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GLOBE Arctic POP's

Annual Report 2001

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NILU
Norwegian Institute for
Air Research

The
GLOBE
Program

Preface

This project seeks to create a network of GLOBE schools and scientists above the Arctic circle that will study the Arctic environment and contribute data to support Arctic research. Students will take GLOBE measurements and investigate the distribution and level of selected POPs in the Arctic region, increase the knowledge of POPs and general environmental science in the involved schools, and contribute to the documentation of new emerging POPs in the Arctic.

15 schools from countries in the Arctic are taking part in an international scientific investigation of toxic pollutants in the Arctic. These pollutants are a threat to the environment in the Arctic. The importance of the problem was clearly shown during the Stockholm Convention in May 2001 where the press release said: “Governments Give Green Light to Phase Out of World's Most Hazardous Chemicals”.

The project started summer 2001 and is planned for 4 years. Responsible for the scientific part of the project is NILU, Norwegian Institute for Air Research, while GLOBE Norway ensures the educational aspects.

This annual report covers the main activities for 2001

GLOBE Norway and NILU want on behalf of everybody involved to thank the external funding institutions, ensuring the coordination and scientific part of the project during 2001:

- Norwegian Ministry of Education
- Norwegian Ministry of Foreign Affairs
- Norwegian Ministry of Environment
- The Barents Secretariat
- Environmental Office US Embassy Copenhagen

In addition various national agencies in the Arctic countries has supported their involved schools in various ways. GLOBE US has also supporter with very important funding and staffs for the workshop in Fairbanks.

Last but not least we want to thank all the involved GLOBE coordinators, schools, teachers and students for their strong commitment, inspiring enthusiasm and very nice cooperation during 2001 and we luck forward for fruitful work also in the coming years.

Kjeller, Norway July 2002.

Contents

Summary

This first year of the project has in general been a big success. The project was established very fast and it is very comprehensive to be an educational project. The schools turned out to be very positive to participate and proved as the year went along a strong commitment and a very positive attitude.

The practicality in organising an extensive scientific project for selected schools across the Arctic is a challenge in itself, due to long transport distances to remote areas. The project started off with a very successful workshop in Fairbanks in Alaska in August 2002 where the schools participated with teachers and also headmasters. With a good combination of theoretical lessons and practical training the project got a very good start.

During the autumn the schools took samples in a scientifically controlled manner and sent the samples for analysis at NILU. The results to be ready for the winter/spring 2002.

A lot of written material is made, web pages, CD-ROM's etc in order to ensure a good platform for the teachers. It is expected that 2002 will confirm the expected positive outcome of the project both scientifically and educationally for all involved parties.

GLOBE Arctic POP's
Annual Report 2001

1 Background

For some time, there has been an idea of creating a network of GLOBE schools and scientists above the Arctic circle to encourage students to study the Arctic environment and contribute data to the research being conducted by Arctic scientists. An initiative was taken by the GLOBE Office to present the GLOBE Program and this idea to the Arctic Council. First, the idea was to plan GLOBE teacher training workshop for schools in Arctic countries to which Arctic scientists would be invited, but after a while, the idea of creating a special GLOBE protocol that would be uniquely interesting to Arctic scientists was developed by GLOBE Norway. To this end, GLOBE Norway started to involve the Polar Environmental Centre in Tromso.

Different ideas were discussed and in May 2000 we ended up with the proposal presented in this paper. The Norwegian Institute for Air Research (NILU), one of the institutes in the Polar Environmental Centre, came up with an idea of studying new POPs in the Arctic region. Thus, in addition to the GLOBE Protocols, the schools will also do this new protocol.

GLOBE's role will be to train GLOBE schools in the Arctic on the GLOBE Protocols and archive and provide visualizations (maps and graphs) of the GLOBE data submitted and GLOBE Norway/NILU's role is to develop the new POPs protocol.

1.1 Briefly about POPs (Persistent Organic Pollutants)

Persistent Organic Pollutants (POPs) are chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. With the evidence of long-range transport of these substances to regions where they have never been used or produced, and the consequent threats they pose to the environment of the whole globe, the international community has called for urgent global actions to reduce and eliminate releases of these chemicals.

1.2 Project framework

The goal is to make a professional scientific Globe project for schools in the Arctic regions. The project will be integrated with ongoing scientific research programs in the Arctic. NILU will develop and train the POP protocols and ensure the scientific validity of the data so the results will be usable for scientific publication while the GLOBE Program will train and be in charge of the GLOBE protocols.The content of the project will follow international environmental education guidelines. In collaboration with the Norwegian Ministry of Education, the project will be integrated with international environmental policy goals.

1.3 Scientific background

Toxic chemicals are recognized as such a serious threat to humans and wildlife that the management goals are zero discharge of the priority compounds (selected POPs). Several other POPs are listed as "Candidate substances" on an international priority list, indicating a need for scientific research on distribution, fate and environmental effects. Arctic ecosystems function as a sink for POPs due to long-range transport and lipid rich food chains. New environmental pollutants have gotten an increased focus in the Arctic Monitoring and Assessment Programme, AMAP phase-II.

1.4 Project goals

- Investigate the distribution and level of new selected POPs in the Arctic region.
- Increase the knowledge of POPs and general environmental science in the involved schools.
- Contribute to the documentation of new POPs in the Arctic, needed to increase scientific knowledge of the region and potentially for international political processes.

1.5 Overall description

- Investigation of a specific toxic compound or group of compounds in the Arctic biosphere.
- Circumpolar, 2 schools from each country.
- Measurements 2 days every 6 months per school (3 year project).
- New tasks to accomplish, knowledge builds on previous tasks and accumulates during the project.

2 Activites 2001

2.1 Project development

The full project description was presented at GLOBE Annual Conference in Annapolis in USA in July 2000 (See Appendix A). The project was very well received and all the Arctic representatives were interested in joining the project. Invitation to countries and arctic scientists were sent in December 2000. During the spring 2001 we worked with GLOBE and the University of Fairbanks to design the workshop in Fairbanks in July 2001. NILU, by scientist Eldbjørg Sofie Heimstad, developed the first protocol for fish sampling. The result is presented in a separate chapter.

2.2 Workshop in Fairbanks

At the workshop in Fairbanks, where 60 representatives from 15 schools were gathered, we went through GLOBE protocols and the fish protocol. The teachers learnt in detail how to take the samples and preserve them for sending.

2.3 POPs protocol fall 2001/spring 2002

NILU has developed a protocol where all details about the sampling process are described. Background about the analysing process is also presented.

2.4 Kick-off in Kiruna

At the workshop in Fairbanks schools in Norway, Sweden and Finland decided to have a kick-off of the project in Kiruna. This was an initiative from CC in Sweden Eva Lotta Nyander.

2.5 CD-rom and Home Page

In October 2001 a CD-rom with all the background material and protocols were produced by Geir Endregard and sent to all schools. We also opened the new home page for the project: http://www.nilu.no/niluweb/services/arcticpops/.

2.6 Project week

In October we had a common project week. They all went fishing and took the samples. All the sampling equipment was sent to them from NILU (scalpels, boxes, aluminium foil etc..). The schools had different experiences. Some got a lot of fishes and for some the fishing season was not there. But almost all managed to send the samples. Murmansk had trouble receiving equipment and sending samples due to custom troubles. We hope to solve this problem next year.

The sending of the samples is a story for itself. We made an agreement with DHL so the transportation time should be at a minimum. But it didn't work! One sample used more than 3 weeks.

2.7 Analysis of the samples

At the moment the analysis is not finished. But when we have the results we will send them to the schools and give a specific task for each school. The school will make a report within May/June 2002.

2.8 New samples

In April the schools will do one more sampling of fish. The results will be presented at the workshop in Akureyri in August 2002.

2.9 Workshop in Akureyri

The second workshop will take place in Akureyri at Iceland August 8-12 2002. There will an exchange of experiences from the first year. The next POP protocol will be presented and some new GLOBE protocols will be introduced.

3 Arctic POPs workshop, Fairbanks, Alaska 28 July to 4 August 2001

3.1 Participants

3.2 GLOBE's First Arctic POPs Workshop Agenda

Sunday, July 29

1830 – Barbecue
Location: University Commons also know as Lola Tilly Commons, at the corner of Tanana and Chandalar Rd.

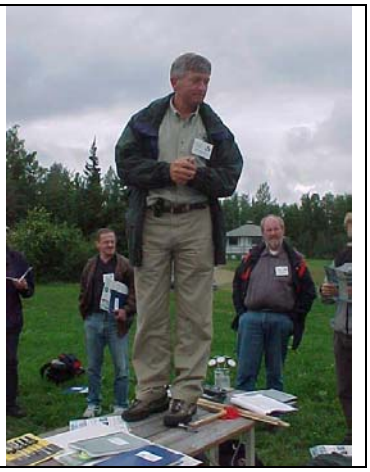
Day 1 – Monday, July 30
0800-0840 Breakfast

Location: 501 IARC

Time	Activity and Location
0845 - 0920	Opening General Session B Welcome to site B Site logistics B Introduction of training team and participants Location: 401 IARC all morning Responsibility:
0920 -	Overview of Arctic Project

0940	Responsibility:
0940 - 1000	Overview of GLOBE Responsibility:
1000 - 1040	Introduction to GLOBE Educational Materials (Teacher=s Guide, GLOBE Science Log, Data Book and videos) Responsibility:
1040 - 1055 (including break)	Introduction to Thermometer Activity Responsibility:
1055 - 1105	Wrap-up of Thermometer activity Responsibility:
1105 - 1125	*Just Passing Through* Learning Activity Responsibility:
1125 - 1145	Intro to GLOBE Science & AEarth as a System@ (video and slides) Responsibility:
1145 - 1200	Where & When - Intro to GPS & UT Responsibility:
1200 - 1300	Lunch - Location: 501 IARC



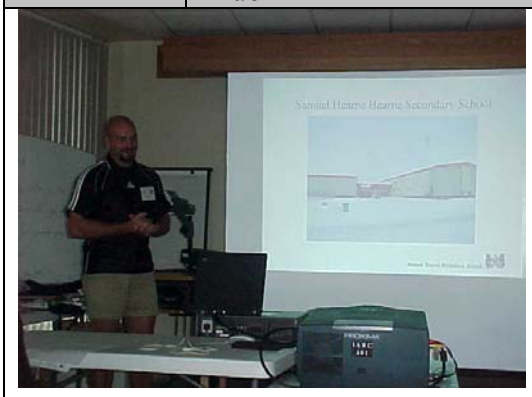
Day 1 – Monday, July 30 (continued)

	Blue	Red
1300 - 1800 (includes 15 min break)	Atmosphere Introduction Protocols (outside) - GPS - Soil Temperature, Soil Moisture - Cloud Type & Cover - Max, Min, Current Temperature Liquid & Solid - Precipitation w/pH Self-paced computer activity Materials - Data Collection GLOBE Data Book GLOBE Science Log Location: 401 IARC, outside, computer lab at 359 O'Neill Responsibility:	Land Cover/Phenology Remote Sensing (Video & slides); MUC Protocols GPS *Land Cover* Manual Mapping Land Cover sites: Qualitative, Quantitative and Biology Biometry *Phenology* Green-Up and Green-Down Materials - Data Collection GLOBE Data Book GLOBE Science Log Location: 417 IARC, outside Responsibility:
1800 - 1815	Regroup & Reflect **Location:** Responsibility:	

18:30 Reception hosted by University of Alaska Fairbanks (UAF) Chancellor Marshall Lind
Location: UAF Museum

Day 2 – Tuesday, July 31
Breakfast
Location: 501 IARC

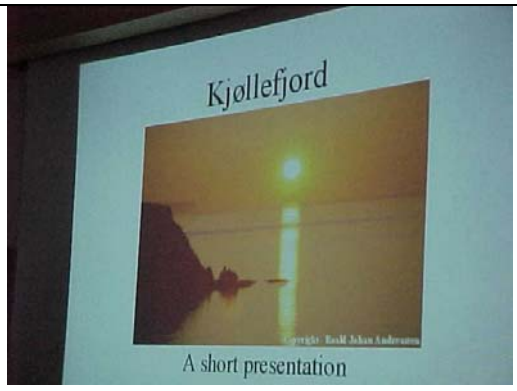
Time	Activity and Location	
	Blue	Red
0845 - 0900	Questions and Answers – Location: 401 IARC	
0900 - 0930	School Presentations- Location: 401	IARC

Time	Activity and Location	
	Blue	Red
		
0930 - 1230 (includes 15 min break	Soil I Introduction Protocols/Field work (outside) Soil Characterization Bulk Density Sampling Lab Work Implementation Strategies for implementation Materials Data Collection GLOBE Data Book GLOBE Science Log Location: 417 IARC and outside Responsibility:	Atmosphere Introduction Protocols (outside) GPS Soil Temperature, Soil Moisture Cloud Type & Cover Max, Min, Current Temperature Liquid & Solid Precipitation w/pH Materials Data Collection GLOBE Data Book GLOBE Science Log Location: 401 IARC, outside Responsibility:
1230 – 1330	Lunch – Location: 501 IARC	
1330 – 1430	Student Inquiry Overview Location: Responsibility	Atmosphere - Self-paced learning activity Location: Computer Lab Responsibility:
1430 - 1530	Start Hydrology	Finish Atmosphere activity
		

Time	Activity and Location	
	Blue	Red
1530 – 1830 (includes 15 min break)	Hydrology Introduction Calibration Protocols/Field work Transparency Temperature pH Salinity Conductivity Materials Data Collection GLOBE Data Book GLOBE Science Log Student Inquiry Looking at your data Earth as a System Development of a Hypothesis Implementation Strategies Location: 501 IARC, outside, computer Lab at 359 O'Neill Responsibility:	Soil I Introduction Protocols/Field work (outside) Soil Characterization Bulk Density Sampling Lab Work Implementation Strategies for implementation Materials Data Collection GLOBE Data Book GLOBE Science Log Location: 417 IARC and outside Responsibility:
1830	**Evening Free**	

Day 3 – Wednesday, August 1
0800-0840 Breakfast
Location: 501 IARC

Time	Activity and Location	
	Blue	Red
0845 - 0900	Questions and Answers – Location: 401 IARC	
0900 - 1000	School Presentations Location: 401 IARC Responsibility:	



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<tr><td></td><td>Blue</td><td>Red</td></tr>
<tr><td colspan="3">  
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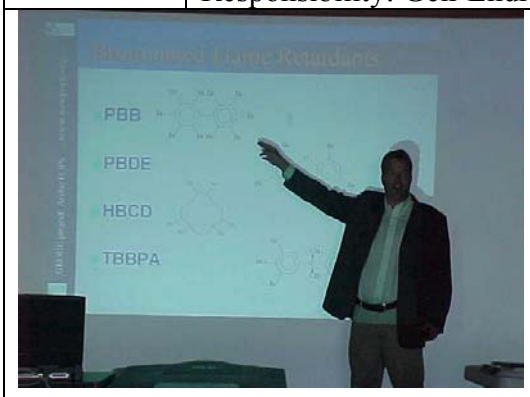
<tr><td>1000 - 1015</td><td colspan="2">Break
Location: 501 IARC</td></tr>
<tr><td>1015 - 1200</td><td colspan="2">GLOBE Arctic Protocols
Introduction
Why investigating POPs in the Arctic?
How to do the investigation
Eldbjørg Sofie Heimstad
The POP Homepage
Location:
Responsibility: Geir Endregard, David Brown</td></tr>
<tr><td colspan="3"> 

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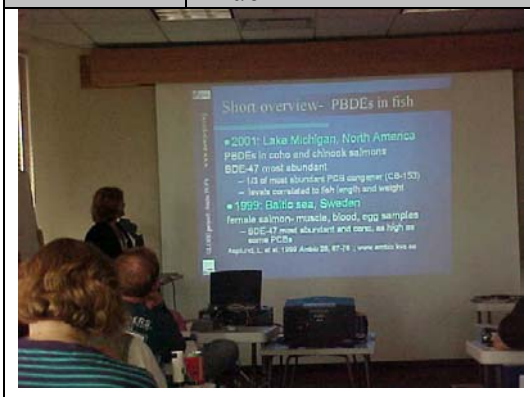
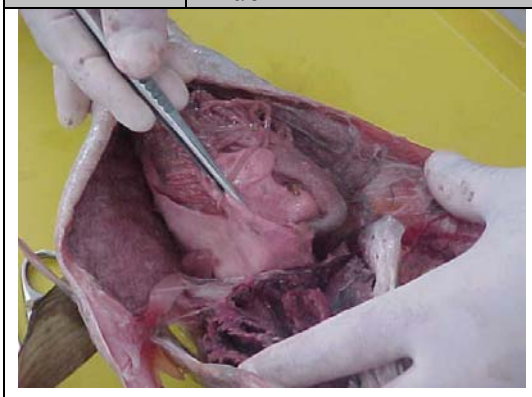
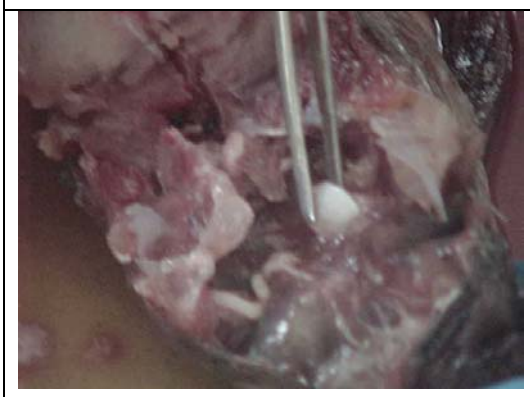
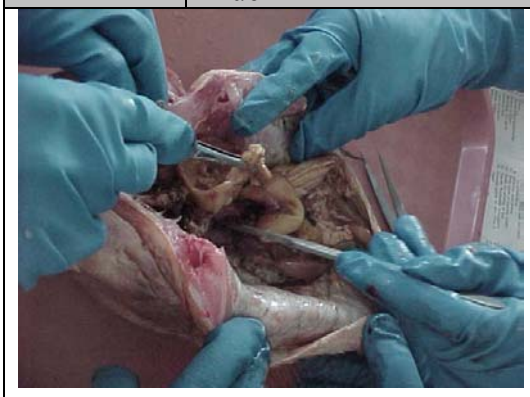
		
1200 – 1300	Lunch – Location: Oick up lunch bags at 501 IARC	
1300 – 1700 (includes break)	GLOBE Arctic Protocols Practical Session Demonstration on cod and salmon Group activities (5-6 persons per group) Protocol Measuring length and weight Cutting the filet Packing Finding the otoliths Determine the age Packing/sending procedure Discussion Location: 501 IARC Responsibility:	
		

Time	Activity and Location	
	Blue	Red
	
	
	
	

Time	Activity and Location	
	Blue	Red
		
1700 – 1715	Regroup and Reflect Location: Responsibility:	
Evening 1800	Bus leaves dorm for Salmon Bake /Theater	
		
		

Time	Activity and Location	
	Blue	Red
		
		
		

Day 4 – Thursday, August 2
0800-0840 Breakfast at 501 IARC

Time	Activity and Location	
	Blue	Red
0845 - 0900	Questions and Answers – Location: 401 IARC	
0900 - 0930	School Presentations 401 IARC	

Time	Activity and Location	
	Blue	Red
		
		
		
0930 - 1030	Finish Hydrology Location: computer lab 359 O'Neill Responsibility:	Student Inquiry Overview Location: 401 IARC Responsibility:
		

Time	Activity and Location	
	Blue	Red
		
		
1030 - 1230 (includes 15 min break)	Computers Location: 359 O'Neill Responsibility:	Hydrology Introduction Calibration Protocols/Field work Transparency Temperature pH Salinity Conductivity Materials Data Collection GLOBE Data Book GLOBE Science Log Student Inquiry Looking at your data Earth as a System Development of a Hypothesis Implementation Strategies Location: 501 IARC, outside, computer lab at 359 O'Neill Responsibility:

Time	Activity and Location	
	Blue	Red
1230 - 1330	Lunch – Location: 501 IARC	
1330 – 1600 (includes 15 min break)	Soil II Lab Work pH Bulk Density Gravimetric Soil Moisture Materials Data Collection GLOBE Data Book GLOBE Science Log Location: 417 IARC Responsibility:	Hydrology (continued)
1600 - 1630	Implementation presentation by a Country Coordinator Location: 401 IARC Responsibility:	
1630 – 1800	Implementation – Break into teams by country Location: 401 IARC, 501 IARC, 417 IARC as needed Responsibility:	
1800 – 1815	Regroup and Reflect Location: Evening FREE	

Day 5 – Friday, August 3
0800-0840 Breakfast at 501 IARC

Time	Activity and Location	
	Blue	Red
0845 - 0900	Questions and Answers – Location:	

Time	Activity and Location	
	Blue	Red
		
0900 – 1145 (includes 15 min break)	Land Cover/Phenology Remote Sensing (Video & slides); MUC Protocols GPS Land Cover Manual Mapping Land Cover sites: Qualitative, Quantitative and Biology Biometry Phenology Green-Up and Green-Down Materials - Data Collection GLOBE Data Book GLOBE Science Log Location: 401 IARC, outside Responsibility:	Computers Responsibility: Location: 359 O'Neill
1145 - 1245	Lunch – Location: 501 IARC	
1245 - 1500	Land Cover/Phenology (continued)	Soil II Lab Work pH Bulk Density Gravimetric Soil Moisture Materials Data Collection GLOBE Data Book GLOBE Science Log Location: 417 IARC Responsibility:

Time	Activity and Location	
	Blue	Red
		
		
1500 – 1630 (includes 15 min break)	Implementation Discussion Break into groups: Country Coordinators and teachers per country Location: 401 IARC, 417 IARC, 501 IARC as needed Responsibility:	
1630 - 1730	Learning Communities Implementation presentations Location: 401 IARC Responsibility:	
		

Time	Activity and Location	
	Blue	Red
		
1730 - 1800	Graduation ceremony Group photo Location: 401 IARC or 501 IARC Responsibility:	
		
		
Evening	Banquet Learning Activity Presentations Location: 109 Butrovich	

Time	Activity and Location	
	Blue	Red
	
	
	

Day 6- Saturday, August 4
0800- Bag Breakfast and transport to Riverboat Discovery available
Location: Moore Dorm
1300 - Return to DORM

4 Kick-off in Kiruna 18-19 September

Kick off,
The GLOBE Arctic Project.

September 18-19 in Kiruna, Sweden

Draft Programme

Tuesday, September 18th

14.00 Arrival and lodgings at Hjalmar Lundbohmsskolan, Kiruna

15.00 LKAB's visitors' mine
http://www.lkab.com/frameset_2.html

17.30 Dinner

19.00 Programme for the students arranged by students in MSP2, Hjalmar Lundbohmsskolan

Wednesday, September 19th

08.00 Breakfast
08.45 Welcome to Hjalmar Lundbohmsskolan, Kiruna
The GLOBE-program - Introduction,
POPs in the Arctic - Geir Endregard, Norwegian Institute for Air Research

12.00 Lunch at Hjalmar Lundbohmsskolan

13.00 POPs in the Arctic

14.00 Departure

HJALMAR LUNDBOHMSSKOLAN

Skolverket

4.1 Newspaper articles from Kiruna

NSD TORSDAGEN DEN 20 SEPTEMBER 2001 19

Elevernas arbete används för vetenskaplig forskning

KIRUNA

Elevers arbete kommer att användas för vetenskaplig forskning.

Hjalmar Lundbohmsskolan deltar i ett projekt som ska ta reda på hur miljösituationen är i länder norr om polcirkeln.

Globe är ett projekt som omfattar 97 länder i hela världen. Det startade 1995 med bland annat USAs förre vicepresident Al Gore i spetsen, och Hjalmar Lundbohmsskolan var med redan från början. Tanken var att skapa kontakt mellan studenter, lärare och vetenskapsmän för att tillsammans lära sig mer om miljön.

Fyraårigt projekt

Nu har ett fyraårigt delprojekt vid namn "Pop's in Arctic" inletts. Pop står för persistent organic pollutants, fritt översatt ihållande organiska föroreningar. 14 skolor är utvalda, varav två i Sverige; Hjalmar Lundbohmsskolan i Kiruna och Laestadiusskolan i Pajala.

Eleverna ska genom att samla in prover från fiskar få reda på om vissa ämnen finns i för hög koncentration.

dra vetenskapsmän, berättar Siv Wiss, studierektor.

Prover från fisk

Elever som har ämnena biologi och miljövård på schemat deltar i projektet. Tack vare elevernas arbete kan forskare ta reda på om vissa ämnen i norr är giftiga, samtidigt som eleverna lär sig hur forskning går till.

I år ska klasserna ut och fiska, för att sedan ta prover från fiskarna. Läraren Britt Holmlund är en av två lärare som har fått gå en utbildning i Alaska för att lära sig hur proverna tas på rätt sätt.

En utmaning

– Vi vet inte vad det blir för resultat, men det är en utmaning. Det är spännande för både elever och lärare, säger hon.

Hon tror också att dagens föreläsningar har väckt elevernas intresse, och det styrker Oscar Hammarfjord, MSP2.

Bättre miljö

– Jag tror att det blir ganska roligt. Jag har ingen aning om vad det kommer att ge, men kanske får vi bättre miljö här uppe, säger han med ett leende.

Gymnasieelever hjälper till att spåra gift

KIRUNA, KURIREN

I går inleddes ett unikt internationellt forskningsprojekt i Kiruna. Sju länder deltar i vad som kallas "Globe-Pop's in arctic".

En giftig beståndsdel i plast har förorenat miljön världen över. Omfattningen ska nu kartläggas.

Området som undersöks är stort och ligger ovan polcirkeln, och forskningsledningen har tagit hjälp av en ny sorts assistenter: gymnasieungdomar.

I går samlades för första gången skolungdomar från Norge, Finland, Pajala och Kiruna för en första introduktion till den kommande forskningen.

Forskningsledare Geir Endregard, från de norska miljöinstitutet Nilu, föreläste om organisationen och uppdraget.

– Att bedriva forskning är att upptäcka något nytt, förklarar han, och poängterar att detta inte är en övning.

Ytterligare fyra skolor i Kanada, USA och Ryssland har klasser som deltar.

Kartlägga gifter

Det är första gången som skolungdomar deltar i sådan omfattning med det verkliga arbetet. Ungdomarna kommer att vara assistenter, forskarnas händer i verkligheten.

Prover ur naturen, bland annat från fisk, fågelägg och musslor, kommer att samlas in av eleverna.

– Alla deltagande elever kommer göra samma sak, under samma vecka. Därefter lämnas alla prover till Nilu. Och om fyra år beräknar vi ha kunnat kartlägga gifterna och deras skadeverkningar, säger Geir Endregard.

Mycket avancerade mätmetoder behövs för att spåra giftet, som förkortas POP, och Geir Endregard tror att också andra gifter kan upptäckas genom mätningarna. Och eleverna får erfarenhet.

– Eleverna kommer att få en inblick i hur forskningen fungerar. Och projektet är viktigt. Kunskaperna om det här giftet måste bli bättre, vi kan litet om riskerna eller följderna av giftet, säger Geir Endregard.

NÅGOT NYTT. När forskningen blir undervisning förenas nytta med nytta. Och Geir Endregard förklarar att det är ett viktigt projekt som inte kunnat genomföras utan samverkan med skolor från sju länder.

Omöjligt utan hjälp

Han förklarar att projektet, då det spänner över ett mycket stort geografiskt område, inte hade kunnat genomföras utan hjälp från skolorna.

– Vi kommer till exempel behöva 20 fiskar från ett träsk utanför Kiruna, och fisken måste vara färsk vid mätningen. Det hade varit omöjligt utan denna samverkan.

Skolverket applåderar projektet och meddelar att de ser detta som en mycket bra lokal tolkning av kursplanen, och något som verkligen stärker utbildningen.

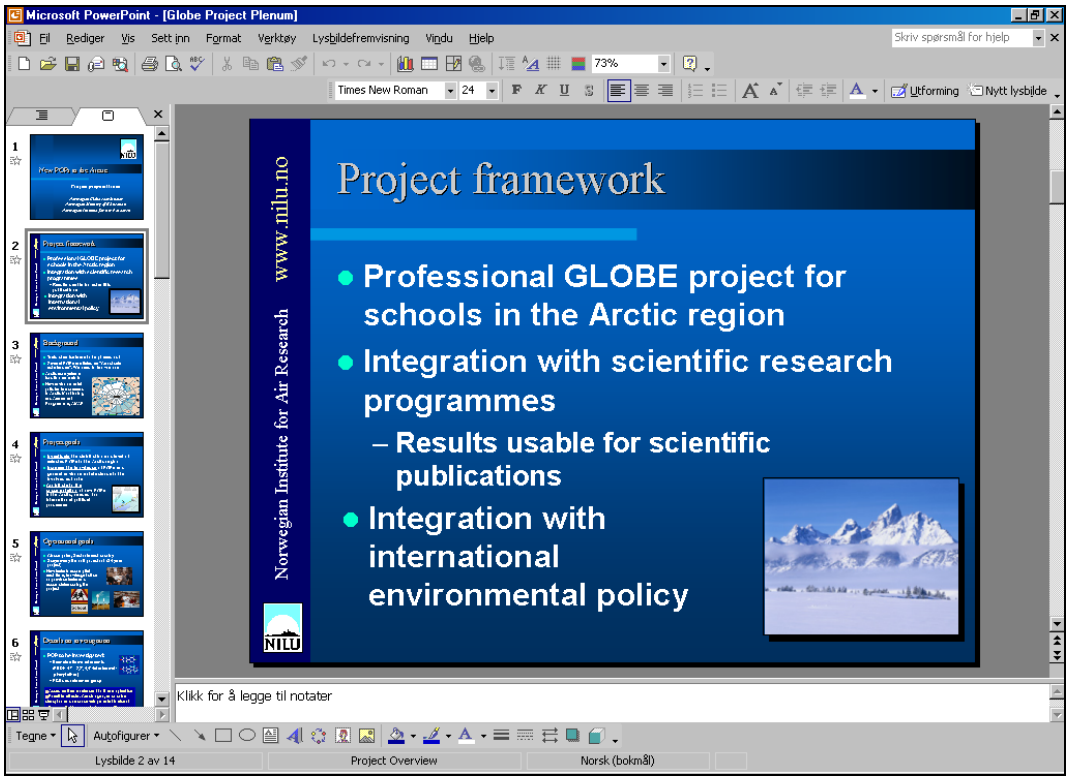
Geir Endregard är hoppfull inför den nya idéen.

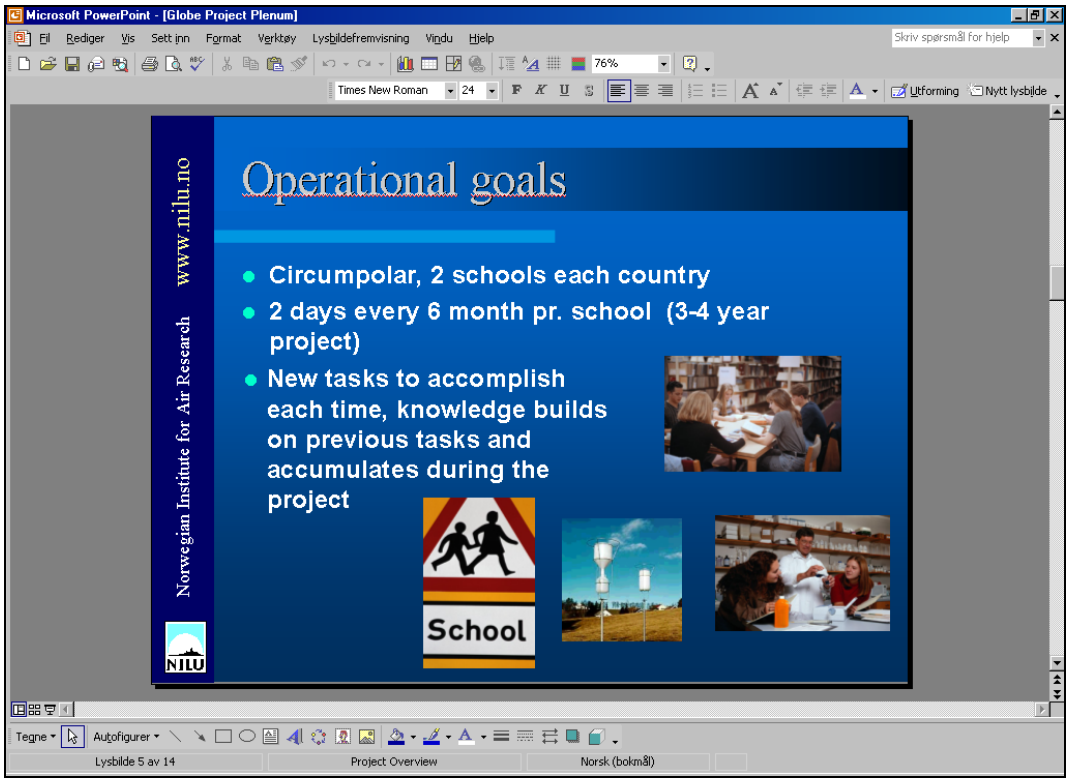
– Det är forskning som fungerar som undervisning, inte omvänt.

Linus Höök
linus.hook@kuriren.com
0980/831 25

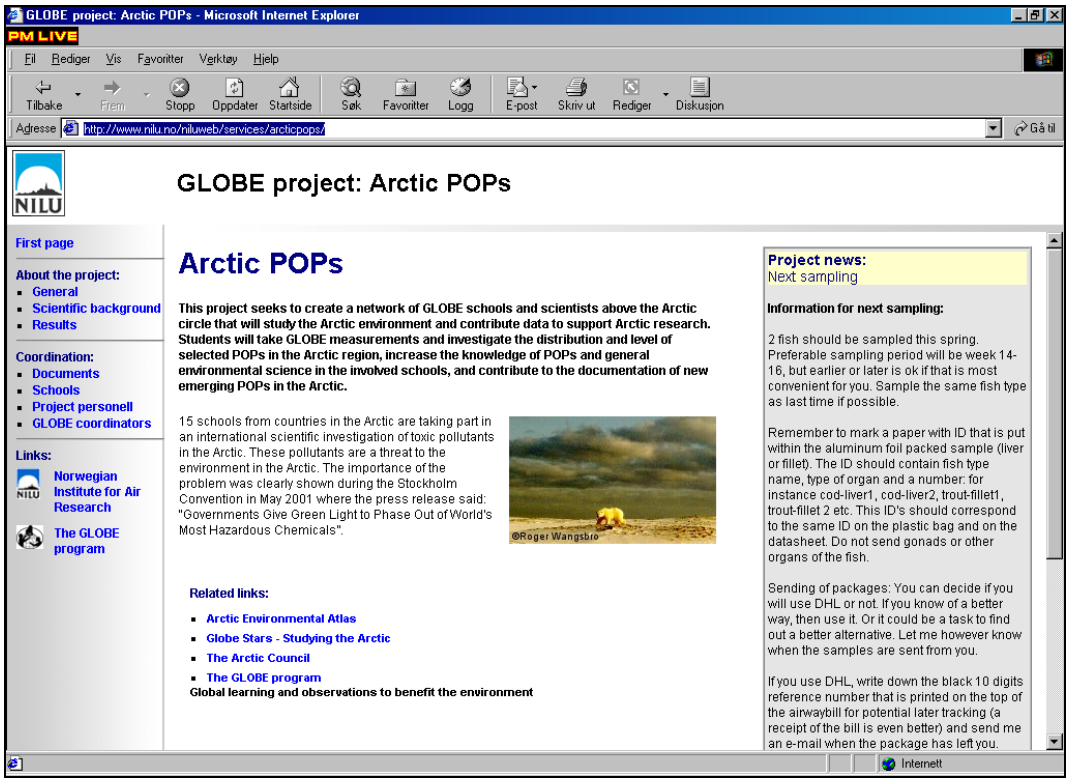
4.2 POWERPOINT-presentations

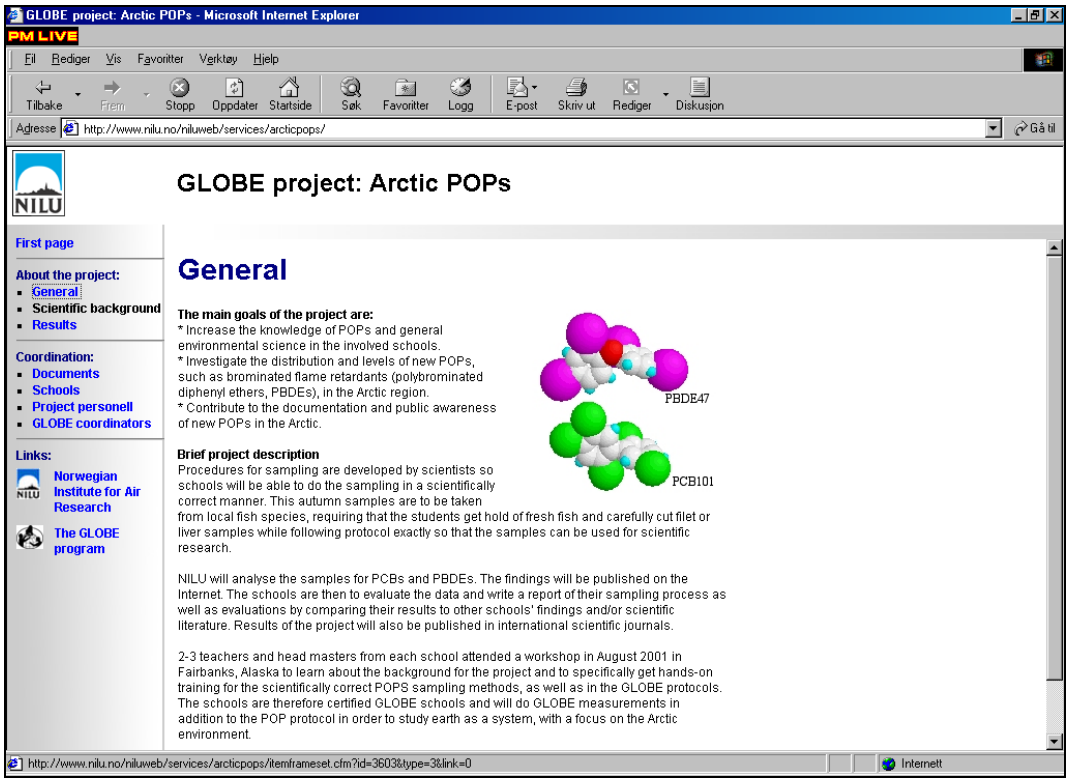
We have designed several Powerpoint presentations for use for the schools. You will find all of them on the CD-rom. Here is one example:

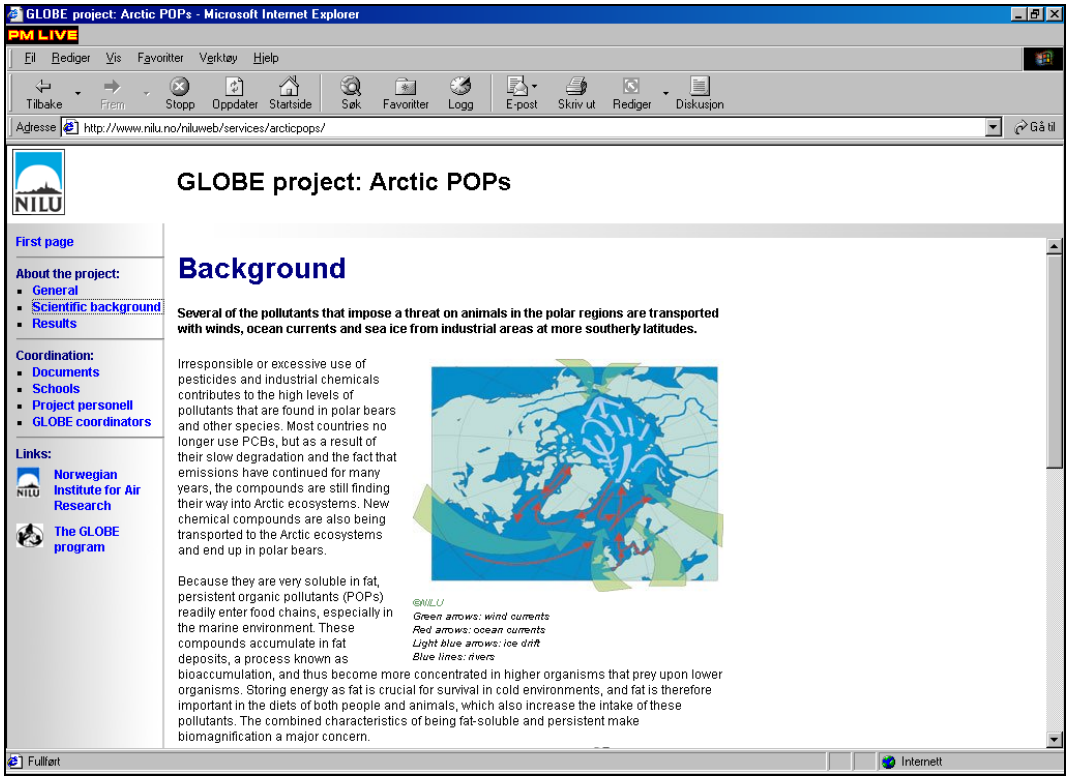




The Home Page for Arctic POP
http://www.nilu.no/niluweb/services/arcticpops/.






GLOBE project: Arctic POPs - Microsoft Internet Explorer
PM LIVE
Fil Rediger Vis Favoritter Verktøy Hjelp
Tilbake Frem Stopp Oppdater Startside Søk Favoritter Logg E-post Skriv ut Rediger Diskusjon
Adresse http://www.nilu.no/niluweb/services/arcticpops/
Gå til
NILU
GLOBE project: Arctic POPs
First page
About the project:
General
Scientific background
Results
Coordination:
Documents
Schools
Project personell
GLOBE coordinators
Links:
Norwegian Institute for Air Research
The GLOBE program
Background
Several of the pollutants that impose a threat on animals in the polar regions are transported with winds, ocean currents and sea ice from industrial areas at more southerly latitudes.
Irresponsible or excessive use of pesticides and industrial chemicals contributes to the high levels of pollutants that are found in polar bears and other species. Most countries no longer use PCBs, but as a result of their slow degradation and the fact that emissions have continued for many years, the compounds are still finding their way into Arctic ecosystems. New chemical compounds are also being transported to the Arctic ecosystems and end up in polar bears.
©NILU
Green arrows: wind currents
Red arrows: ocean currents
Light blue arrows: ice drift
Blue lines: rivers
Because they are very soluble in fat, persistent organic pollutants (POPs) readily enter food chains, especially in the marine environment. These compounds accumulate in fat deposits, a process known as bioaccumulation, and thus become more concentrated in higher organisms that prey upon lower organisms. Storing energy as fat is crucial for survival in cold environments, and fat is therefore important in the diets of both people and animals, which also increase the intake of these pollutants. The combined characteristics of being fat-soluble and persistent make biomagnification a major concern.
Fullført
Internett

5 Poster

Circumpolar project: New POPs in Arctic Collaboration between schools and research institutes

Eldbjørg S. Heimstad[1], Karl T. Hetland[2] and Geir Endregard[1]
[1]Norwegian Institute for Air Research, NO-9296 Tromsø, Norway E-mail: esh@nilu.no
[2]Dalen videregåande skule, 3886 Dalen, Norway

Schools

- Alaska: Anchorage, Kodiak
- Canada: Inuvik, Old Crow, Pangnirtung
- Russia: Apatity, Murmansk
- Iceland: Akureyri, Vestmannaeyjar
- Norway: Leknes, Kjøllefjord, Vannareid
- Sweden: Kiruna, Pajala
- Finland: Tornio

Laestadiusskolan, Pajala, Sweden. Photo: Martin Zingmark

Char from Attagoyuk school, Pangnirtung, Nunavut, Pangnirtung, Canada. Photo: Donald Mearns

Background

- Globe initiative for an Arctic project in 1999
- Globe Norway together with NILU developed a specific Arctic protocol: New POPs in Arctic
- Workshop and start autumn 2001

Project goals

- Investigate the distribution and levels of selected POPs (PBDEs and PCBs) in the Arctic region
- Increase the knowledge of POPs and general environmental science in the involved schools
- Contribute to the documentation of new POPs in the Arctic, needed for international political processes

General work description

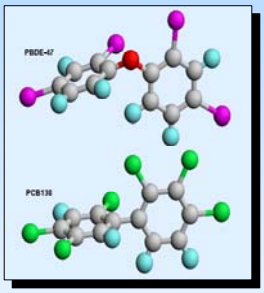
- Schools perform the environmental sampling
- NILU analyses the samples
- NILU publishes results on Internet
- Schools evaluates the results and write reports
- NILU publishes results in scientific journals
- NILU reports relevant findings to AMAP

Protocol 2001/2002

- Scientific correct sampling of fish tissue (liver from cod or fillets from salmonids) with precleaned and burned equipment from NILU
- Biological parameters: length, weight, maturity, otoliths and scales
- Preparing datasheets, marking and packing in a correct way and shipping to NILU
- Documentation with camera
- The autumn fish samples are now analysed by NILU

Web links

- www.nilu.no
- www.globe.gov
- www.nilu.no/web/arcticpops



Happy students with a very nice salmon catch! Laestadiusskolan, Pajala, Sweden. Photo: Martin Zingmark

Filleting and estimation of maturity. Laestadiusskolan, Pajala, Sweden. Photo: Martin Zingmark

6 Participating schools

6.1 GLOBE Arctic POP Schools 2001

Polaris K-12
1444 East Dowling Rd.
99507 Anchorage
Alaska

Phone: 907-742-8700
Fax: 907-561-7023

Age 12-16:
Age 16_19: X

School email: Lyke_mark@msmail.asd.k12.ak.us
School Homepage:

First name	Last name	Email
Denise	Greene-Wilkinson	wilkinson_denise@msmail.asd.k12.ak.us
Mark	Lyke	Lyke_mark@msmail.asd.k12.ak.us
Tania M.	Spurkland	Tspurk@alaska.net

Kodiak High School
722 Mill Bay Road
99615 Kodiak
Alaska

Phone: 907-486-9211
Fax: 907-486-9152

Age 12-16:
Age 16_19: X

School email: Cbaker@kodiak.k12.ak.us or Clam@kodiak.k12.ak.us
School Homepage: http://www.kodiak.k12.ak.us/schools/khs/default.html

First name	Last name	Email
Larry	Le Doux	lledoux@kodiak.k12.ak.us
Craig	Baker	cbaker@kodiak.k12.ak.us
Carla	Lam	clam@kodiak.k12.ak.us

Samuel Hearne High School
Northwest Territories
Inuvik
Canada

Phone:
Fax:

Age 12-16:
Age 16_19: X

School email:
School Homepage:

First name	Last name	Email
Stacy	Applejohn	stacyapplejohn@canoemail.com
Jeff	Szeryk	Jeff@Szeryk.ca
Andrew	Applejohn	andrew_applejohn@gov.nt.ca

Chief Zzeh Gittlit School
Yukon Territory
Old Crow
Canada

Phone:
Fax:

Age 12-16:
Age 16_19: X

School email:
School Homepage:

First name	Last name	Email
Mabel	Tetlichi	
Bob	Sharp	bobsharp5@hotmail.com
Sandra	Newman	snewman@vgfn.net

Attagoyuk School
Nunavut
Pangnirtung
Canada

Phone:
Fax:

Age 12-16:
Age 16_19: X

School email:
School Homepage:

First name	Last name	Email
Donald	Mearns	dmearns@qikiqtani.edu.nu.ca

Pudas School
Hannulankatu 2
95420 Tornio
Finland

Phone: 358-16-432356
Fax: 358-16-432361

Age 12-16: X
Age 16_19:

School email: ilkka.halmkrona@pudas.tornio.fi
School Homepage: http://www.pudas.tornio.fi

First name	Last name	Email
Ilkka Sakari	Halmkrona	ilkka.halmkrona@pudas.tornio.fi
Riitta Kyllikki	Rainio	riitta.rainio@pudas.tornio.fi
Seppo Petteri	Kemppainen	Seppo.kemppainen@pudas.tornio.fi

Verkmenntaskólinn á Akureyri
Eyrarlandsholti
Is 600 Akureyri
Iceland

Phone: + 354-464-0300
Fax: + 354-464-0301

Age 12-16:
Age 16_19: X

School email: vma@ismennt.is
School Homepage: http://www.vma.is

First name	Last name	Email
Benedikt	Barðason	bensi@vma.is
Garðar	Lárusson	gardarl@ismennt.is

Barnaskoli Vestmannaeyja
Við Skólaveg
900 Vestmannaeyjar
Iceland

Phone: 3,544,811,944
Fax: 3,544,811,948

Age 12-16: X
Age 16_19:

School email: barney@ismennt.is
School Homepage: http://vestmannaeyjar.ismennt.is

First name	Last name	Email
Hanna	Fridthorsdottir	sigurh@ismennt.is
Dora Bjork	Gunnarsdottir	dorabj@ismennt.is

Vestvågøy videregående skole
Box 23
8370 Leknes
Norway

Phone: 76 06 43 00
Fax: 76 08 07 76

Age 12-16:
Age 16_19: X

School email: adm@vestvagoy.vgs.no
School Homepage: http://www.lofoten.vgs.no/vvs/

First name	Last name	Email
Arve	Engum	arve.engum@vestvagoy.vgs.no
Johan	Sirnes	johan.sirnes@vestvagoy.vgs.no
Svenn Erik	Odden	svenn.erik.odden@vestvagoy.vgs.no

Honningsvåg fiskarfagskole og videregående skole
Elveveien 1
9790 Kjøllefjord
Norway

Phone: (47) 78 47 60 14 (12)
Fax: (47) 78 49 86 76

Age 12-16:
Age 16_19: X

School email: kjepe@fm.telia.no
School Homepage:

First name	Last name	Email
Sigfred	Andersen	sigfred.andersen@honvgs.finnmark-f.kommune.no
Kjell Helge	Nordal	
Thord Ivar	Karlsen	thordka@online.no

Vannareid skole
Vannareid
9136 Vannareid
Norway

Phone: 77 74 97 00
Fax: 77 74 97 16

Age 12-16: X
Age 16_19:

School email: vannareid@hotmail.com
School Homepage: http://www.geocities.com/Paris/Palais/9561/

First name	**Last name**	**Email**
Asle Harald	Larsen	rektor.vannareid@karlsoy.kommune.no / aslelars@hotmail.com
Stigbjørn	Mårtenson	stikkan46@hotmail.com
Odin	Engamo	randi.odin@c2i.net

Gymnasium 1
House 11, Lenin Street
184209 Apatity Murmansk region
Russia

Phone: (815-55)62464
Fax: 40870

Age 12-16: X
Age 16_19: X

School email: gymnasium1@aprec.ru
School Homepage:

First name	Last name	Email
Lioudmila	Semitcheva	gymnasium1@aprec.ru
Svetlana	Semenova	
Elena	Zarjetskaia	

The Murmansk Vocational Maritime lyceum 6
24, Festivalnaya St.
183001 Murmansk
Russia

Phone: + 7 (8152) 472949
Fax: + 7 (8152) 472949

Age 12-16:
Age 16_19: X

School email: gregor@aspol.ru
School Homepage:

First name	Last name	Email
Oleg Viktorovich	Ovechkin	gregor@aspol.ru / olegat99@mail.ru
Viktoria Arkadievna	Volkova	xr2000@mail.ru
Svetlana	Paikina	

Hjalmar Lundbohmsskolan
Hjalmar Lundbohmsskolan
98185 Kiruna
Sweden

Phone: +46 980-70413
Fax: +46 980-80851

Age 12-16:
Age 16_19: X

School email: hjampis@skola.kiruna.se
School Homepage: http://www.hjampis.kiruna.se/

First name	Last name	Email
Siv	Wiss	Siv.Wiss@skola.kiruna.se
Britt	Holmlund	Bhol@skola.kiruna.se
Sara	Persson	sper@skola.kiruna.se

Laestadiusskolan
Box 73
984 22 Pajala
Sweden

Phone: +46 978 121 53
Fax: +46 978 121 75

Age 12-16:
Age 16_19: X

School email: laestadiusskolan@edu.pajala.se
School Homepage: http://www.pajala.se/

First name	Last name	Email
Lars Olof	Snell	lar00sne@edu.pajala.se
Martin	Zingmark	martin.zingmark@edu.pajala.se
Leif	Johansson	lei00joh@edu.pajala.se

7 Project week

We have received reports from many of the schools about the data sampling. It seem they have had a lot of fun going fishing together with other students.

Here is what Peter Hardy reported:

7.1 Progress report from Inuvik

Just a note to let you know that despite about 16 hours of fishing from 5-12 pm/am in temperatures of -4 to -8C on Wed and Thursday NIGHTS of last week, we only secured one burbot or loche, (a type of cod.). We had hoped for a class catch, one per student, 18-20 for Stacy and her enthusiastic group, we booked the local media and all was set for a big showing.

Unfortunately someone told the burbot and they went off the bite. Mind you, the season for Loche does'nt start for two weeks! None of the local experts thought we would even get one!

Hopefully we will get enough over the next few days as we now have thebest fisher persons from the Gwich'in and Inuvialuit looking for Loche exclusively on our behalf. As well , the Natural Resource Technology Program Students from Aurora College are out fishing again too.

I do have some interesting photos of fishing from boats in an ice filled river with snow falling and of course I have a frozen arse to boot!

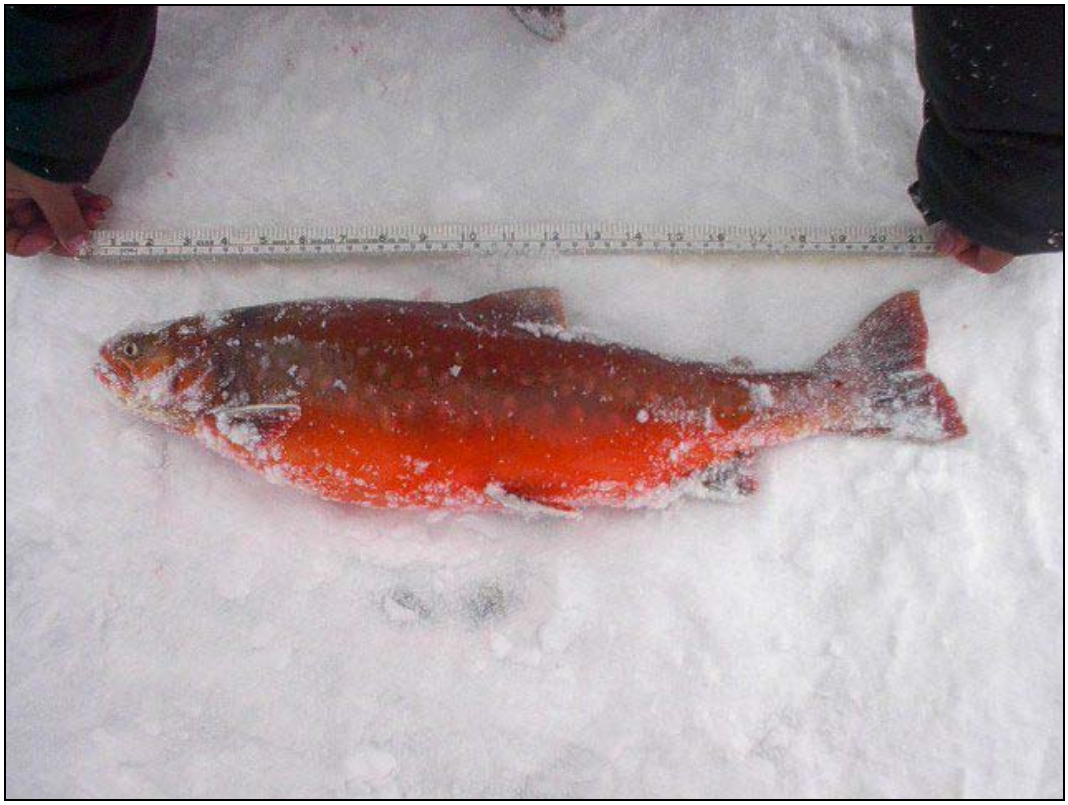
Many thanks, you both must be laughing merrily!
Let me know how others faired,

Pete"

What happened at Nunavut you can see at:
http://www.edu.nu.ca/~attagoyuk/globe.html.

7.2 Attagoyuk Ilisavik is a Globe school

Here are images from our recent field trip to take samples from Arctic Char. Six students, two guides, two teachers and the Canadian Globe Project coordinator traveled to Avataktoo Lake, northwest of Pangnirtung, Nunavut. These samples will be tested for Brominated Flame Retardants a new Persistant Organic Pollutant by NILU. The schools are given the task to identify and sample a suitable fish based on certain criteria. Then to prepare samples for the chemical analysis by cutting and packing defined organs of the fish and send this to NILU. The schools is then expected write a report of their performance of the protocol including the results of their evaluation of the analytic results and submit this on the Arctic POPs web page. Based on all the reports, NILU will look into the most suitable follow-up protocol and prepare it for the next year. Furthermore the results will be used for publications in scientific journals and forums.



Link to the main sites:
NILU: http://www.nilu.no/niluweb/services/arcticpops/
Globe: http://www.globe.gov/.

8 Invitation to countries

Dalen December 11, 2000

To GLOBE Country Coordinators in the Arctic countries

INVITATION
TO
Globe Arctic: New POPs in the Arctic
(POPs = Persistent **O**rganic **P**ollutants)

Refering to earlier information about the project we are happy to formally invite you to take part in The GLOBE Arctic Project.

In the project proposal you find detailed information about the content of the project. More information will be given as soon as we have developed material.

There is some milestones you need to be aware of . First of all we want you to give us feedback on your interest as soon as possible. Look at the timeline in the project proposal.

The schools
We want you to find two schools in the Arctic part of your country. You can find information about Arctic at http://www.arctic-council.org/. We want two teachers and the principal from each school to participate at the first workshop in Fairbanks, Alaska, in early August 2001. Each country must cover the costs for the travel and accomodation at the workshop (CC + six persons). The travel cost will differ, but from Scandinavian countries it will be approx. USD 1200-1500 per person. Accomodation in Fairbanks will be approx. USD 100 per night per person. The workshop will last for 6-7 days, but you will probably need to stay over a weekend due to the air fare. I hope this is enough information for you to put up a budget for your own country.

Scientists
We want you to involve one or more scientist in your country. The scientists shall advise you to implement the project at the schools. NILU develops a list of relevant scientists they know of in each country, whom you can contact. This will be sent you early January. But you are free to

contact scientists you know of yourself. Please give us a name before January 30, 2001.

Application deadline
The final application deadline is January 31, 2001. We will send you an application form in the beginning of January 2001.

We look forward to work together with you in this exciting project and hope to hear from you soon.

Yours sincerely

Karl Torstein Hetland Project coordinator Globe Norway	Geir Endregard Scientific coordinator NILU	Randi Stone Project Supervisor The Globe Program	Astrid Sandås Administrative coordinator Norway

9 Invitation to scientists

Norsk institutt for luftforskning
Norwegian Institute for Air Research

Deres ref./*Your ref.*: Vår ref./*Our ref.*: O-100112/ESH Tromsø, 11th January 2001

Invitation to participate in the GLOBE POPs project

We are pleased to invite you to participate as scientific contact person and adviser for the participating schoolteachers and students in the GLOBE POPs project within your country. This project is a new GLOBE protocol with the emphasis on the study of new persistent organic pollutants (POPs) in environmental samples from the Arctic region.

The GLOBE program
Global Learning and Observations to Benefit the Environment (GLOBE) is a hands-on international environmental science and education program. GLOBE links students, teachers, and the scientific research community in an effort to learn more about our environment through student data collection and observation. The goals of GLOBE are to enhance the environmental awareness of individuals throughout the world; to contribute to scientific understanding of the Earth; and to help all students reach higher levels of achievement in science and mathematics. GLOBE students transmit their data to a central data processing facility via the Internet (www.globe.gov), receive vivid images composed of their data and data from other GLOBE schools around the world, acquire information from a variety of sources, and collaborate with scientists and other GLOBE students and communities world-wide in using these data for education and research.

A new GLOBE POPs protocol
Recently, an initiative by GLOBE and Norwegian Institute for Air Research (NILU) has been made to create a new protocol, GLOBE POPs. The main objective of GLOBE POPs is to investigate new POPs, such as brominated flame retardants (PBDE 47) in addition to PCBs, within the Arctic environment and to do this by establishing collaboration between schools and research groups. Research groups working with the monitoring and analysis of POPs in Arctic are well aware of the need for further studies of both "old" and "new" POPs to enlarge the knowledge of sources, transport, "hot spots" for contamination, accumulation and health risks. This planned project, with the participation of 2 schools from each Arctic country, will give the environmental research community a useful data set covering new POP levels in the Arctic region. From this large data set, the

research communities have the opportunity to evaluate the distribution of POPs throughout the Arctic, to compare the European and American/Canadian Arctic, and to get insight into potential sources and transport routes and the risk for environment, animals and humans. In addition, this study will deliver important information and assessment for political decision-makers.

The main goal of the project are

- Increase the knowledge of POPs and general environmental science in the involved schools.
- Investigate the distribution and levels of new POPs, such as brominated flame retardants (polybrominated diphenyl ethers, PBDEs), in the Arctic region.
- Contribute to the documentation and public awareness of new POPs in the Arctic.

Brief project description

NILU will be responsible for the scientific co-ordination, procedures for sampling and the delivery of sampling equipment to the schools. The scientist will review the program and the protocol developed by NILU and give advice to the schools in their country. Schools (2 from each country) will perform the sampling and NILU will be responsible for the analysis of PCBs and PBDEs in different environmental samples as fish, bird eggs, water etc. NILU will publish the result on the Internet, give comments on the results and give schools new evaluation and reporting tasks. NILU will also be responsible for the publication of the data in international scientific journals and reports to AMAP (Arctic Monitoring and Assessment Program). Suggested timeline is from 2001 to 2004 and three workshops will be organised with the startup workshop in early August 2001 in Fairbanks, Alaska. The invitation to schools will be sent in spring 2001.

There is a fact nowadays that many higher education institutions experience the difficulties to recruit students in mathematical sciences such as chemistry, physics and mathematics. We hope that this project, with the objective to help all students reach higher levels of achievement within environmental sciences, will contribute to engage the students and enlarge their interest for chemistry and environmental sciences. We therefore hope that your scientific group will see the importance and benefit in being part of this project as advisers for the selected schools in your country. As part of this collaboration, access to national data set will be offered.

Sincerely yours,

Eldbjørg Sofie Heimstad
(project leader)

10 Personell

Project management:

Hetland, Karl Torstein
Project Coordinator

Endregard, Geir
Scientific coordinator

Heimstad, Eldbjørg Sofie
Project scientist

Stone, Randi
GLOBE Point of Contact

Country coordinators:

Arzhanova, Irina
GLOBE contact - Russian Federation

Berndtsson Goldbech, Maj-Britt
GLOBE Country coordinator - DENMARK

Brown, David H.
GLOBE Program

Gudjonsson, Johann
GLOBE Country coordinator - ICELAND

Hetland, Karl Torstein
Project Coordinator

McEwen, Catherine
GLOBE Country coordinator - CANADA

Nyander, EvaLotta
GLOBE Country coordinator - SWEDEN

Salmio, Kaija
GLOBE Country coordinator - FINLAND

Sparrow, Dr. Elena
Co-coordinator Alaska

Stone, Randi
GLOBE Point of Contact

11 Funding

The project is funded by a multiple of sources:

External:
The Barents Secretariat: 16.600
Ministry of Education: 31.600
Ministry of Foreign Affairs: 8.300
Ministry of Environment: 8.800
Environmental Office US Embassy Copenhagen: 15.000

Internal:
NILU: 15.000
GLOBE US: 35.000

All figures in USD (NOK conversion to Dollar used 1 : 9)

Total budget for 2001 was: 130.300 USD

The costs are generally for the scientific and support work, sampling equipment and chemical analysis by NILU, and practical support and coordination by GLOBE Norway and conference expenses as well as travels and accommodations for the school representatives.

Financial reporting is done directly to each funding institution based on individual rules, and the budget was generally spent as planned.

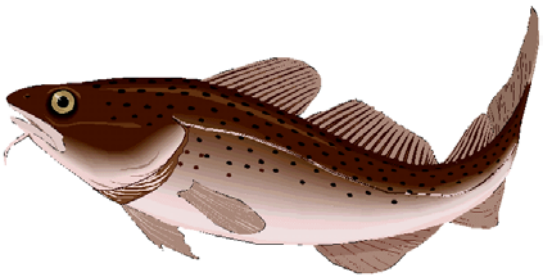
The GLOBE Program: Arctic POPs
Protocol 1: PCBs and PBDEs in local fish

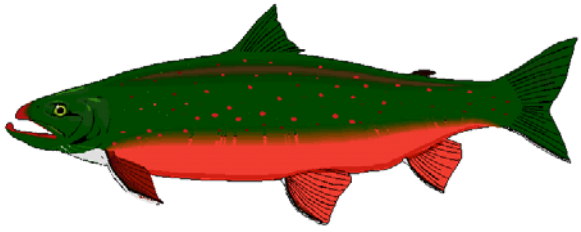
The GLOBE Program

Arctic POPs

Protocol 1: PCBs and PBDEs in local fish

Fall 2001





Content

1 Introduction to FISH POPs Protocol

The purpose of this protocol is to investigate the level of selected PCBs and brominated flame retardants in fish used for local consumption in the various Arctic countries. For PCBs we do expect to find relative high levels due to existing scientific investigations, but on the flame retardants we do not know if we will find them at all in measurable quantities. So this first protocol in the Arctic POP project will give us a broad screening on what to expect and thereby help us setting up the protocols for the coming years.

The fish POP protocol consists of 4 main phases:

- **Phase I: Fish sampling**
- **Phase II: Chemical analysis**
- **Phase III: Evaluating results**
- **Phase IV: Writing**

Phase I, III and IV are done at the school, while phase II is done at NILU in Norway, but there is a full description on what is being done given in the protocol suitable for teaching options.

Short description of each phase:

Phase I: Sampling
The schools are given the task to identify and sample a suitable fish based on certain criteria. Then to prepare samples for the chemical analysis by cutting and packing defined organs of the fish and send this to NILU. A specific sample sheet is to be used in the process.

The sampling is to be one by all involved schools in the same predefined week.

Phase II: Chemical analysis
NILU analyses the samples in during 8 weeks time and submits the results on the web pages.

Phase III: Evaluating results
Each school will then be given a specific task in evaluating their results. Either compared to other schools or scientific literature.

Phase IV: Writing
The schools should then write a report of their performance of the protocol including the results of their evaluation of the analytic results and submit this on the web page.

Based on all the reports, NILU will look into the most suitable follow-up protocol and prepare it for the next year. Furthermore the results will be used for publications in scientific journals and forums.

The GLOBE Program

Arctic POPs

Protocol 1: PCBs and PBDEs in local fish

1.1 Phase I: Fish sampling

The Phase I of the protocol, fish sampling, consists of fish catching, recording data, high quality sample preparation and to collect biological data. The fieldwork is to get suitable fish, record sampling location data and taking photos. Sample preparation and recording biological data may also be done in the field or at the school. Packing and freezing the samples should also be done in a scientifically correct way before shipping the samples to NILU in Norway.

The recording of data is to be done by filling out a sampling data sheet.

Objectives

The purpose of this part is to find a good representative fish for this project, to prepare samples in a scientifically correct manner and to record all relevant information useful for the evaluation of the results. The ID of the sample is the most important parameter that should follow the sample when packing and to be filled in the datasheet for each of the 3 fish. The ID should tell the name of the species, the number 1, 2 or 3 and what kind of sample. Examples: cod1-liver, cod2-liver, cod3-liver or salmon1-muscle, salmon2-muscle or salmon3-muscle.

Field work

The schools are to identify a suitable local fish and then either catch it themselves by ordinary equipment or get it from local fishermen. The fish must be fresh when retrieved and the sample preparation should preferentially be prepared in the field or at school the same or the next day (store refrigerated). Fish from fish farming is not an option; it must be wild fish.

Which fish and location to choose

The selection of fish should be as close as possible to the following criteria:

Species	**cod, salmon, trout or char.** If none of these are relevant for you, choose the most common fish type for local consumption in your community.
Sample type	The purpose of fish sampling is to have a representative organ to analyze POPs. Salmonids (salmon, trout, char) are fat-rich fish, where the muscle (fillet) is a representative sample, whereas cod is a lean fish where liver is a representative fat-rich organ for the analyses of POPs.
Size	2-3 years old fish, preferable female Find out by local expertise what this age corresponds to of length and weight of the fish.
Number	Get at least 4 fishes of same species. 3 are to be used for sample preparation, and it is nice with one extra to test the protocol on. Remember, if you are testing fillet cutting or removal of liver on the test fish, use your own equipment and not the equipment sent by NILU.

Fishing equipment	Use ordinary available fishing tackle as rod, line etc. As clean equipment as possible.
Type of water	It can be either fresh water or salt water
Surroundings	The absolute best is an area away from local industry and sewage discharges. We want to know the background level in your area.

Fill out datasheet

Please ensure to have all necessary facts to fill out relevant parts of the sampling data sheets. The one page "Field-Datasheet" is to be used when performing the protocol for each of the 3 fish. Use pencil to fill in the "Field-Datasheet" during fieldwork outside (in case of rain). Use this one-page "Field-Datasheet" to finally fill in the large 5 pages "Sample Datasheet" afterwards for each of the 3 samples. However, put both "Field-Datasheet" and "Sample Datasheet" for each fish in one plastic bag before sending. Take photos when performing the different parts of the protocol!

OBS! A separate sampling data sheet is to be completed for each of the 3 samples!

Sampling should be done in week 41.

Sample preparation in the field or at school:

All schools should do the sampling in week 41 (8.-12.10.01)

Equipment

Balance(s) for total body weight and possible gonad weight
Square (angle iron) or similar equipment for measuring total length
Gloves,
One scalpel handle for each fish,
One scalpel blade for each fish,
One pair of scissors for each fish,
One large pair of forceps for each fish,
One knife and one small pair of forceps for otoliths for all 3 fish,
Aluminum foil (plastic free foil),
One page datasheet for each fish sample,
One 5 pages Sample datasheet for each fish sample
Camera
White paper, pencil, permanent pen
2 ziplock plastic bags for each fish; one for the sample and one for the two datasheets and scale envelope.

Note: Students should not attach or change scalpel blades due to the very sharp blades.
The teachers are responsible for attaching scalpel blades to the scalpel handlers.

It is very important not to mix the equipment used for sample preparation of the 3 fish.
If necessary, mark the 3 scalpel handlers, 3 large pair of forceps and the 3 pair of scissors with fish1, fish2 and fish3, respectively. You can write on some tape and put it on parts of the equipment that is in contact with your hands and not the sample.

The protocol can be performed at the same day out in the field at the sampling site. Remember to have the datasheet and camera available out in the field. Also, remember to measure the total body weight (and the total length) before cutting the samples. The preparation of samples in field is most important for salmonids to avoid contamination of the surface layer of the muscle tissue during handling and transport. If necessary, the samples may be cleaned with ambient water, that is the same water as they came from.

If the sampling preparation is not possible at the same day the fish are caught, keep the fish cold in the refrigerator or frozen to the next day. The filleting may actually be easier when the surface layer of the muscle tissue is half frozen. This may also be the case for removal of the cod liver. We would anyway prefer that the preparations of samples are done the same day the fish are caught. The students can test the protocol by using some additional "test fish", but remember not to use the same scalpel handlers, scalpel blades, scissors and large forceps that are to be used for preparation of the 3 fillet or liver samples.

Cover all areas as cutting boards and balances with aluminum foil that will be in contact with the fish and change after each fish. If the samples are prepared of frozen or partially frozen fish, do the sampling quite fast and immediately transfer the packed and marked samples to the freezer (-20 °C) to avoid water and fat loss during potential melting.

Salmonids (salmon, trout, char)

Sample preparations of the salmonids should preferentially be performed out at the sampling site to avoid unnecessary transport that may contaminate the surface layer of the fillet. **Remember to measure the weight of the fish before cutting the fillets**. If transported to the school before sample preparation, cover a washed and clean stainless steel bucket or similar equipment with aluminum foil, wrap aluminum foil around each fish and put them into the bucket.

Cod or similar fish

Cod and similar lean fish where the internal organ liver is the representative sample, can be transported to the school for sample preparation without taking any strong precautions about contamination. Although, we will recommend that the fish are wrapped into aluminum foil before they are put into plastic bags or buckets for transportation.

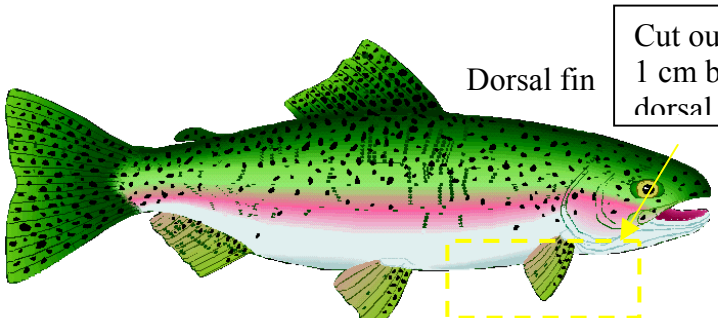
Procedure for sample preparation

DO NOT MIX THE EQUIPMENT FOR THE 3 FISH!

1. Measure **total body weight** of the fish before you do anything else. Use gloves. Avoid touching the fish where the fillet (muscle) of salmonids should be cut.

2. The **total length** (the distance from the most anterior part of the head to the tip of the longest caudal fin ray) of salmonids may be measured after filleting if contamination is potential. For cod, measure the total length before sampling the liver. Use squares, angle iron or similar equipment to be able to measure the total length correctly (see Appendix).

3. ***For salmonids***: cut a fillet (~ 100 g or more) beneath the right dorsal fin. If the fish is small, cut out fillets on both sides. Use one new scalpel blade and pair of forceps for each fish, and immediately transfer the sample to aluminum foil and close properly.



4. ***For cod***: Carefully cut the fish open with a **pair of scissors** up from the anus to the bottom of the jaw, taking care not to cut into the fish's internal organs. Also avoid cutting into the gall bladder nearby the liver. **Remove the liver** of each fish.
   Use the forceps to handle the liver for each fish, avoid touching the liver with the hands, and immediately transfer the sample to aluminum foil and close properly.

5. Put a **pencil written paper** with **ID, Name of School and Date** on top of the closed foil packed samples and wrap around more aluminum foil so the sample is fully covered. Write the ID, Name of School and Date on a ziplock plastic bag with a permanent pen before putting the foil packed sample into it. Carefully check that the sample is fully covered by foil and that nothing of the sample is in directly contact with the plastic. Close the plastic bag properly. Do this for each of the 3 samples. Put the samples immediately in the freezer. **The samples (3 fish fillets or 3 fish livers) should be kept frozen at –20^{o} C before sending. Do not forget to put the freezing elements into the freezer before or at the same time you freeze the samples.**

6. Open the fish with a pair of scissors, find the gonad if it is visible and measure the length of the gonad. If possible, measure the weight of the gonad. If the gonad is very small, this would require a fine (letter) balance. See Appendix for more information. Fill in the datasheet.

7. If possible, try to sample the otoliths. Wrap soft paper around them and put them into the scale envelope. If you cannot find the otoliths then sample fish scales, see appendix for preferred areas of salmonids. Scales should be sampled for pacific salmon. Put the scales in the same envelope as the otoliths. Write in the information on the scale envelope. The ID is the very most important parameter. Put the filled in datasheet and the fish scale envelope for each fish sample into a plastic bag and lock it.

Documentation

In general, it is desirable to have real hands-on documentation for practical projects like this you perform in the field and at school. Therefore, a pocket disposable camera will be sent together with the equipment for this purpose.

Following events should be taken pictures of:

- Sampling site
- During fishing (or of fishermen/women)
- Biological data – picture of the internal organs
  - Fish lying next to measuring tape
  - Fish during weighting
  - Cutting of fillet or liver
  - Dissection of head for otoliths

- Length of gonad (gonads lying next to fish)
- Packing and marking samples

This will require approximately 12-14 pictures. The rest of the pictures on the film can be taken as the class/school choose, and a set of all pictures will be sent back to the schools after the film is developed.

Sending the fish samples

Put the 3 plastic bags with foil packed fish samples into the polystyrene box. Add cooling or freezing elements into this box to keep the samples at as low temperatures as possible during transport. If enough space in the box, put the 3 plastic bags with the datasheets and envelope on the top of the polystyrene box. Close the box with solid tape. If not enough space, put them into a large envelope. The box and eventually the large envelope are now ready to be picked up by courier service.

Sending by Courier

NILU is setting up courier service for this project and will provide information how this will going to be done at each school. The courier service will be prepaid and the courier agency will pick the polystyrene box at the school during opening hours and twill then ensure an express delivery directly the laboratory of NILU. All the details for this service will be available on the Internet web page for the project and also by e-mail.

Sending the equipment

Wash the 3 scalpel handlers, the 3 large pair of forceps, the small pair of forceps, the 3 pair of scissors, dry them and wrap some clothing or paper around to avoid sharp edges from the small pair of forceps, scissors etc. Pack it securely and put the equipment into some ordinary cardboard box and send it to NILU by mail.

Address: NILU, Norwegian Institute for Air Research
Polar Environmental Centre
Hjalmar Johansens gt. 14
NO-9296 Tromsø, NORWAY

Contact and questions:

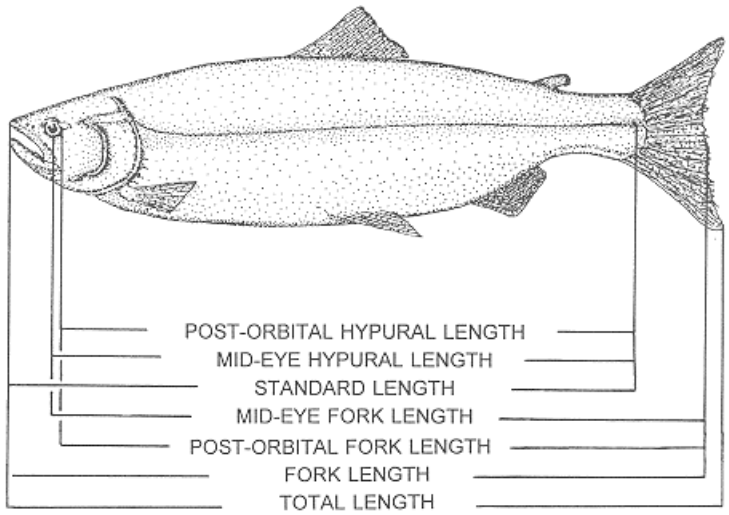
Dr. Eldbjørg Sofie Heimstad
Tel. (direct) +47 77 75 03 84
Tel. (switchboard) +47 77 75 03 75
Fax. +47 77 75 03 76
E-mail: Eldbjorg.Sofie.Heimstad@nilu.no

1.2 Appendix to Phase I

Length of fish

Source: Fisheries and Oceans Canada

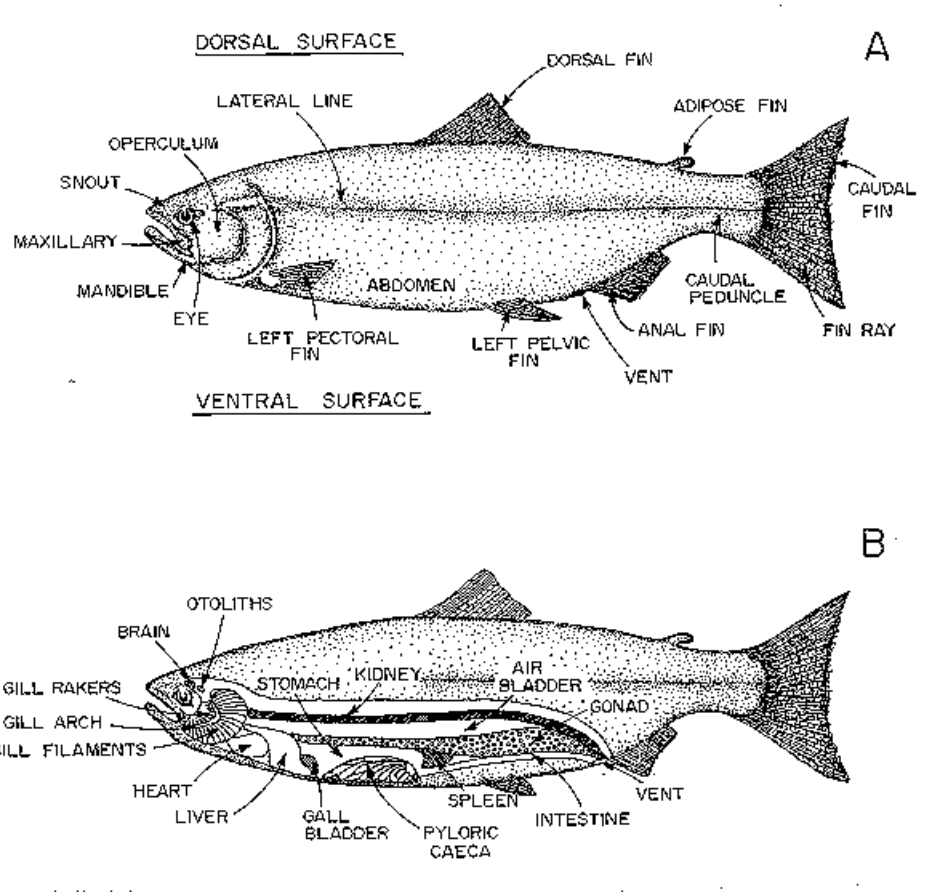
Measure the TOTAL LENGTH of the fish



Anatomical Features of a Typical Salmonid

Source: Fisheries and Oceans Canada

Locate the liver, gonad and otoliths on figure B.



Additional fish data: Gonads, otoliths and scales

The removal of gonads and otoliths is done after you have sampled the fillet or liver. This part does not require sterile equipment since neither otoliths nor gonads are used in chemical analysis of organic pollutants. A knife may be better than a scalpel for the dissection of the fish head. Use the small forceps to remove the otoliths from the cranial grooves.

The gonad of female fish is the ovary (hard roe/spawn) and the testis (milt) of male fish. The maturation stage (length and weight of gonads) and age (otoliths, scales) will provide important information for use in scientific evaluation and comparison of POPs levels in fish. However, otoliths may be difficult to locate and to remove, and the gonad may be absent if the fish is very young. If the gonad is very small, a small letter balance may be necessary for determining the weight. The weight is therefore optional, but please measure the length with a ruler if the gonad is visible. The gonads for immature fish appear as thin ribbons of tissue only a few centimeters in length with almost no volume. As the fish grows and matures the gonads elongate and the testes and ovaries become easily distinguishable. The ovaries will have a granular appearance (developing eggs) in comparison to the testes, which will appear smooth and whiter in color than the ovaries. The ovaries eventually take on a red or light orange color while the testes will appear translucent to white. Use the Maturity figure in Appendix to estimate if the fish is immature, mature or spent and mark the sample datasheet with Mature, Immature or Spent, also use the code I-V if desirable. Shortly described; the fish is approximately mature if the ovaries or testis fill up more than the half of the body cavity.

Female/male

The sex can be easy to determine. Among most fish types the female fish has yellow or orange ovaries where one can find some eggs. The eggs can be just tiny small corns until 5 mm in diameter. The testicles of the male fish are usually less colorful and the content is more homogenous in structure. For younger fish where the gonads hardly can be seen, the sex does not matter.

For more detailed information on maturity, otoliths and scales:
Biological Sampling Manual for Salmonids, Chapter 2 - Biological Event Attributes
http://www.pac.dfo-mpo.gc.ca/ops/biosample/chapt_2/biologic/biologic.htm

If the school wants to do an age determination from otoliths, catch one additional fish for that purpose. A good idea is to take contact with a freshwater-/marine researcher if not the knowledge and equipment for age determination is present within the school. This is however an optional task since NILU will be responsible for the age determination.

Schematic outline of the maturity, trout (salmonids)

Use this figure to estimate the maturity of the fish.

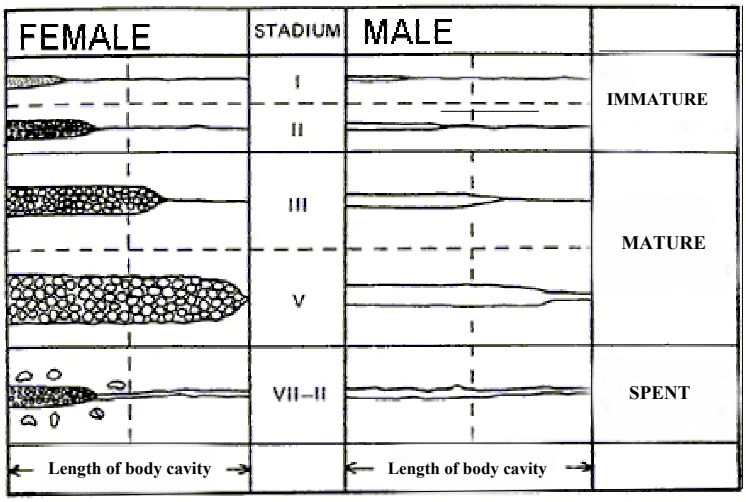


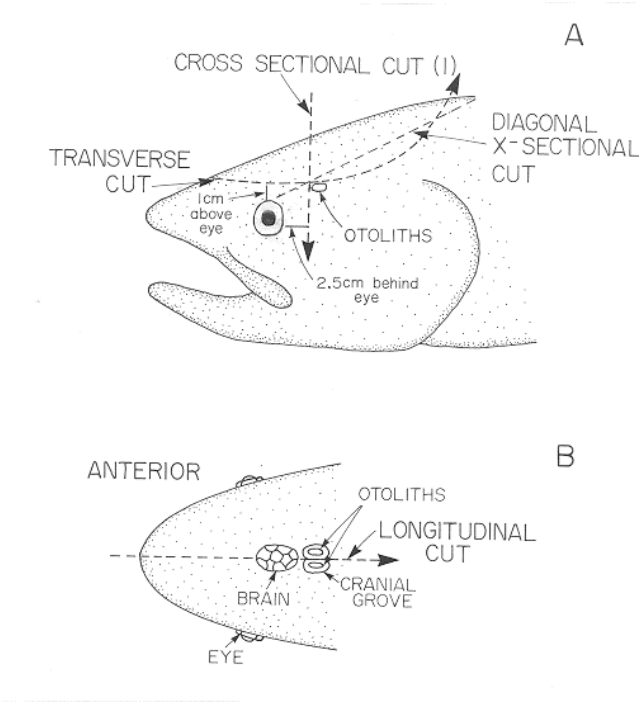
Figure adopted from
http://miljolare.uib.no/fagstoff/vann/artikler/kompendier/fiskekompendiet/kjonnsmodning.php

and translated into English

Otolith location and removal in salmon

Source: Fisheries and Oceans Canada

Otolith removal; **A)** the 3 common cuts used to remove the paired otoliths from the cranium; and, **B)** the otoliths are located in cranial grooves directly behind the brain.



There are many ways to remove a pair of otoliths. Here is one way:
See: http://www.mar.dfo-mpo.gc.ca/science/mfd/otolith/english/remove.htm

1) Use a knife with at least a 15-20 cm blade. It should be as sharp as possible. You'll also need a pair of forceps or tweezers about 10 cm long.

2) Grip the head of the fish by putting your thumb and forefinger in its eye sockets (it IS dead remember!). Lay the body of the fish on a counter with the tail pointing away from you.

3) Put the knife blade on the top of the fish's head about 1 eye diameter behind the eyes. Slant the blade AWAY from you, at about a 30° angle.

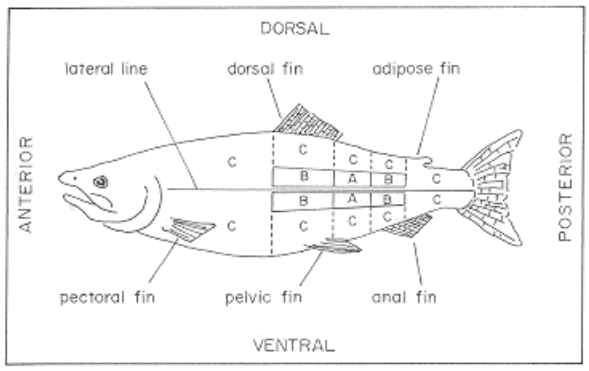
4) Slice back and down about one head length. You should feel the knife cut through the top of the skull. For flatfish and some other species, a vertical cut through the top of the skull directly over the preopercle (the curved line 3/4 of the way back on the gill flap) also works well.

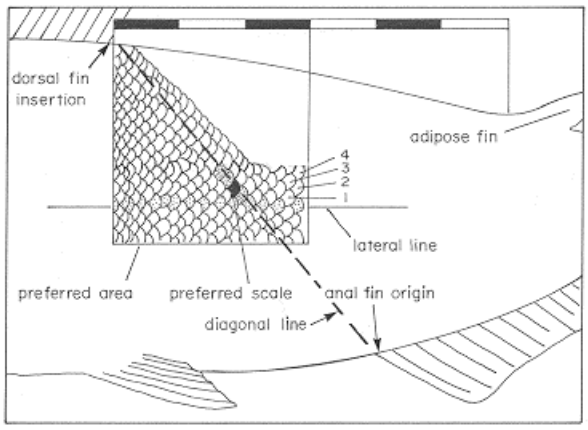
5) Check to see if you've cut the top off the skull. If you haven't, make another slightly deeper cut. An ideal cut removes the top of the skull, revealing the full length of the soft white brain underneath. Note that the brain joins the much narrower (but still white) spinal cord at the rear. Once the brain is visible, expose the brain even more by pressing the nose and body down and towards each other. This should "snap" a portion of the skull, and push the brain and otoliths up. Very often, this exposes the otoliths and allows them to be removed immediately.

Preferred areas for scale removal for salmonids

Source: Fisheries and Oceans Canada

A) area A is the primary preferred area; area B is the second preferred area if no scales in area A; and, area C is the non-preferred area. B) Close up of the preferred area with the preferred scale in solid black. It is located 2 rows up from the lateral, on a diagonal from posterior the dorsal fin insertion to the origin of the anal fin.





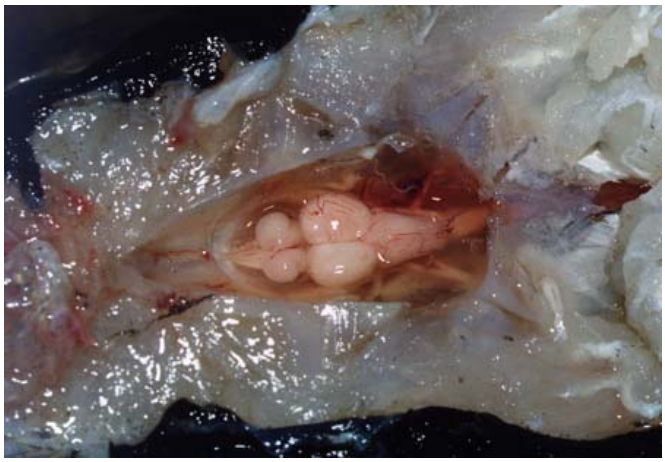
Dissection of cod head – location and removal of otoliths

1. The head is ready to be examined

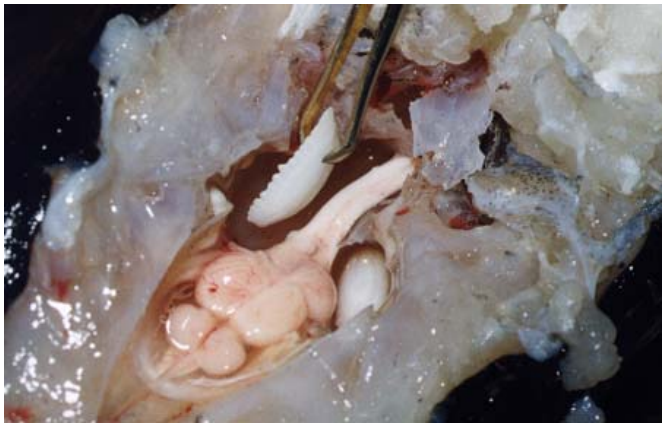
2. Cut thin slices of the forehead from the eyes and backwards

3. The first cut

4. After 2-3 thin slices one can see the brain



5. The brain with membranes and fluid



6. Otoliths are part of the fish vestibular apparatus and reside in the cranial cavity. They are composed of calcium carbonate and protein and are formed by the process of biomineralization. Otoliths function as sound receptors and are also used by the fish for balance and orientation.
Otoliths can provide useful information on age, growth rate, life history, recruitment, and taxonomy.

Adopted from
http://www.miljolare.uib.no/fagstoff/vann/artikler/dyr/marint/torskehode.php (in Norwegian)

Learning activities

A.. Fish and biology links

Links marked with stars are recommended

Biological Sampling Manual for Salmonids
Source: Fisheries and Oceans Canada
Chapter 1- Adult Species Identification
* http://www.pac.dfo-mpo.gc.ca/ops/biosample/chapt_1/chapt_1.htm
Chapter 2 - Biological Event Attributes
* http://www.pac.dfo-mpo.gc.ca/ops/biosample/chapt_2/biologic/biologic.htm
Color plates of different salmonids:
* http://www.pac.dfo-mpo.gc.ca/ops/biosample/chapt_1/chapt_1.htm
Useful figures:
* http://www.pac.dfo-mpo.gc.ca/ops/biosample/chapt.htm

Fish (good educational background and nice pictures):
*
http://www.school.discovery.com/homeworkhelp/worldbook/atozscience/f/198340.html

External and internal anatomy of a salmon:
* http://www.state.ak.us/adfg/sportf/region2/ie/anatomy.pdf

FISH SAMPLING PROCEDURES:
* http://www.for.gov.bc.ca/ric/pubs/aquatic/fishcol/fish-3.htm#fish.3.3

Fishbase:
http://www.fishbase.org/home.htm

Fish links:
http://www.newberg.k12.or.us/ey/html/fishlinks.html

http://www.odysseyexpeditions.org/indexfh.asp

Classroom salmon dissection:
http://www.state.ak.us/adfg/sportf/region2/ie/dissectn.htm

Getting into a fish:
http://www.northcoast.com/~fishhelp/edu_f/dissect.html#external

Atlantic salmon:
http://www.asf.ca/Overall/atlsalm.html

Fish anatomy:
http://www.enchantedlearning.com/subjects/fish/printouts/Fishcoloring.shtml

Fish-age determination:
http://www.wh.whoi.edu/fbi/age-man.html

How should you clean and cook fish that might contain PCBs?:
http://sites.state.pa.us/PA_Exec/Fish_Boat/qpcb2000.htm

Links to marine biology:
http://www.meer.org/

General Biology links
http://education.zefex.com/biology2.htm
http://www.nsta.org/onlineresources/site/

The school page - The Educator's Resource:
http://www.theschoolpage.com/

B. POPs links

AMAP
http://www.amap.no
i) Click on: AMAP's Assessment , SOAER Text (HTML)
ii) Click on: Online documentation, AMAP Fact Sheets and AMAP/ACAP project reports

Bromine Science & Environmental Forum
http://www.bsef.com/

An introduction to brominated flame retardants
http://www.ebfrip.org/download/weeeqa.pdf

The PBDEs: An Emerging Environmental Challenge and Another Reason for Breast-Milk Monitoring Programs
http://ehpnet1.niehs.nih.gov/docs/2000/108p387-392hooper/hooper-full.html

Brominated flame retardants -endocrine disruption
http://website.lineone.net/~mwarhurst/bfr.html

Describing the Flows of Synthetic Musks and Brominated Flame Retardants in the Environment: A New Ecotoxicological Problem?
http://newstrategy.ecotox.lu.se/Publications/AtSIntrou.html

The Swedish National Chemical Inspectorate, "Phase out of PBDEs and PBBs", mars 99. http://www.kemi.se/aktuellt/pressmedd/1999/flam_e.pdf

BRIEFING NOTE ON PERSISTENT ORGANIC POLLUTANTS (POPs)
http://irptc.unep.ch/pops/iccappops.html

The Arctic Council
http://www.arctic-council.org/index.asp

Contaminants in Alaska
http://www.state.ak.us/dec/deh/contaminants.htm

What is ecotoxicology?
http://www.pestmanagement.co.uk/special/ecotox/eco_int.html

Physical-chemical properties of POPs
http://www.es.lancs.ac.uk/kcjgroup/model.html#PCHTML

US EPA- Pollutants/Toxic
http://www.epa.gov/ebtpages/pollutants.html

The GLOBE Program
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Protocol 1: PCBs and PBDEs in local fish

1.3 Phase II: Chemical analysis

Homogenization First the fish sample (min.5 g liver, 10-25 g muscle, depending on the lipid content) is cut into small pieces and mixed with sodium sulfate in a conventional food processor. This is to dry and to increase the surface area of the sample. The simple combination of sodium sulfates high capacity to bind water in combination with mechanic homogenization lead to the sample dryness as well as accessibility of the compounds for extraction.	

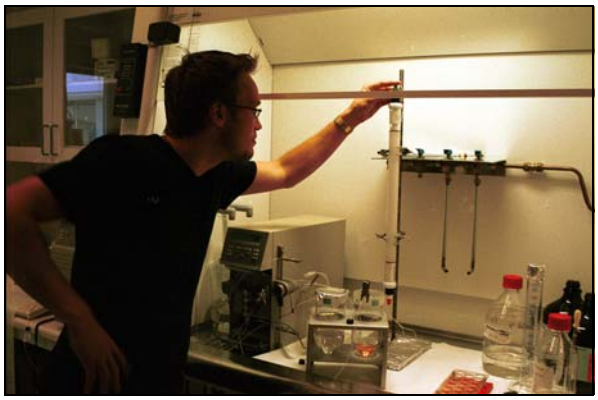
Extraction

A part of the homogenized sample is added internal standard. An internal standard* is a compound that resembles the analytes as much as possible. It is used for quantification of the analytes, and then also for correction of losses during sample preparation. The fat is then extracted with an organic solvent, a mixture of cyclohexane and ethyl acetate. PCB and PBDE, along with all the other halogenated organic pollutants, are fat-soluble.

*At NILU we use stable isotope labeled PCBs and pesticides in the preparation and quantification. That is: analyte and internal standard are the same but the carbon atoms in the internal standard are substituted with 13C carbon atoms.

Fat removal

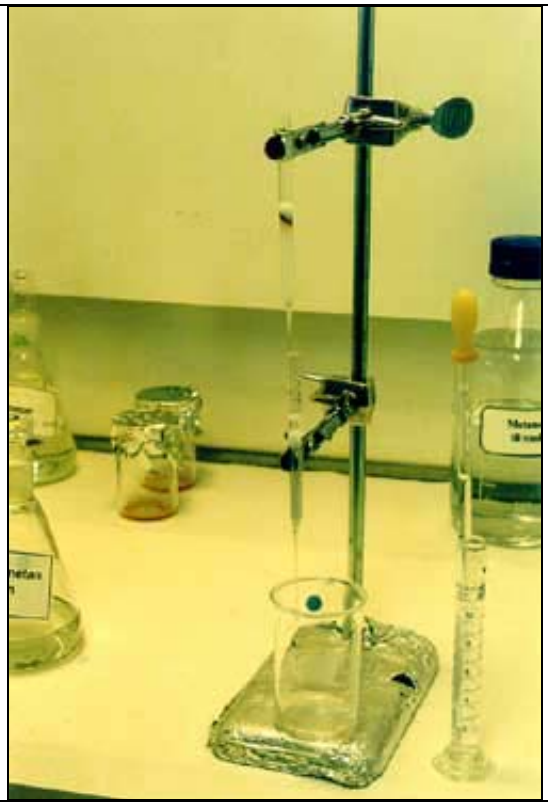
The sample extract has to be cleaned before it is possible to analyze it. The first step is to remove fat, without removing analytes. This is done by Gel Permeation Chromatography (GPC), a very common fat removal system. Chromatography means in this case separation. The sample is put onto a column, filled with a porous packing material (a polystyrene polymer), and pushed through the column by organic solvents. The different components of the sample are roughly separated according to molecular size, and fat comes out first.



Final cleanup

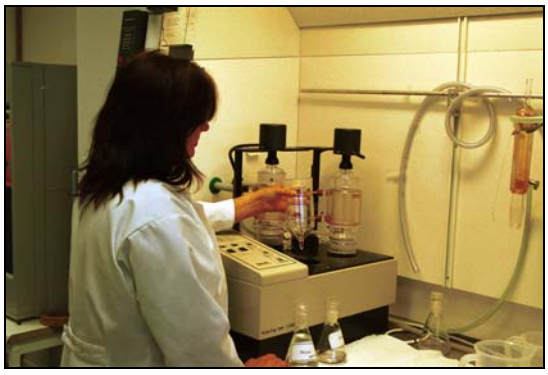
Biological materials contain fat, proteins, peptides etc, which disturb the analytical procedure. These substances must be removed before trace analysis takes place.

The final step, in the cleanup of the samples, is chromatography on a column system filled with aluminum oxide. The remaining compounds that could be a problem during analyses will be removed in this stage. Analytes are being pushed through the column with organic solvents.



Volume reduction

The volume of this cleaned extract has to be reduced so that the concentrations of the analytes are high enough to be detected. A system that vaporizes and removes the organic solvents is used here. The analytes will not disappear in this case because their boiling points are much higher than the organic solvents. The samples are now ready for analysis, and are added a recovery standard. This standard is used for determination of the recovery of the internal standard, which was added before cleanup.



Analysis and quantification The samples are then analyzed on a gas chromatograph coupled to a mass spectrometer. This is probably the most common system used for chemical analyses. The samples are quantified by comparing the areas under the peaks in the chromatograms of the samples and the standards.	

After extraction a volume of about 150 mL is reduced to 0.5 mL there are several reduction steps during a sample preparation. Before quantification the extract (ca. 20 mL) is reduced again to 0.2 mL. In general the volume reduction during the sample preparation process is about **10 000 x**.

The GLOBE Program
Arctic POPs

Protocol 1: PCBs and PBDEs in local fish

1.4 Phase III: Evaluation of analytical results

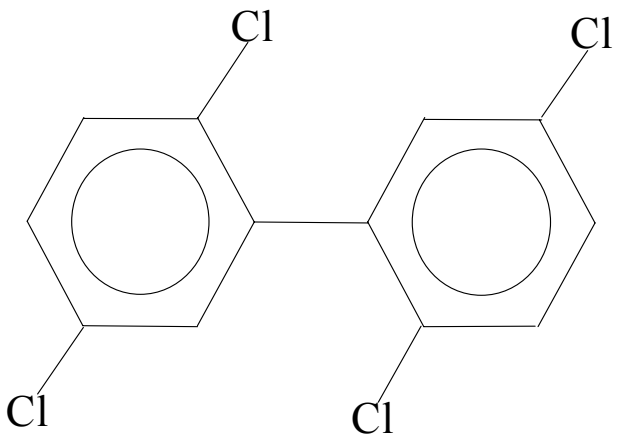
When phase II (Chemical Analysis) is done, the result for each sample will look like the pages attached. (Appendix 1 for the PCB isomers and appendix 2 for the Brominated flame-retardants). What we in this protocol is looking for is twofold:

1. The level of well-known POPs. PCBs which we know are distributed in the whole Arctic ecosystem
2. The level of "new" POPs. Brominated flame retardants, which we do not know if exist in the entire Arctic ecosystem, part of the ecosystem or not.

Compounds selected

Both of these compounds, PCBs and Brominated flame retardants, are not one specific type of chemical but group of chemicals with very similar chemical structure (for PCBs there are 209 different molecules (congeners).

Figure 1: Example of individual PCB:



The figure show 2,2`,5,5´-polychlorinatedbiphenyl called PCB 52.

Congeners to be measured

When one analyzes PCBs and Brominated flame-retardants as described in phase II chemical analysis, one is identifying and quantifying the individual congeners one by one and also given the sum of the quantities.

When PCBs and Brominated flame-retardants are discharged into the environment, the individual congeners have different fate. Some are more persistent than others, some more fat-soluble, some are more toxic or with different biological effects etc. The longer we are from the source of origin, the more "treated by natural processes" the compounds are. Over the years the scientific community have developed several standard PCB measuring options, and some other more specific for different areas/biota's. In this protocol we are to use a selected group of 7 PCB congeners which we know there are plenty of results for in the scientific literature and also are likely compounds to be found in reasonable quantities in the Arctic. These are:

PCB compounds selected:	
Structure	**IUPAC-no.***
2,4,4'-TriCB	28
2,2',5,5'-TetCB	52
2,2',4,5,5'-PenCB	101
2,3',4,4',5-PenCB	118
2,2',3,4,4',5'-HexCB	138
2,2',4,4',5,5'-HexCB	153
2,2',3,4,4',5,5'-HepCB	180

**IUPAC-no is a specific number given for easier identifications and communication internationally by the International Union of Pure and Applied Chemistry.*

For Brominated flame-retardants the knowledge of their fate in the environment and in particular in the Arctic is not very well known, one major reason for this protocol in the first phase. Here we have selected congeners from the PBDE group (polybrominated diphenyl ethers). They are the focus for concern for several reasons. The selected congeners are the ones produced in highest amount and most commonly found in environmental samples. We want to know if they are present in the Arctic in measurable quantities, where in the Arctic, and how they are distributed in the ecosystem. The levels can then be compared with levels found elsewhere.

PBDE compounds selected:	
Structure	**IUPAC-no.***
2,2',4,4'-TetBDE	47
2,2',4,4',5-PenBDE	99
2,2',4,4',6-PenBDE	100

**IUPAC-no is a specific number given for easier identifications and communication internationally by the International Union of Pure and Applied Chemistry,*

Understanding the received result sheets

As can be seen from the attached sheets the results are given in a table and in a graph.

The first part is information on the sample itself, reference number, dates type of sample etc. Very important is the reference to the protocol data sheet "School sampling data sheet" which contains all the additional facts on the sample. For the evaluation the students are to use both the Analysis result sheets and the Sampling data sheet.

Reference facts:

School:	Name of school
Country:	Name of country where school is located
Sampling date:	Date of the samples was taken by the school
Type of sample:	Medium (water (salt or fresh), air, soil (type) etc) Species + organ if biological
Sample received at NILU:	Date when the sample was received
NILU sample number:	A reference ID given by NILU
Sample amount:	Amount of sample used by NILU
Concentration units:	Measurement unit used (see explanations to table)
Date of analysis:	Date when chemical analysis was completed
Data file:	Name of file in NILU archive

Table:

Compound structure		This is the official chemical name.
IUPAC no.		IUPAC-no is a specific number given for easier identifications and communication Internationally by IUPAC.
Concentration		This is the measured concentration of the individual compounds in the given concentration units. The compounds are given as either ppm, ppb, ppt levels or µg/g, ng/g, pg/g. for biological samples. Please see appendix 3 for details on this. Concentrations in biological samples can be either given as grams molecule/gram flesh or grams molecule/gram fat. Every organ in an animal contains fat. The POPs are stored in the fat. Let say we have 1 kg of liver and in this liver there are 100 gram of fat and in this fat there are 1 gram of PCBs in total. This can either be reported as 1 g/kg ww (meaning wet weight) or 10 g/kg of lipid (lw)

Recovery %		This is for information purposes only. The % recovery is how much of an added internal ^{13}C-standard is found in the end of the analytical phase. It tells how "difficult" the sample was to work with and the results are corrected for this recovery percentage.

Graph:

The graph is only a visualization of the data in the table for easier reading and comparison between different samples. The results entered in the table automatically create the table.

Evaluation of the results

NILU scientists will evaluate the results after the samples are analyzed. Based on this, NILU will post the result sheet on the web site for the respective school and give each school an evaluation task. These evaluations are to be written in the report in phase IV.

The details of the task for each school cannot be given before the results are available but it will follow a standard format where all schools should do some general evaluations.

Example of specific tasks school can be given:

PCBs

1. Look at your data sheets for PCBs and compare the levels with the previous years result of your school. Are the results from different compartments/animals different? Can you by studying relevant literature give an explanation for the different levels observed?

2. Look at all PCB data from fish samples for all the Arctic schools. The levels are different. Please discuss the possible reasons for this based on geographical distribution and different biology of the analyzed fish.

3. Look at the levels for PCBs in gull eggs you have found and compare this to scientific articles on PCB levels in gulls in your area if existing, and in Arctic in general. Also look for reported time trends and see where your result fit in.

PBDEs

1. In your data we did find all the PBDEs investigated. Find relevant scientific articles on PBDE levels and discuss if your levels are different from these reports, and try to discuss a reason for this difference.
2. In your data we did not find any PBDEs but in 3 of the other schools. Discuss how this can be the case by studying existing information on POPs distribution in the Arctic.

The GLOBE Program
Arctic POPs

Protocol 1: PCBs and PBDEs in local fish

1.5 Phase IV: Writing report

The background for writing the reports are the work done in phase I and III. The aim of this phase is to learn how to report properly as well as collecting the evaluations and lessons learned in order to improve the protocols as well as ensuring the scientific use of the evaluations.

Format of report

The reports are to be maximum 15 pages long, including pictures and figures. The report should be made in Microsoft Word.

The report should contain the following sections:

1. Preface
2. Content list
3. Summary (half page)
4. Report of sampling (Phase I)
    a. Description of how it was done (pictures can be included)
    b. What was good and what can be improved
5. Report on PCB/PBDE evaluation (Phase III)
    a. Description of tasks given
    b. How the task was solved
    c. Discussion
    d. Conclusion
    e. Reference list
6. OPTIONAL: Report on other teaching activities resulting from this protocol
7. Resources used (institutes, resources persons, web sites, agencies, NGOs etc)

How and when to submit the report

The report are to be sent on e-mail to esh@nilu.no within 8 weeks from when the results and evaluation task where given to each school.

1.6 Sampling datasheet

GLOBE project POPs in the Arctic

The sampling datasheet consists of the following for the POP project:

1. Key facts

2. School/class facts

3. Sampling location facts

4. Sampling performance

5. Sample identification names

Appendix 1: Fisk specific facts

The Appendix will be replaced by specific sheets depending on what to sample each year, but tables 1-5 will be kept as they are.

1. Key facts	
Name of school	
Country	
Sample type*	
Sample year	
ID of animal/fish/bird**	
NILU sample number***	

*What type of sample, water, air, fish bird etc. for biological sample, what part of the animal, fish/bird

**In sampling one might take several samples from same animal/bird/fish. E.g from one fish one might take several samples, one filet, one liver sample etc. To be able to keep track of which samples comes from which animal/fish/bird the individual must be given an ID. This could be like “Cod1-liver” or “salmon1-muscle”, but needs to be done and the samples should be marked with this ID no.

***To be filled in by NILU

2. School/class facts	
Name of school	
Post address	
Country	
Telephone	
Telefax	
E-mail school	
Teacher	
E-mail teacher	
Name of school class	
E-mail school class	

3. Sampling location facts	
Name of location	
Region/county	
Community	
Longitude, latitude and elevation*	
Type of location	
Nearest city/town/village	
Distance to city/town/village	
Near industry (if, which industry)	
Distance to industry	
Description of location	

*Use GLOBE GPS Protocol if possible or use maps to give the data. The format is to be given with dots in accordance with the GLOBE GPS protocol: http://archive.globe.gov/sda-bin/wt/ghp/tg+L(en)+P(GPS/HowToPerform

4. Sampling performance	
Sampling method in field	
Date of sampling in field	
Location for sample preparation	
Date of packing/freezing sampling	
Approx. weight of sample sent (optional)	
Date of sending sample	
Date sample received at NILU*	
Condition of received sample*	

**To be filled in by NILU*

5. Sample identification names	
Local name of species **	
Latin name of species **	

*** If biological sample*

6. Additional information about sampling, transport, preparation etc.

Appendix 1: Fish specific facts

Name of school	
ID of fish sample	
Total weight of species (in whole grams)	
Total length of fish (in mm)	
Sampled otoliths (YES/NO)	
Sampled scales (YES/NO)	
Female/Male/Unknown	
Length of gonad (if possible)	
Weight of gonad (if possible)	
Mature/Immature/Spent	
General or unusual observations ***(for example if there is a large scar on the fish, tumors, heavy parasite load, odd coloring etc.)***	

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ABSTRACT
This annual report gives an overview of the first year of the project "GLOBE: POP's in the Arctic".

The project seeks to create a network of GLOBE schools and scientists above the Arctic circle that will study the Arctic environment and contribute data to support Arctic research. Students will take GLOBE measurements and investigate the distribution and level of selected POPs in the Arctic region, increase the knowledge of POPs and general environmental science in the involved schools, and contribute to the documentation of new emerging POPs in the Arctic.

The project started in 2001 and is planned for 3 more years.

NORWEGIAN TITLE

KEYWORDS		
Arctic	POPs	GLOBE

ABSTRACT (in Norwegian)

** Classification*
A Unclassified (can be ordered from NILU)
B Restricted distribution
C Classified (not to be distributed)