



# Norwegian Monitoring Programs with Hg

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# Agencies and institutes with long-term Hg monitoring programs



Norwegian Environment Agency

Institute of Marine Research

Norwegian Polar Institute

Program Management Groups

Sub-contractors  
ie. NIVA and NILU

Several Monitoring programs

Several Monitoring programs

Environmental monitoring of  
Svalbard and Jan Mayen



# Monitoring programs with Hg managed by the Norwegian Environment Agency

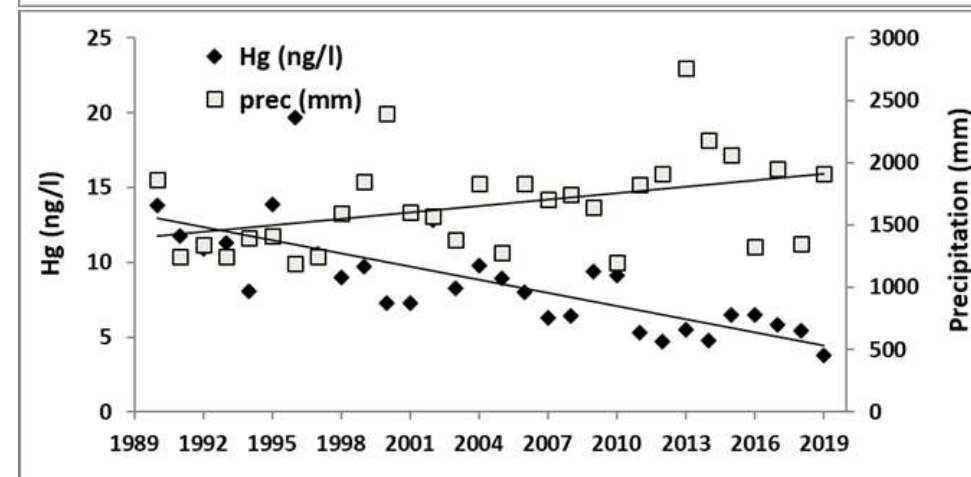
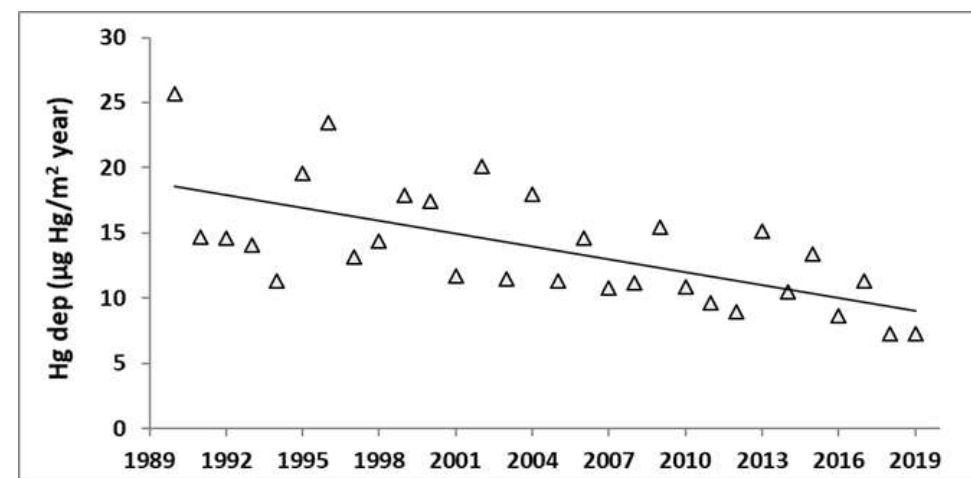
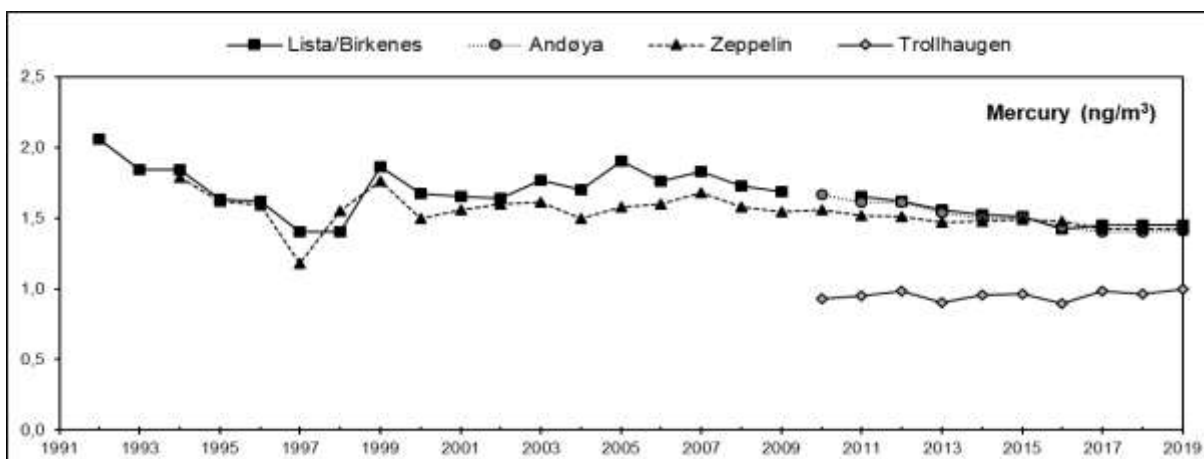


- Long-term programs
    - Atmospheric transported contaminants
    - Contaminants in coastal waters in Norway
    - Contaminants in freshwater ecosystems
      - EU Water framework directive priority contaminants in Norwegian freshwater fish
    - (The Norwegian River Monitoring Programme)
      - 20 rivers, (whole body) THg from 2004 →, most results close to LOQ
  - Short-term programs
    - Food-web studies, cocktail effects and source-appointment around Oslo
      - Environmental pollutants in the terrestrial and urban environment
      - Environment contaminants in an Urban fjord
-

# Long-range atmospheric transported contaminants program



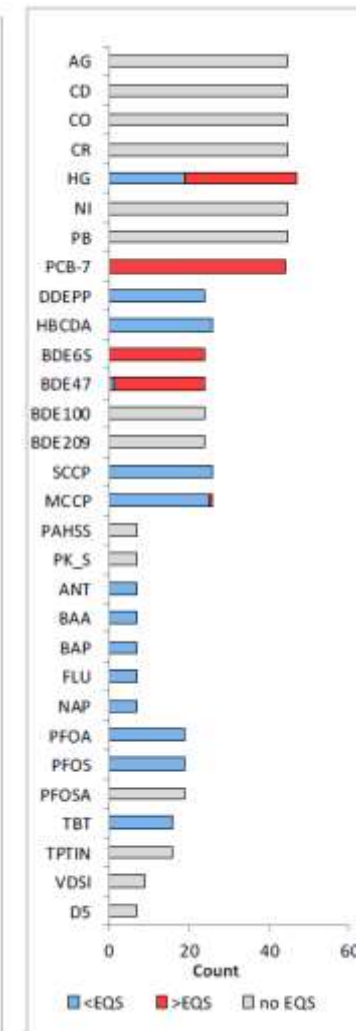
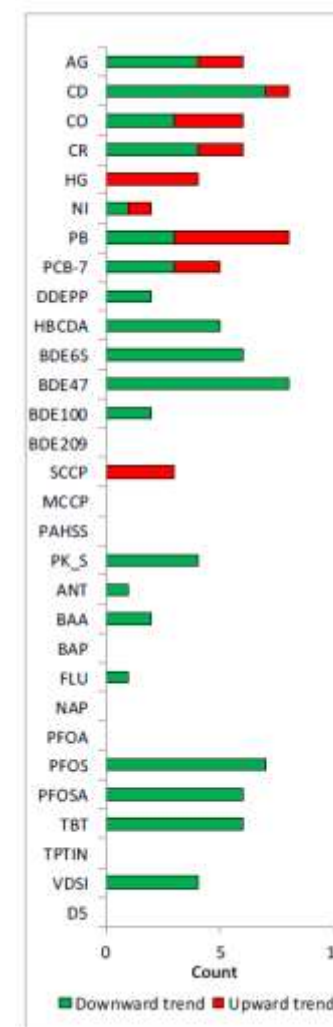
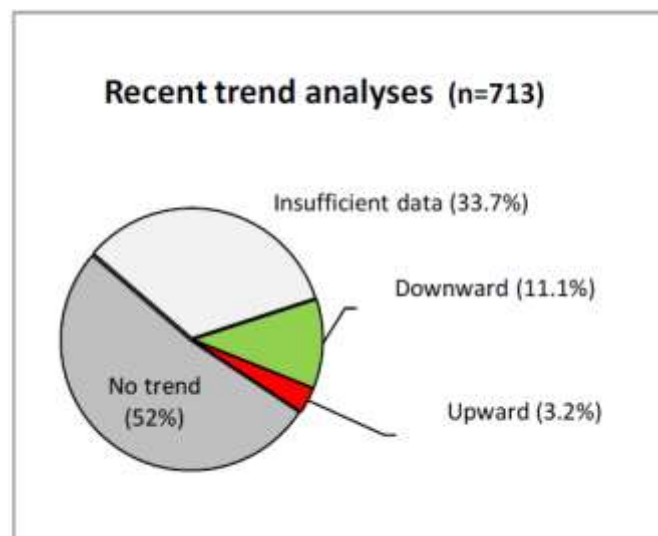
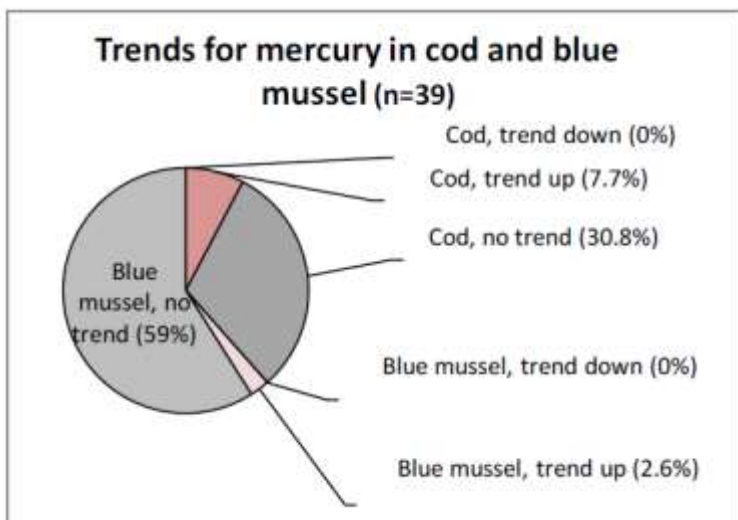
- Two stations, measurements since early 1990
  - Ny Ålesund (GEM)
    - Decreasing trend (bottom image)
      - GEM down 13% from 1994 to 2019
  - Lista and Birkenes (GEM and precipitation)
    - Faster decreasing trend
      - GEM down 22% from 1991 to 2019 (bottom image)
      - Wet. Dep. decrease at same pace despite increase in precipitation (image to the right)



# Contaminants in Coastal Waters in Norway



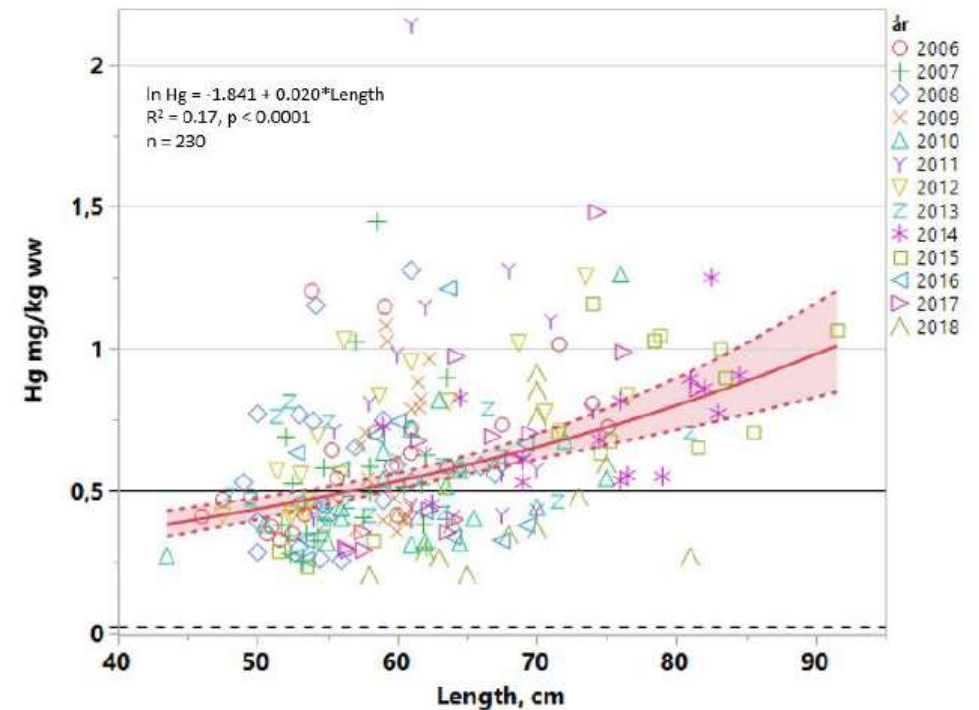
- Hg currently measured in cod fillet at 17 stations, blue muscle at 28 stations, several trends from mid 1980→
  - Recent trends from 2009 to 2018 for THg are varying, depending on local influence (bottom left image)
  - Trend compilation of 30 selected contaminants considered as basis for revised environmental status indicator (bottom right, and right image)



# Environmental Contaminants in Freshwater Ecosystems



- Food web studies in two large and deep fjord lakes, Brown trout muscles
  - Mjøsa (several potential local sources) & Lake Femunden (reference lake)
  - Large fish exceed dietary consumption limit (see image to the right for lake Mjøsa)
- EU Water framework directive priority contaminants in Norwegian freshwater fish
  - 14 lakes, Arctic char/Troun/Perch/Whitefish fillet depending on the lake
- Current programs from 2006 and 2017 respectively
  - But data available in Norway from mid 1980s→
    - [Recent publication using dataset from 3132 lakes in entire Fennoscandia going back to mid 1960s<sup>1</sup>](#)



Monitoring of environmental contaminants in freshwater ecosystems 2018 - Occurrence and biomagnification. Morten Jartun, Asle Økelsrud, Thomas Rundberget (NIVA), Ellen Katrin Enge, Pawel Rostkowski, Nicholas Warner, Mikael Harju (NILU) and Ingar Johansen (IFE). ISBN 978-82-577-7132-4

<sup>1</sup>Improved Environmental Status: 50 Years of Declining Fish Mercury Levels in Boreal and Subarctic Fennoscandia. Hans Fredrik Veiteberg Braaten, Staffan Åkerblom, Kimmo K. Kahilainen, Martti Rask, Jussi Vuorenmaa, Jaakko Mannio, Tommi Malinen, Espen Lydersen, Amanda E. Poste, Per-Arne Amundsen, Nicholas Kashulin, Tatiana Kashulina, Petr Terentyev, Guttorm Christensen, and Heleen A. de Wit. *Environmental Science & Technology* 2019 53 (4), 1834-1843. DOI: 10.1021/acs.est.8b06399

# Monitoring programs with Hg managed by the Institute of Marine Research



- Responsible for environmental monitoring of commercial fish species
- Several programs in the Barents Sea, Norwegian Sea and North Sea with rotating species and locations (see examples in table to the right)
  - THg concentrations in 17 different fish species (n=8459) sampled during 2006 - 2015 had an increasing gradient north to south and from shore towards the open sea (in the same species)<sup>2</sup>
- Also long time series, like Atlantic Cod from the Barents sea 1995→, Norwegian Sea 2010 → and North Sea 2014 →

Species	Samples	Year
Greenland Halibut	1288	2006-2010
Atlantic Herring	800	2007-2010
	999	2009-2013
Mackerel	850	2007-2010
Cod	2064	2009-2013
Atlantic Pollock	1620	2010–2013
Atlantisk halibut	392	2013-2016
Cusk	1396	2013-2016
Common ling	822	2013-2016
Haddock	1179	2013-2018

<sup>2</sup>Atabak M. Azad, Sylvia Frantzen, Michael S. Bank, Bente M. Nilsen, Arne Duinker, Lise Madsen, Amund Maage, Effects of geography and species variation on selenium and mercury molar ratios in Northeast Atlantic marine fish communities, Science of The Total Environment, Volume 652, 2019, Pages 1482-1496, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2018.10.405>.

# Monitoring programs with Hg managed by the Norwegian Polar Institute



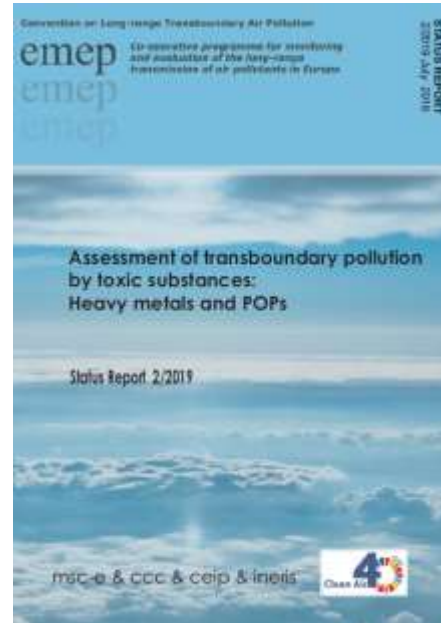
- Environmental monitoring of Svalbard and Jan Mayen
  - Long time series of Hg in arctic species, particularly top predators, starting from mid 1990s →
  - Polar bear
    - Diet corrected THg in polar bear hair increased 0,86 µg/g between 1995 and 2016 (variation between 1,61 and 2,75 µg/g, Barents sea region)<sup>3</sup>
  - Arctic Fox
    - Liver THg levels increased in arctic foxes (liver) with 7.2% (95% CI: 2.3, 9.6) per year when the concentrations were adjusted for variation of  $\delta^{13}\text{C}$ , sea ice cover, and reindeer carcasses<sup>4</sup>
  - Black-legged kittiwake
    - Data from 1995 to 2019, manuscript in preparation

<sup>3</sup>Two Decades of Mercury Concentrations in Barents Sea Polar Bears (*Ursus maritimus*) in Relation to Dietary Carbon, Sulfur, and Nitrogen. Anna Lippold, Jon Aars, Magnus Andersen, Aurore Aubail, Andrew E. Derocher, Rune Dietz, Igor Eulaers, Christian Sonne, Jeffrey M. Welker, Øystein Wiig, and Heli Routti. *Environmental Science & Technology* Just Accepted Manuscript DOI: 10.1021/acs.est.0c01848

<sup>4</sup>Ingeborg G. Hallanger, Eva Fuglei, Nigel G. Yoccoz, Åshild Ø. Pedersen, Max König, Heli Routti, Temporal trend of mercury in relation to feeding habits and food availability in arctic foxes (*Vulpes lagopus*) from Svalbard, Norway, *Science of The Total Environment*, Volume 670, 2019, Pages 1125-1132



# From national programs to global impact through regional networks





**Thank you!**