

information

Keywords

Fish, PCBs, trend, climate change

Project title

POPs in Arctic char from a remote Arctic lake: Long-term trends and responses to changing inputs, fish ecology and a warming climate (FishTrend)

Year

2018

Project leader

Anita Evenset/Jenny Bytingsvik

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

74.384 N, 19.014 E

Participants

Akvaplan-niva: Guttorm Christensen, Anita Evenset, Jenny Bytingsvik

NIVA: Amanda Poste

NILU: Nick Warner

Flagship

Hazardous Substances

Funding Source

The project was planned as a 1-year project in 2018, funded by the Fram Centre Flagship for Hazardous Substances

Summary of Results

In recent decades, global regulatory efforts have led to reduced emissions of persistent organic pollutants (POPs) such as PCBs and HCB. However, predicting the degree to which (and rate at which) concentrations of these compounds in the Arctic environment and in Arctic organisms will respond to changing inputs is complicated by additional stressors including climate change and related physical, chemical and ecological changes. The FishTrend project focuses on using a comprehensive sample archive of fish (Arctic char) from a remote Arctic lake (Lake Ellasjøen, Bjørnøya, Svalbard) to: 1) determine temporal trends (from 1995–2015) in PCB and HCB concentrations in Arctic char, and 2) identify the main drivers of the observed trends (e.g. changing inputs from long-range atmospheric transport and seabird biovection, climatic changes, and changes in fish biometry and ecology). Our project results will yield important insight into the complex set of factors that can affect concentrations of POPs in Arctic biota, and will provide an important basis for current and future risk assessment for contaminants in Arctic ecosystems.

To date, the following milestones have been achieved:

- We identified a comprehensive sample set including 130 fish collected over two decades (fish collected in 13 years between 1995 and 2014). Fish selection focused on providing good temporal coverage (n=10 fish per sampling year), and on covering a broad size range/achieving an even sex balance within each sampling year.
- Fish muscle tissue was homogenized, extracted and analyzed for HCB and several PCB congeners (PCB-28, -52, -99, -101, -138, -153 and -180) at NILU's analytical lab in Tromsø, with analytical results available as of November 2016.
- We have compiled additional relevant data on potential drivers of contaminant concentrations in fish (see Table 1 for an overview of the additional parameters considered).
- We have made a detailed outline of a planned manuscript

Table 1. Overview of potential drivers considered and their known temporal trends.

Drivers	Parameters considered	Temporal trends
Fish ecology	Biometric data: length, age, condition, sex, reproductive stage	None, but high interannual variability
	Parasite burden	None, but high interannual variability
	Stomach contents	None, but some interannual variability
	Fish diet	None, but some interannual variability
Climate	Annual mean temperature, summer mean temperature (from Bjørnøya met station)	Significant increase
	Annual total precipitation, total summer precipitation (from Bjørnøya met station)	None
POPs input	Seabird population size: kittiwakes, glaucous gulls (from www.mosj.no)	Kittiwakes: none; Glaucous gulls: decrease. Interannual variability.
	Atmospheric POP concentrations on Svalbard (from NILU's Zeppelin station)	PCBs: decrease; HCB: decrease until early 2000's, then increase from 2003 to present.
	Sediment core POP data from Ellasjøen (2014 core collected by Akvaplan-niva)	PCBs: decrease; HCB: increase.

Master and PhD-students involved in the project

We were unable to recruit a MSc student for such a short-term (1-year) project, and as such there have been no students involved in the project to date.

Contaminants in aquatic food webs and climate change are both key topics of concern for the general public, as well as for policy makers and managers, particularly considering the potential for these stressors to exert wide-ranging environmental, economic, health and social effects. Although global regulatory efforts have led to reduced emissions of pollutants including mercury (Hg) and POPs such as PCBs, predicting the degree to which (and rate at which) environmental and biotic contaminant concentrations will respond to changing inputs is complicated by additional stressors including climate change and associated physical, chemical and ecological changes. This project will contribute essential and timely information about how contaminant concentrations in Arctic biota respond to changing inputs, climate and ecology. Our results and conclusions will be highly relevant for current and future risk assessment for contaminants in Arctic organisms, as well as implications for ecosystem health and the health of those who rely on aquatic food resources.

Published Results/Planned Publications

We have prepared a manuscript outline for one manuscripts based on this work, which we intend to finalize and submit in late 2018/early 2019:

Potential Title: *“PCBs, HCB and Hg in Arctic char from a remote Arctic lake: Long-term trends, interannual variability and drivers”*

Target journal: Environmental Science and Technology

Note: This manuscript combines and contrasts the PCB/HCB data generated in the current project with previous data on Hg concentrations in the same set of fish samples, thus allowing us to make broader inferences about long-term trends in contaminants in fish from Ellasjøen.

Planned oral presentation at a scientific conference (abstract to be submitted 28 November):

SETAC 2019

Location: Helsinki, Finland

Presentation title: "PCBs, HCB and Hg in Arctic char from a remote Arctic lake: Long-term trends, interannual variability and drivers"

Planned forskning.no article in early 2019:

We will aim to write an article outlining the key findings of the FishTrend project for forskning.no in parallel with the preparation of the manuscript.

Interdisciplinary Cooperation

The FishTrend project takes an interdisciplinary approach to analyzing a unique and comprehensive set of existing samples and complementary data from Lake Ellasjøen (Bjørnøya, Svalbard) in order provide new and warranted knowledge about the complex interplay between contaminant transport and fate, climate and ecology and their effects on bioaccumulation of contaminants in aquatic food webs.

Budget in accordance to results

The budget for 2018 is in agreement with the budget of the project as outlined in the proposal. However, some key outputs have been delayed due to delays in PCB/HCB analysis because of NILU's move to a new lab. However, all analyses are now complete, and the remainder of 2019 will be used to carry out the data analysis and work more closely with the planned manuscript.

Could results from the project be subject for any commercial utilization

No

Conclusions

Since we have only recently wrapped up the analytical work in the project, we do not have any conclusions to report at this time. The work planned for the remainder of 2018 will allow for the successful completion of the project, and the communication of project results and conclusions.