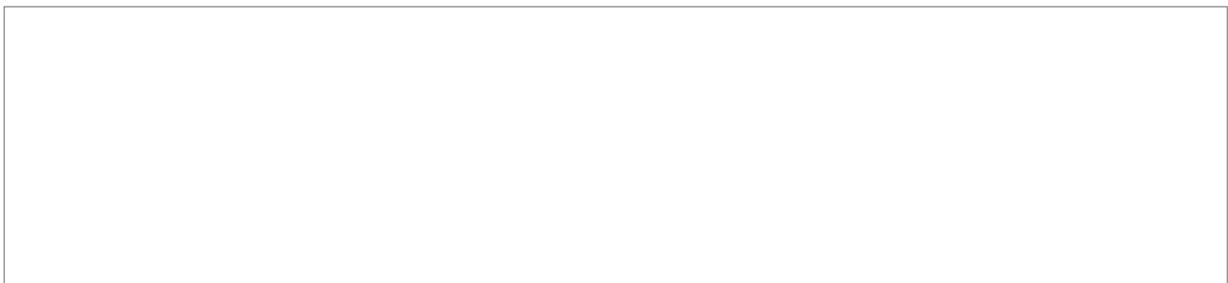
**Figure 2.** Sediment concentrations of PAHs and alkylated PAHs in sediment collected along a pollution gradient in Kongsfjorden. Red circles indicate compounds included in the 16 EPA PAH priority list.

## Task 2

*Bioaccumulation experiment with Marine Diesel.* Sediments and amphipods (*Gammarus* sp.) were collected at heavily PAH contaminated (Thiisbukta, Kongsfjorden) and truly pristine (Ebeltofthamna, Krossfjorden) sites in the Kongsfjorden/Krossfjorden system. The pristine sediment was spiked with marine diesel at a sublethal concentration. Individuals from the two populations of amphipods (*i.e.* unexposed and historically exposed to PAHs) were exposed to all three sediments, *i.e.* pristine, historically PAH contaminated and pristine spiked with diesel, for a total period of 30 days with five sampling times. Amphipods will be analysed for accumulated concentrations of PAHs and alkylated PAHs and produced PAH metabolites. Effects endpoints include lipid peroxidation and genotoxicity (Comet assay). Toxicity endpoints will be evaluated against concentrations of individual and classes of PAHs accumulated.

*H1:* Historically PAH exposed populations are adapted to PAHs and are therefore less sensitive to an oil spill?

No results are available yet since analyses are still being made but enclosed pictures (Fig. 3) show the progress of field and experimental work.



**Figure 3.** Sampling and experimental work in Ny Ålesund/ Marine Laboratory. From left to right, Marina Vazquez sampling amphipods in the Kongsfjord, Experimental setup in the Marine lab, experimental exposure aquaria with sediment and amphipods.

Three MSc students are involved in different parts of the project. 1) Ola Tilset (NTNU-NPI), correlation between POPs and PAHs and genotoxicity in blood of Common Eider and Glaucous Gull in Kongsfjorden; 2) Randi Rodvelt (NTNU-NPI), correlation between POPs and PAHs and genotoxicity in eggs of Common Eider and Glaucous Gull in Kongsfjorden; 3) Marina Vazquez (UiT-NPI), Marine invertebrate population sensitivity to marine diesel-role of adaptation to historical coal exposure. All are planned to hand in their MSc reports

#### Published Results/Planned Publications

We plan 3-4 publications from this work.

#### Communicated Results

- Ny Ålesund Newsletter no 35, popular science article
- Swedish national television (SVT). Participated in TV series showing our work in Ny Ålesund, june 2015.
- Oral presentation at the Kongsfjorden seminar held at the FRAM center in October.

#### Interdisciplinary Cooperation

No.

#### Budget in accordance to results

	NP	ApN	NINA	UiT	NTNU	KU
Admin	15					
Experiment	40					
Field	30	30	30			
PAH analyses						100
DNA strand break					30	
Lipid peroxidation				25		
Sum	85	30	30	25	30	100

Could results from the project be subject for any commercial utilization

No

#### Conclusions

Se project results.