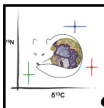
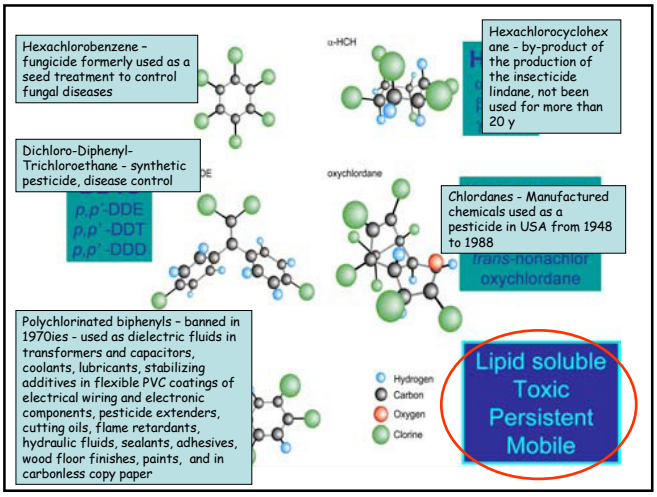


Stable isotopes as a tool for environmental contaminant studies

Workshop in Stable Isotopes and Predator-Prey Interactions.
March 17, 2009, University of Tromsø

Eva Fuglei, Norwegian Polar Institute, Norway

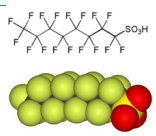


New compounds

PFOS - a man-made fluorosurfactant and global pollutant.

PFOS was the key ingredient in Scotchgard, a fabric protector made by numerous stain repellents.
PFOS has been used to make *aqueous film forming foam*, a component of fire-fighting foams, and alcohol-type concentrate foams.
PFOS compounds can be also found in some impregnation agents for textiles, paper, and leather; in wax, polishes, paints, varnishes, and cleaning products for general use; in metal surfaces, and carpets.
In the semiconductor industry, PFOS is used in multiple photolithographic chemicals including: photoacid generators (PAGs) and anti-reflective coatings (ARCs). Phased out in the European Union semiconductor industry due to health concerns.

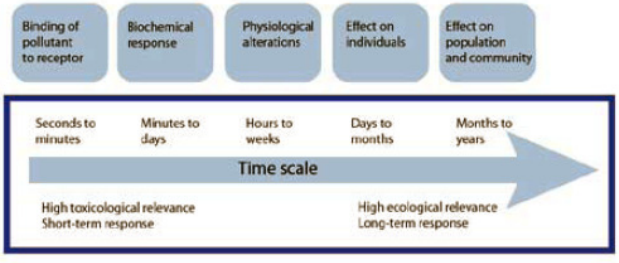
Perfluorooctanesulfonic acid



Other names PFOS

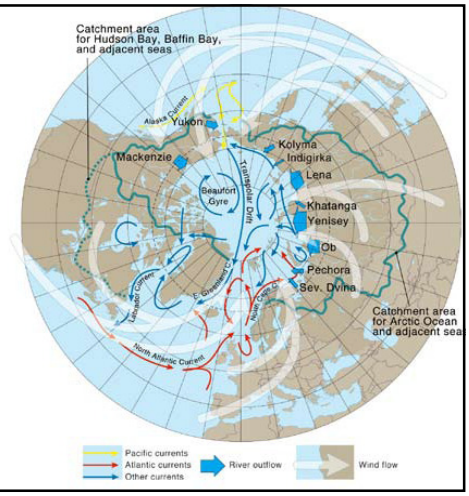
Repel both water and lipids,
Extremely resistant to degradation

BIOLOGICAL EFFECTS



The different physical pathways by which POPs are transported into the Arctic

Transports both into and within the Arctic occurs via *air*, *ocean currents*, *rivers*, and *sea ice*



AMAP 2004

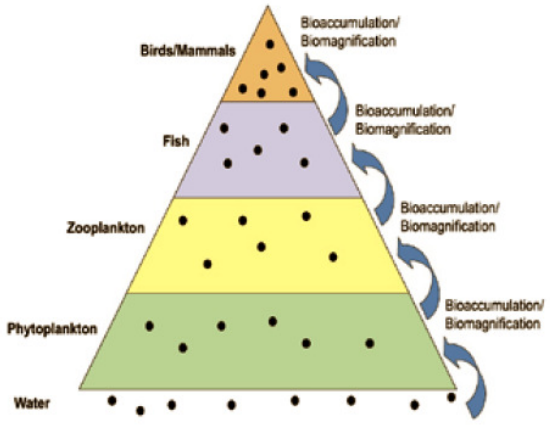
In addition to being toxic, organochlorines:

- high lipid solubility
- mobility
- low degradability

⇨ They are transported to areas distant from the sources of use

⇨ Potential to bioaccumulate in Arctic organisms

Organochlorine transported through the food chain

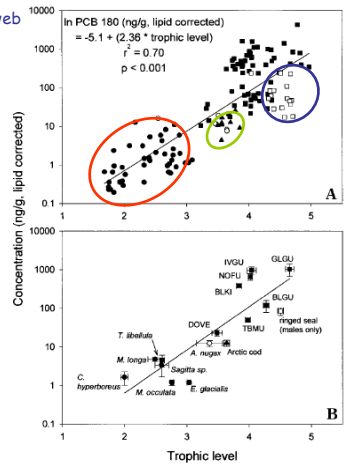


Example from arctic marine food web

Exponential relation between PCB 180 concentration and trophic level for the Northwater Polynya marine food web.
(A)All data points
(B) Species means

Trophic level based on 15N.
(●) Pelagic zooplankton,
(O) Benthic amphipods,
(▲) Arctic cod,
(□) Ringed seals,
(■) Seabirds.

Fisk et al. 2001

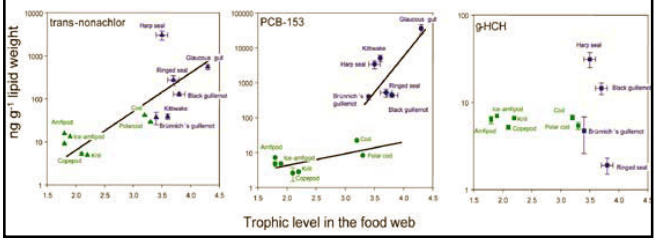


Biomagnification in a Barents Sea food web

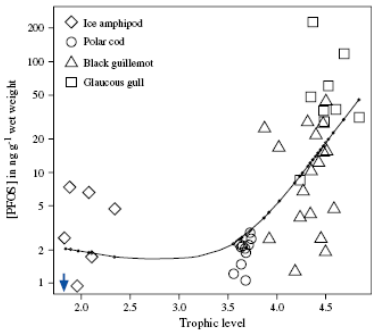
In general: concentration of organochlorine compounds increases often exponentially through the food web. But…

Some compounds, such as PCB 153 accumulate faster in endotherms (purple) than in ectotherms (green). And…

Some compounds do not biomagnify at all: as, γ-HCH



New compounds are still found



Non-linear (on log scale) relationship between concentration of PFOS and Trophic level quantified by stable N for the ice edge food web

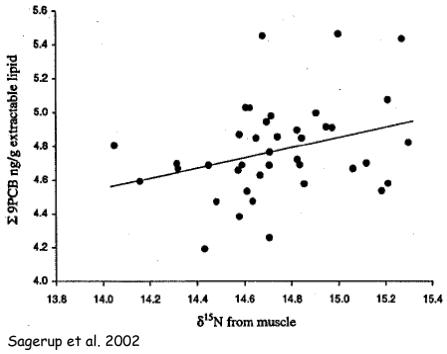
Haukås et al. 2007

Variation in contaminants within each species

- Different individuals or segments within populations can have different trophic positions as revealed by stable isotope signatures
- There are several examples of good correlations between individual contaminant levels and isotope signature levels

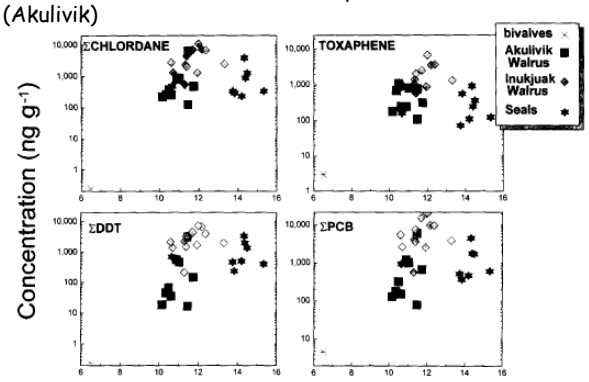
Correlation between PCB in liver and stable nitrogen isotopes from muscle of glaucous gulls from Bjørnøya (Bear island), the Barents Sea

Explain up to 18% of the variation in *OCs*



Sagerup et al. 2002

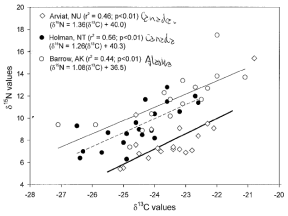
Walrus fed on ringed seals (Inukjuak) had higher OC concentrations than those fed only on benthic crustaceans (Akulivik)



Muir et al. 1995

Arctic fox

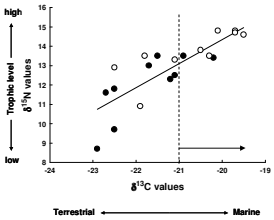
North America



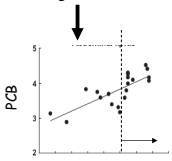
Hoekstra et al. 2003

No relation to contaminants

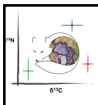
Svalbard



Fuglei et al. 2007



trophic level: δ 15N



Conclusion: Stable isotopes in ecotox studies

- Stable isotopes is useful tool both for explaining variation in contaminant levels:

1) Between individuals within habitats (glaucous gulls) and between habitats (arctic fox) as a function of feeding behaviour

2) Between species as a function of tropic level and food web affiliation (marine and terrestrial)