

The Norwegian Veterinary School, NMBU,
Norwegian University of Life Sciences
have 1700 employees and 5200 students



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Laboratory of Environmental Research,
Campus Adamstuen, Oslo

The Laboratory of Environmental Research

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- From the 1960s veterinarians were concerned because of the use of pesticides.
- Veterinarians are also responsible for food safety in Norway
- From 1970 our laboratory has been analyzing animal samples
- Veterinarians are used to evaluate animal health. Including pathology, animal models and *in vitro* studies.

EEA grant project in Romania

*SIDPOP - Support instrument
for decision making in POP
management: case study -
Mureş catchment area project.*



 MINISTERUL MEDIULUI
APELOR ŞI PADURILOR

 ULBS
Universitatea "Lucian Blaga" din Sibiu

 Norwegian University
of Life Sciences

 MAGNUM
TRAINING SUPPORT PARTNER

SIDPOP

Instrument suport pentru luarea deciziilor
în domeniul managementului poluanţilor
organici persistenti

Studiu de caz: bazinul Hidrografic Mureş

 ICELAND
LIECHTENSTEIN
NORWAY
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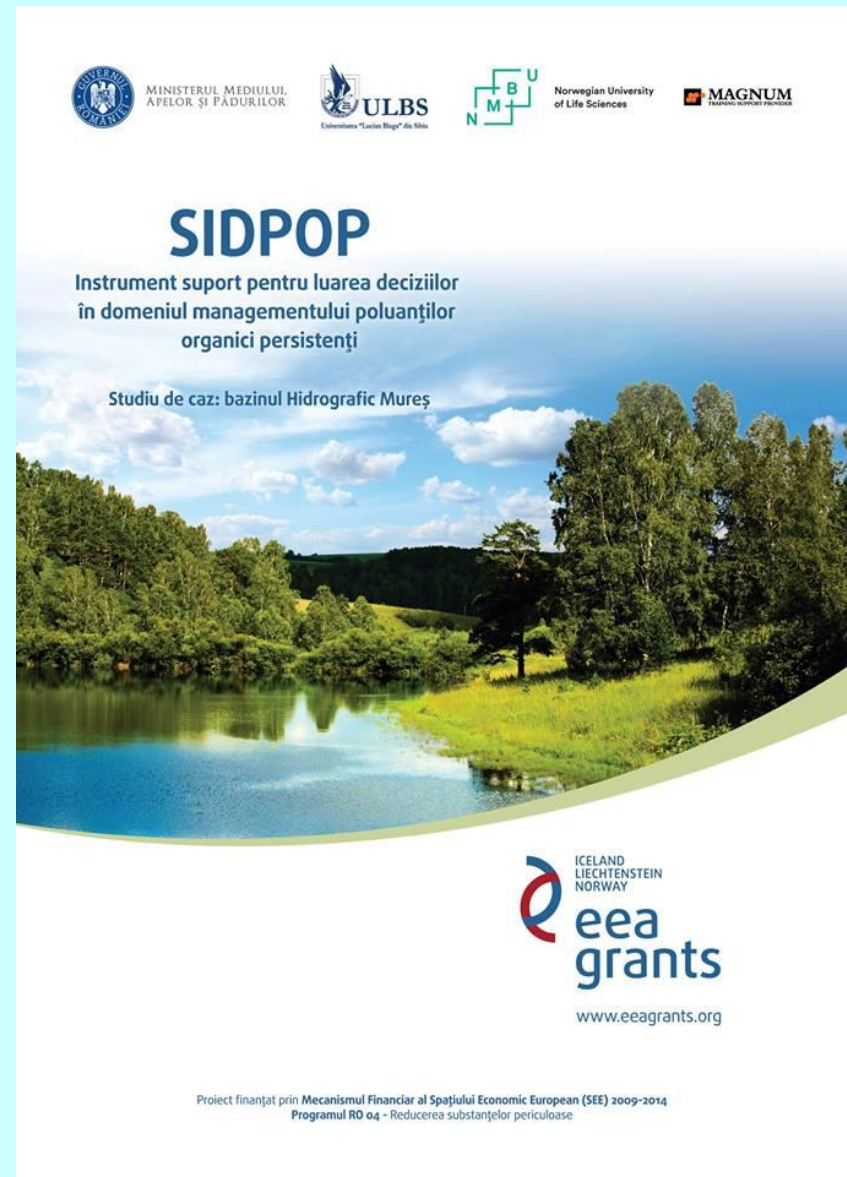
Proiect finanţat prin Mecanismul Financiar al Spaţiului Economic European (SEE) 2009-2014
Programul RO 04 - Reducerea substanţelor periculoase

***SIDPOP - Support instrument
for decision making in POP
management: case study -
Mureş catchment area project.***

(POP is persistent
organic pollutants)

Submitted Nov. 2014

Agreement signed May 2015



1 million Euro, 3 partners

- Lucian Blaga University, Sibiu Romania, (60%)
- Norwegian University of Life Sciences, Norway (20%)
- S.C. Magnum, a company specializing in administrative procedures, reporting etc (20%)

Aims

- Training of staff from Lucian Blaga in Oslo
- Procurement of instruments for a new laboratory in Sibiu
- Procurement of field equipment
- Sampling of fish
- Analyses in Oslo and Sibiu
- Information of administration, population and publications





The Mureș river



Figure 1. The sampling localities in the river Mureș. The stations were located at 1 downstream Toplița, 2 downstream Reghin, 3 downstream Cristești, 4 downstream Luduș, 5 Gura Arieșului below the outlet of Arieș, 6 Cisteiu de Mureș, 7 downstream Sântimbru, 8 Below the outlet of Ampoi, Alba Lulia, 9 Below the outlet of Orăștie, 10 Mintia, 11 downstream Arad, 12 Cenad-Semlac.

Conclusions

- HCHs were found in higher levels, in some stations extremely high
- Both PCBs and DDTs were found in very high concentration in Barbel.

- Spending was reported, according to Romanian authorities guidelines, every 4th months in audit reports from Ernst & Young.
- The project evaluation from Romania was good.

The SIDPOP project was primarily screening of levels of POPs

Two areas where the Laboratory of Environmental Research has extensive experiences are:

- Wild life studies
- Effect studies

Using

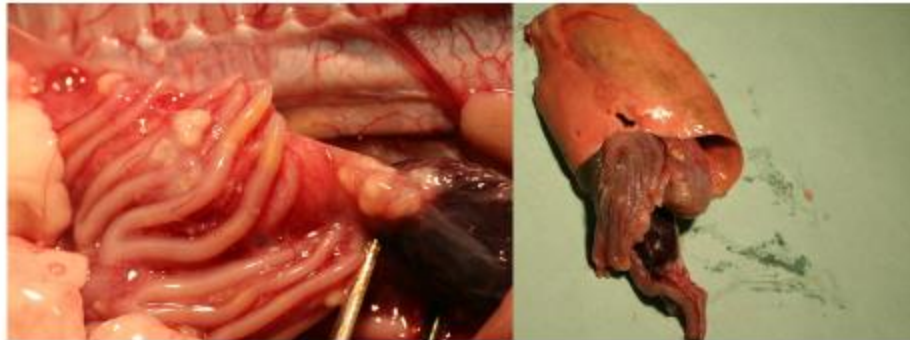
- Animal models
- Pathology
- *In vitro* models

Gross pathology burbot



Norwegian School of Veterinary Science

Visceral gross pathology



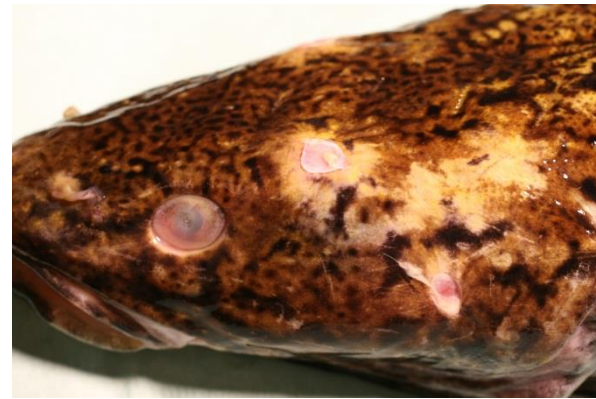
Thesis Vidar Berg 2013

Mycobacterial granulomas

Gross external pathology changes



**Cataract and
ulcers were
observed.**



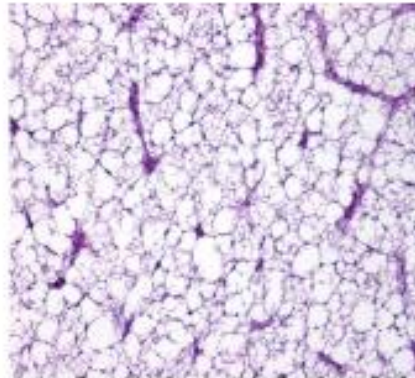
Abdominal petecchiae



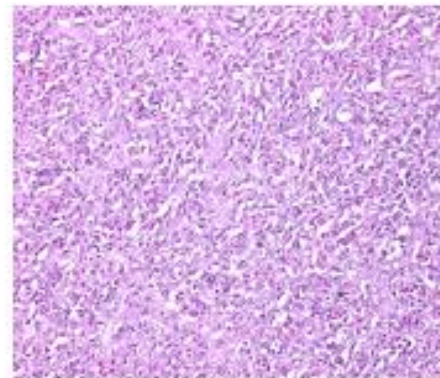
Burbot is a lean fish with fat stores in the liver

Reduced lipid content in the liver

Lake Losna



Lake Mjøsa



Liver pathology burbot

Animal study exposing zebrafish to POPs from Lake Mjøsa and Lake Losna

The fish received POPs extracted from burbot liver oil indirectly by exposing artemia (brine shrimp)

A pilot study was used as basis for determining the dose of Mjøsa and Losna mixtures that would give concentrations in animal model close to wild fish



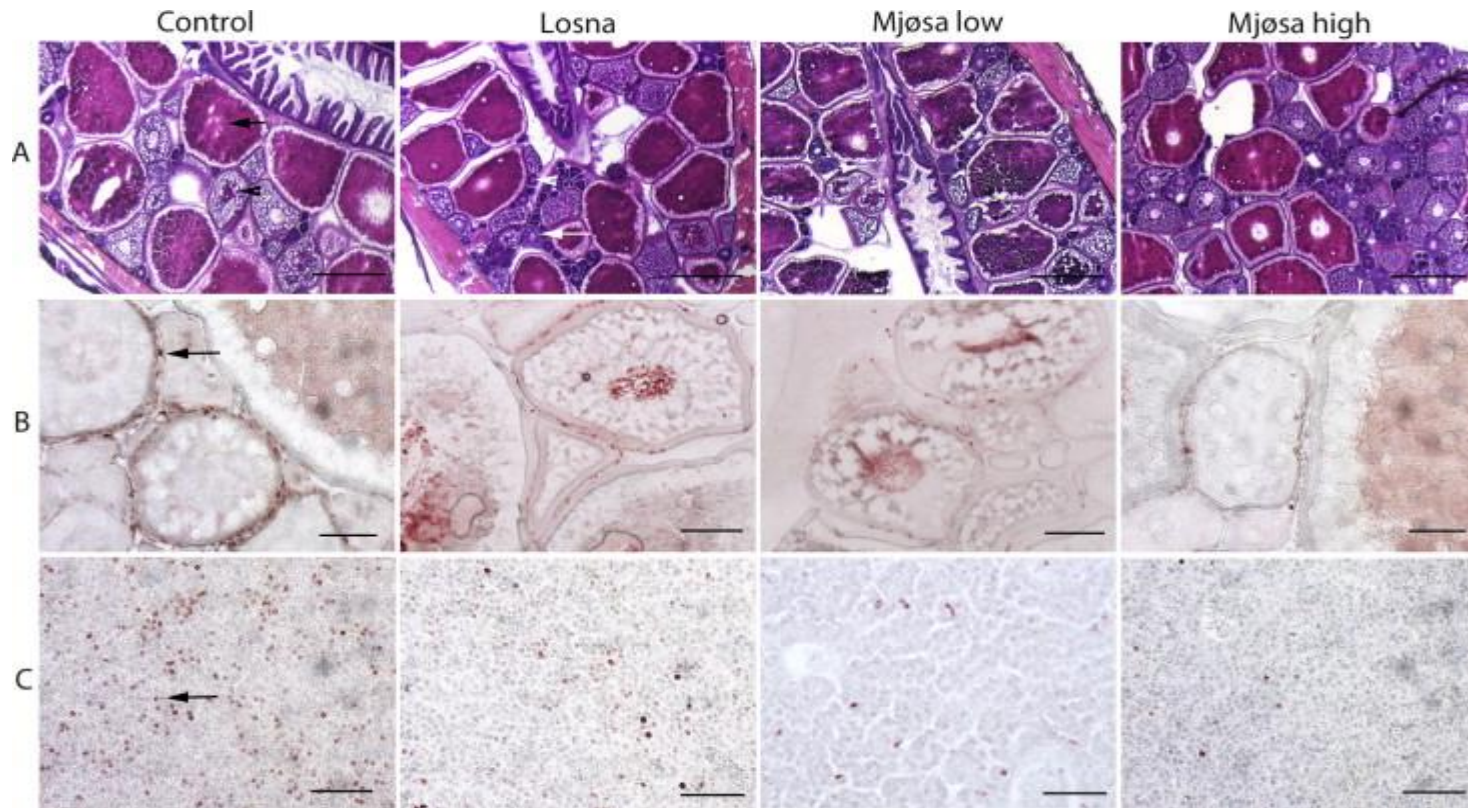
Brine shrimps
hatching in water
added POPs



The *artemia* were fed to zebrafish for two generations. We observed:

1. Changed metabolism
2. Disturbed growth regulation
3. Reproduction effects
4. Biomarker induction
5. Gene expression changes

Zebrafish histology (paper 3)



A. Gonads **B.** PCNA in gonads **C.** PCNA in liver



Cod and burbot liver oil were harvested from wild fish

Mixtures extracts were cleaned

Used to expose

- Pig ovary cells
- Pig Leydig cells
- Human adrenocortical cells

- Our laboratories analyse pharmaceuticals and personal care products (PPCP)
- These analyses are performed on cleaned water from wastewater treatment plants (WWTP).
- We are involved in projects screening antibiotic resistance in municipal wastewater.
- We have also applied for funding of a project that will clean water from WWTP using high energy UV-C dosage

What else?

- We have been analysing arctic animals since the 1970s
- We have extensive cooperation with several countries in the southern part of Africa (PhD students)
- We like new challenges

Grønnestad R, Villanger GD, Polder A, Kovacs KM, Lydersen C, Jenssen BM, Borgå K. Effects of a complex contaminant mixture on thyroid hormones in breeding hooded seal mothers and their pups. *Environmental Pollution*. 2018, Volum 240:10-16.

Hurem, Selma; Martín, Leonardo M; Lindeman, Leif Christoffer; Brede, Dag Anders ; Salbu, Brit ; Lyche, Jan Ludvig ; Aleström, Peter ; Kamstra, Jorke Harmen. Parental exposure to gamma radiation causes progressively altered transcriptomes linked to adverse effects in zebrafish offspring. *Environmental Pollution*, 2018, Vol.234:855-863.

Hurem Selma, Thomas W.K. Fraser, Tânia Gomes, Ian Mayer, Terje Christensen. Sub-lethal UV radiation during early life stages alters the behaviour, heart rate and oxidative stress parameters in zebrafish (*Danio rerio*). *Ecotoxicology and Environmental Safety* Volum 2017. 166: 359-365.

Hurem Selma, Tânia Gomesa, Dag A. Brede, Elisabeth Lindbo Hansen, Stephen Mutoloki, Cristian Fernandez, Carmel Mothersill, Brit Salbu, Yetneberk A. Kassaye, Ann-Karin Olsen, Deborah Oughton, Peter Aleström, Jan L. Lyche. Parental gamma irradiation induces reprotoxic effects accompanied bygenomic instability in zebra fish (*Danio rerio*) embryos. *Environmental Research*. Volume 159, Pages 564-578.

Hurem, Selma; Gomes, Tania; Brede, Dag Anders; Mayer, Ian; Lobert, Viola; Mutoloki, Stephen; Gutzkow, Kristine Bjerne; Teien, Hans-Christian; Oughton, Deborah Helen; Alestrøm, Peter; Lyche, Jan Ludvig. Gamma irradiation during gametogenesis in young adult zebrafish causes persistent genotoxicity and adverse reproductive effects. *Ecotoxicology and Environmental Safety* 2018 ;Vol 154:19-26

Jansen A, Polder A, Müller MHB, Skjerve E, Aaseth J, Lyche JL. Increased levels of persistent organic pollutants in serum one year after a great weight loss in humans; are the levels exceeding health based guideline values? *Sci Tot Environ* 2018. 622–623 (2018) 1317–1326. [Online i 2017](#). Teller ikke I 2018

Jansen Aina, Mette H.B.Müller, Randi Grønnestad, Ole Klungsoyr, Anuschka Polder, Eystein Skjerve, Jan Aaseth, Jan L. Lyche. Decreased plasma levels of perfluoroalkylated substances one year after bariatric surgery. *Sci Tot Environ*, 2019. Vol 657:863-870.

Kamstra J, Hurem S, Martin L, Lindeman L, Legler J, Oughton D, Salbu B, Brede D, Lyche J, Aleström P. Ionizing radiation induces transgenerational effects of DNA methylation in zebrafish. *Scientific Reports* (2018) 8(1).

Tartu S, Aars J, Andersen M, Polder A, Bourgeon S, Merkel B, Lowther AD, Bytingsvik J, Welker JM, Jenssen BM, Routti H. Choose your poison – Space-use strategy influences pollutant exposure in Barents Sea polar bears. *Environ Sci Technol* 2018. 52(5):3211-3221.

Lindeman, Leif Christopher¹², Jorke H. Kamstra¹³, Jarle Ballangby¹², Selma Hurem¹³, Leonardo Martin Martin¹³⁴, Dag Brede¹², Hans Christian Teien¹², Jan Ludvig Lyche¹³, Brit Salbu¹², Peter Aleström¹³ Low dose rate gamma radiation induce intragenerational locus specific changes to histone modification enrichment in zebrafish and Atlantic salmon

Lippold Anna, Sophie Bourgeon, Jon Aars, Magnus Andersen, Anuschka Polder, Jan Ludvig Lyche, Jenny Bytingsvik, Bjørn Munro Jenssen, Andrew E. Derocher, Jeffrey M. Welker, and Heli Routti. Temporal trends of persistent organic pollutants in Barents Sea polar bears (*Ursus maritimus*) in relation to changes in feeding habits and body condition. Accepted Environmental Science & Technology, 14 December 2018.

Müller Mette HB; Anuschka Polder, PhD; Ola B Brynildsrud, PhD; Randi Grønnestad, PhD student; Mahin Karimi, MSc; Elisabeth Lie, PhD; Wilbert B Manyilizu, PhD; Robinson H Mdegela, Professor; Frida Mokiti, MD; Mariam Murtadha, MD; Hezron E Nonga, PhD; Janneche U Skaare, Professor; Anita Solhaug, PhD; Jan L Lyche, Professor Prenatal exposure to persistent organic pollutants in Northern Tanzania and their distribution between breast milk, maternal blood, placenta and cord blood. Environmental Research

Mwakalapa EB, Mmochi AJ, Müller MHB, Mdegela RH, Lyche JL, Polder A. Occurrence and levels of persistent organic pollutants (POPs) in farmed and wild marine fish from Tanzania. Chemosphere 190 (2018) 1-12. Online in 2017!

Mwihia, Evalyn Wanjiru^{1,2,3,*}, Paul Gichohi Mbuthia³, Gunnar Sundstøl Eriksen⁴, James K. Gathumbi³, Joyce G. Maina⁵, Stephen Mutoloki⁶, Robert Maina Waruiru³, Isaac Rumpel Mulei^{2,3} and Jan Ludvig Lyche^{2,*} Occurrence and Levels of Aflatoxins in Fish Feeds and Their Potential Effects on Fish in Nyeri, Kenya. Toxins 2018, 10, 543; doi:10.3390/toxins10120543

Skaar, Jøran Solnes; Ræder, Erik Magnus; Lyche, Jan Ludvig; Ahrens, Lutz; Kallenborn, Roland. Elucidation of contamination sources for poly- and perfluoroalkyl substances (PFASs) on Svalbard (Norwegian Arctic). Environ Sci Poll Res Int 2018 s. -

Steffensen, Inger-Lise; Frølich, Wenche; Dahl, Knut Helkås; Iversen, Per Ole; Lyche, Jan Ludvig; Lillegaard, Inger Therese L.; Alexander, Jan. Benefit and risk assessment of increasing potassium intake by replacement of sodium chloride with potassium chloride in industrial food products in Norway. Food and Chemical Toxicology 2018, Volum 111: 329-340.

Thank You