

DORTE HERZKE¹, TORGEIR NYGÅRD², ELDBJØRG HEIMSTAD¹

PFAS in urban terrestrial environments; the case study of Oslo city

The project

Main objective:

Assessment of **occurrence, sources, bioaccumulation and combined risk** of a broad range of pollutants in the urban terrestrial environment

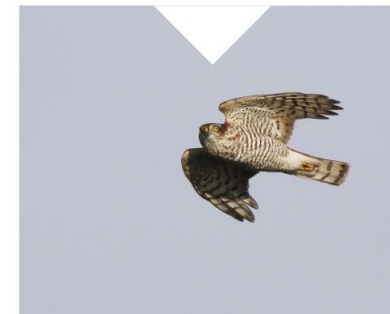
- Pilot project in 2013; comparison of urban and remote sites
- Since 2014 yearly sampling of bird eggs, earthworms, fox and rat liver in urban site
- 2015 soil was added
- 2016 air was added
- Norwegian EPA as project owner



Environmental pollutants in the terrestrial and urban environment



Environmental pollutants in the terrestrial and urban environment

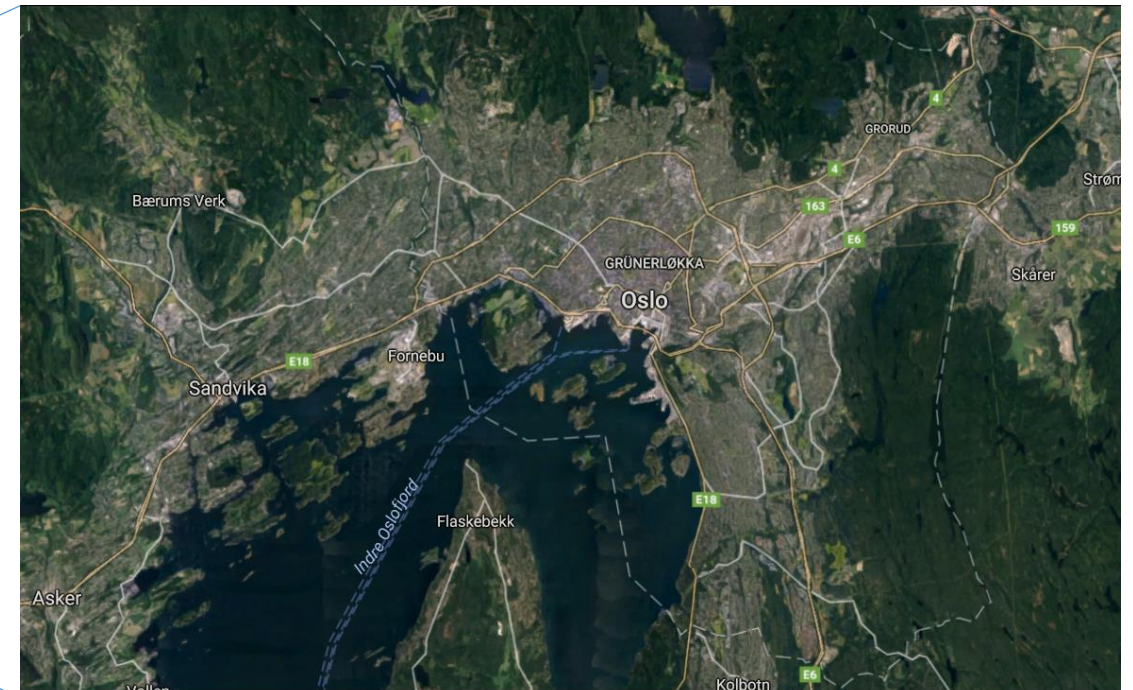


Environmental pollutants in the terrestrial and urban environment 2015

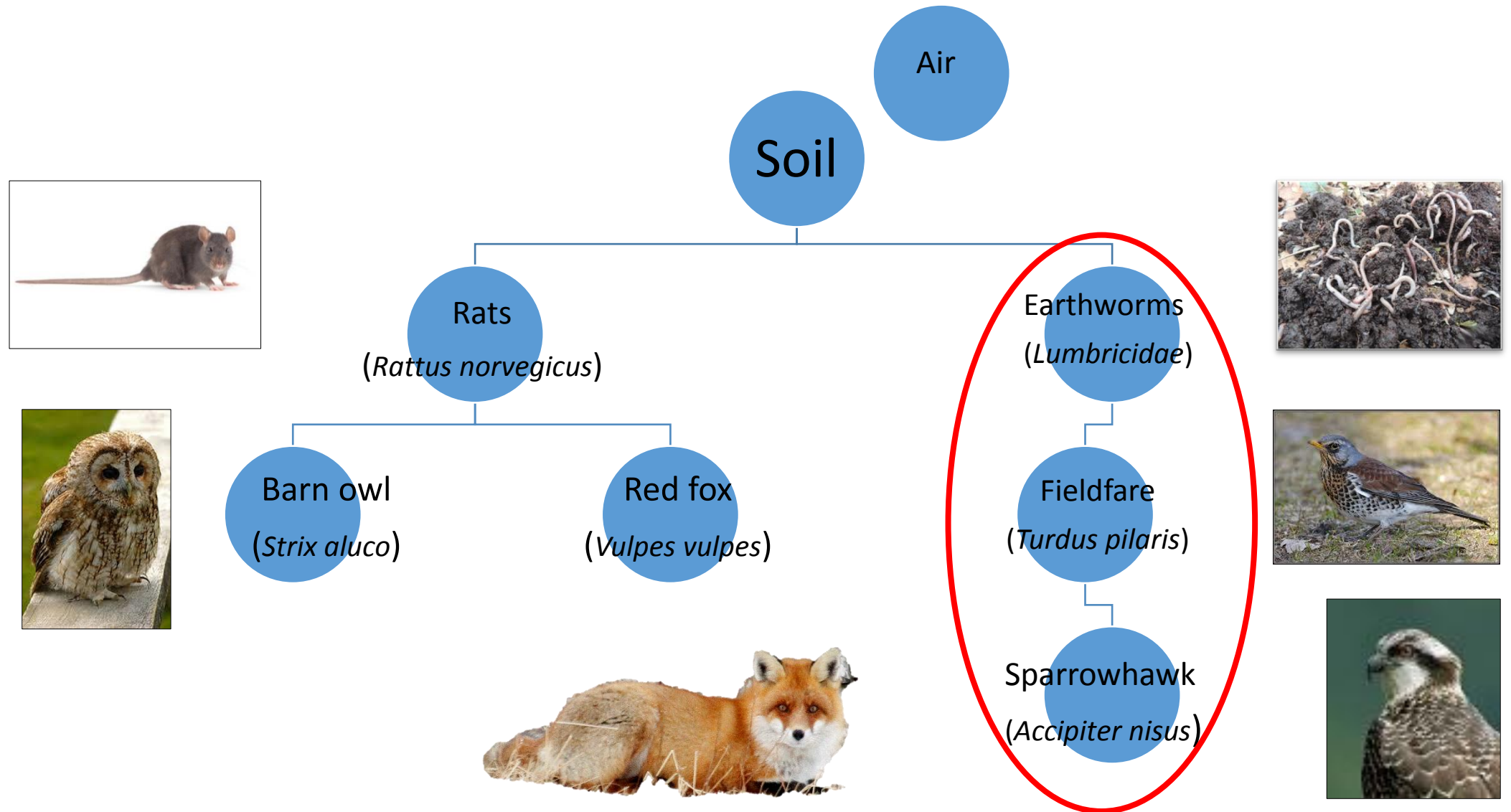


City of Oslo

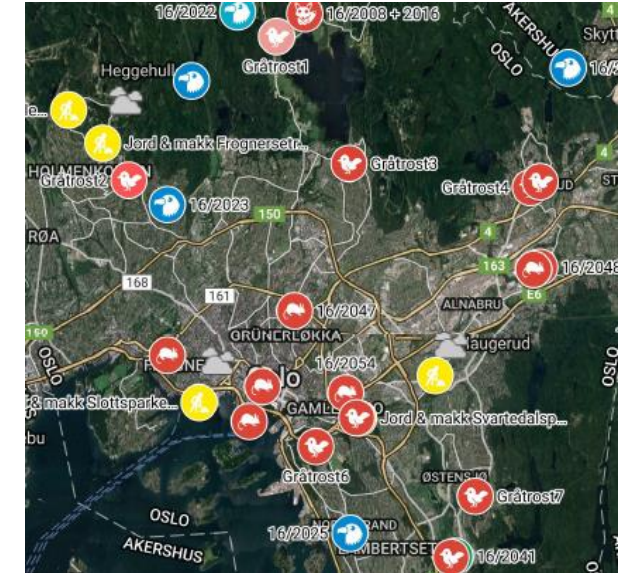
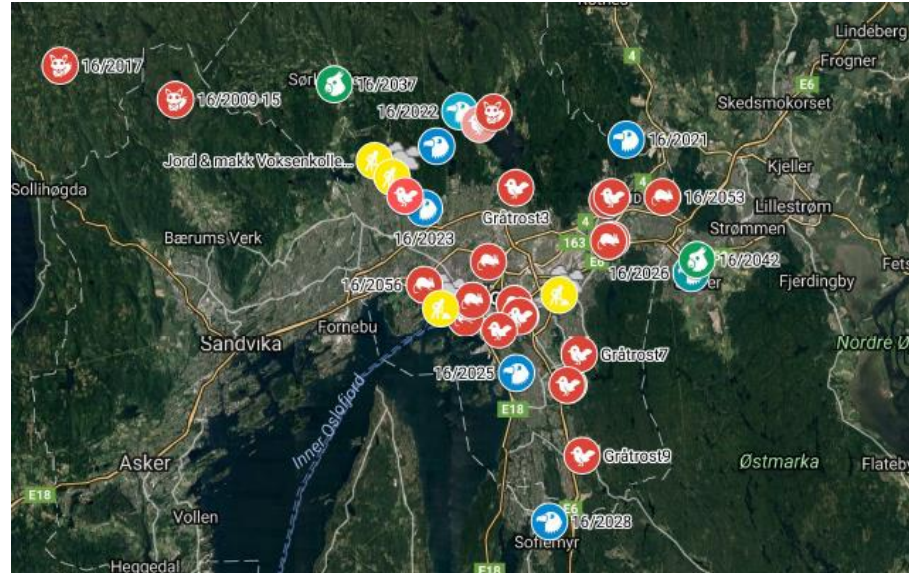
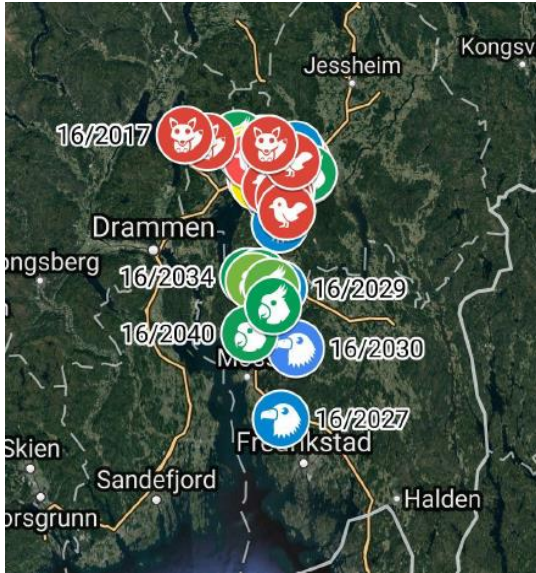
- Capital of Norway
- Largest city in Norway with 666 759 inhabitants (incl. suburbs 1.5 Mill)
- In close vicinity to forrest, lakes and fjord



Sampling design since 2015/6



Sampling sites 2015/6



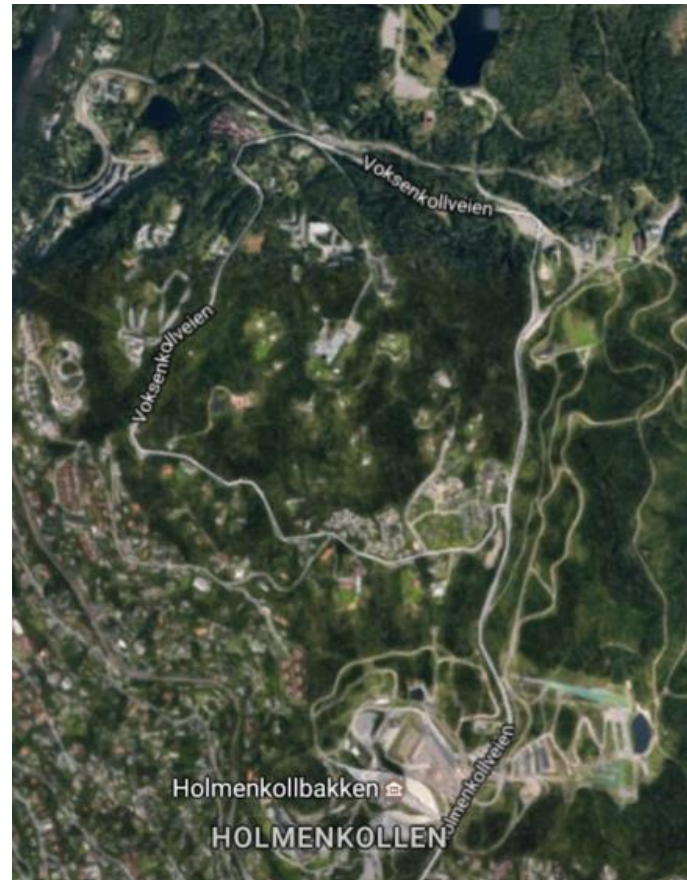
- 5 sites for soil and worms (parks, skiing tracks, road sides, industrialised areas)
- 10 nests for fieldfare, sparrowhawk, barnowl
- 20 liver of rats and 10 of foxes

Selected sites

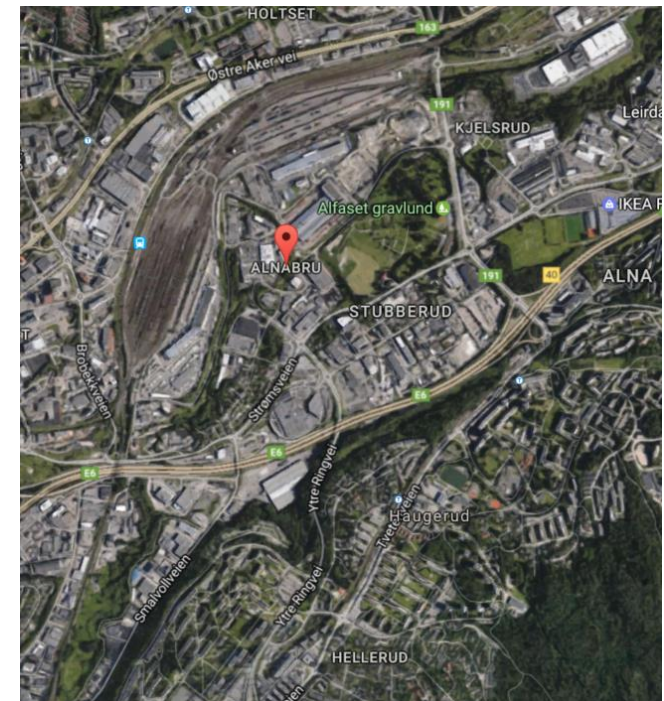
The park



The skiing track



The industry site



PFAS analysed

PFAS

PFSA: PFBS, PFPS, PFH_xS, PFHpS, PFOS, PFNS, PFDcS, PFOSA

PFCA: PFH_xA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrA, PFTeA

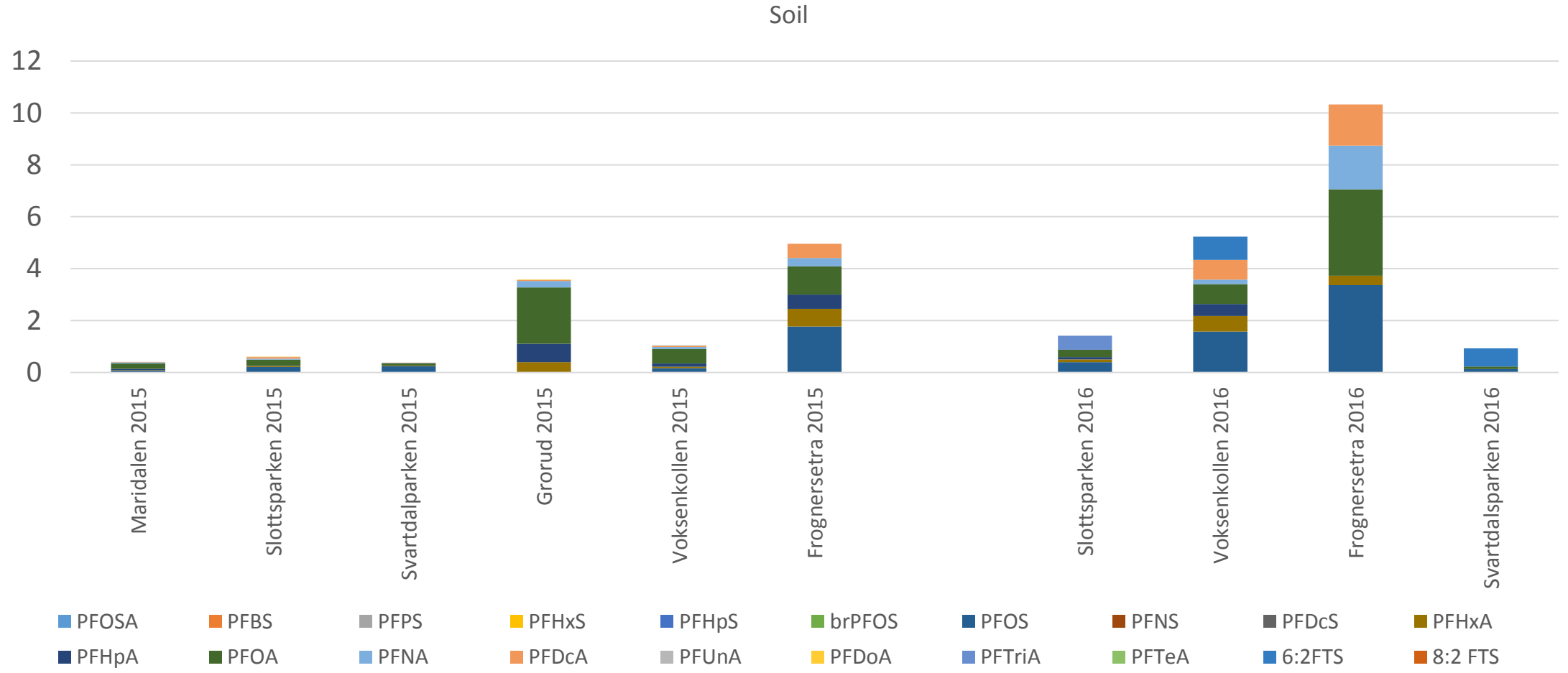
FTS: 6:2- and 8:2 FTS

NewPFAS: F53, F53B, Cl-PFOS, Cl-PFOA

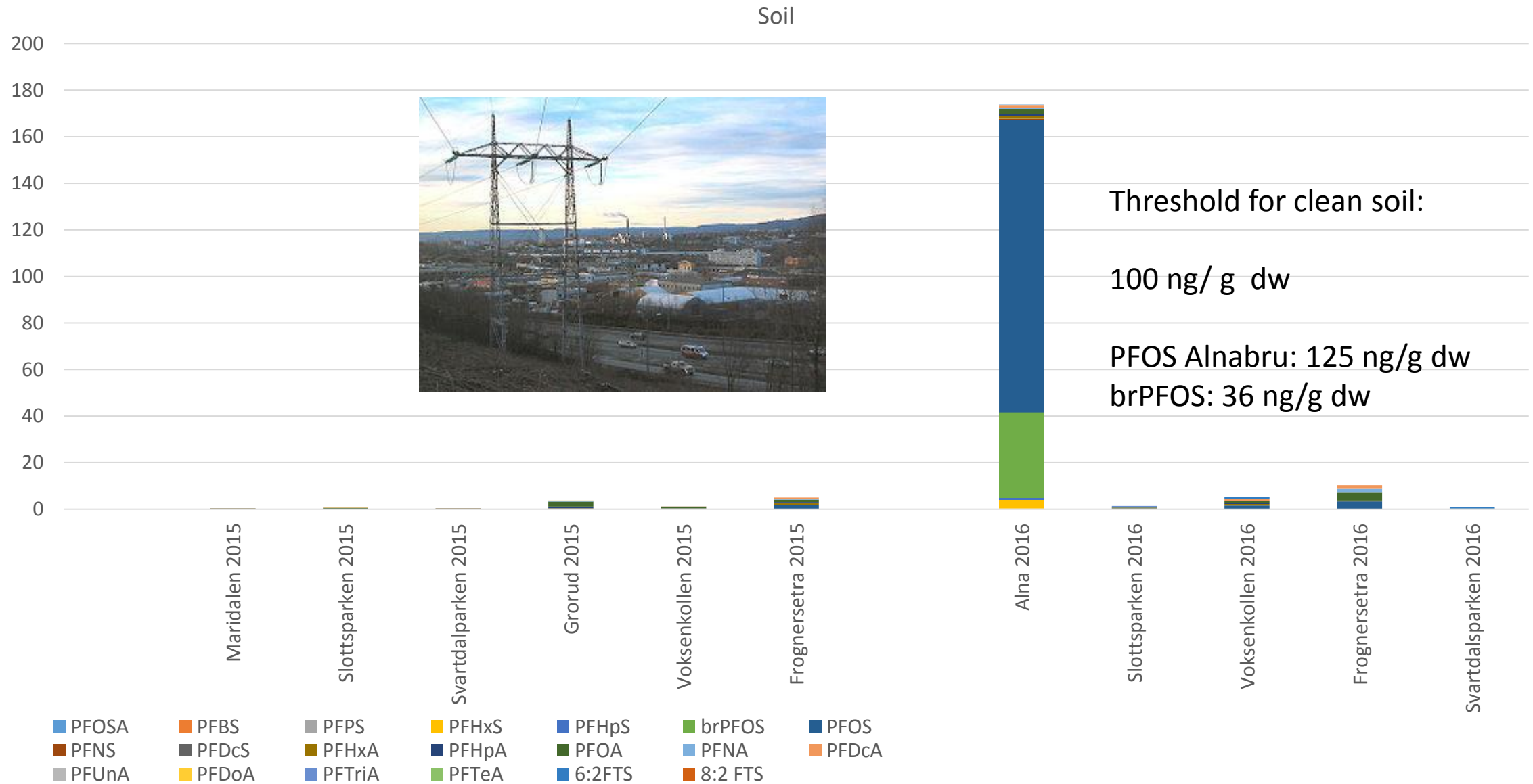
Stabile isotopes

$\delta^{15}\text{N}$, $\delta^{13}\text{C}$, $\delta^{34}\text{S}$

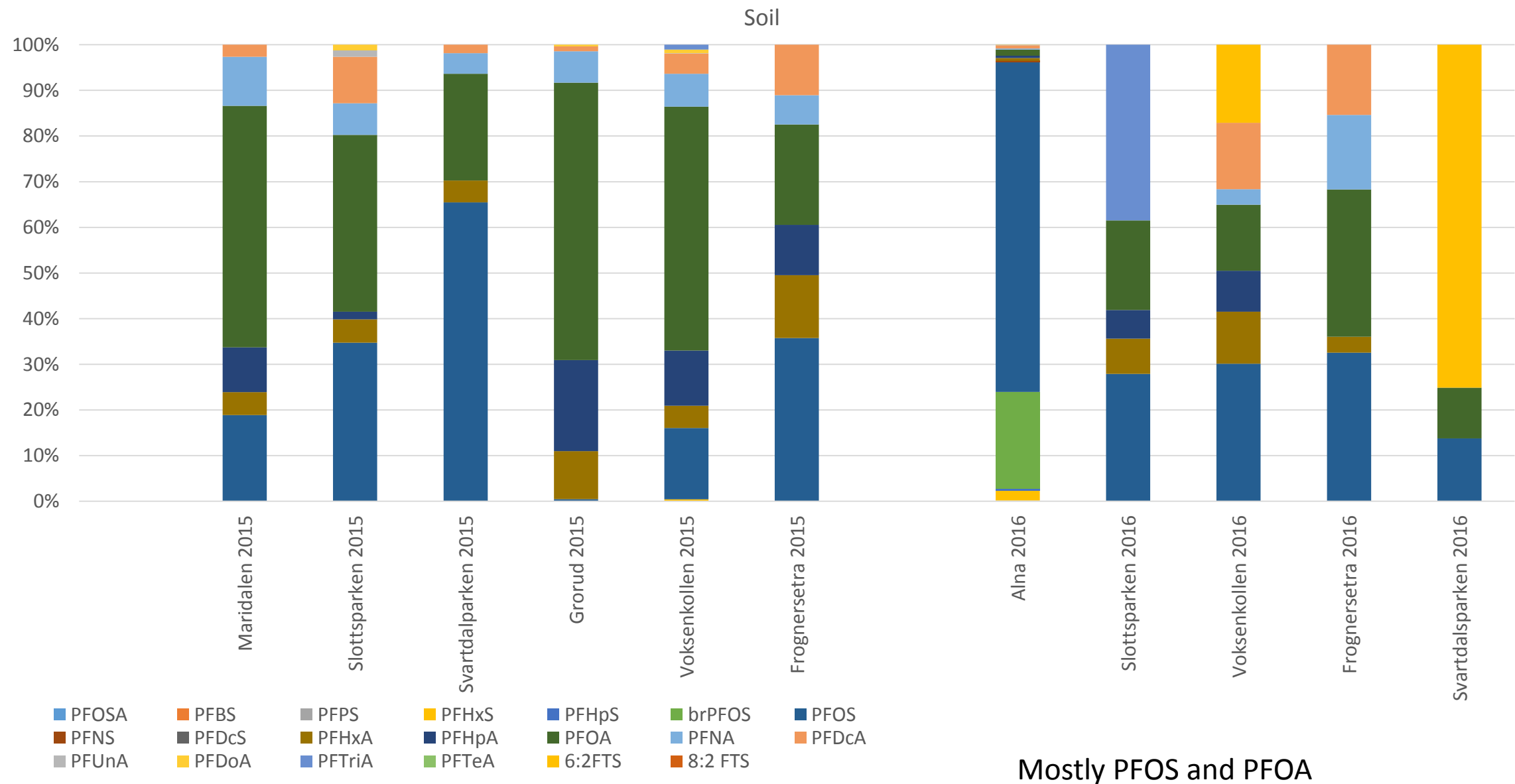
Soil in ng/g dw



Soil in ng/g dw

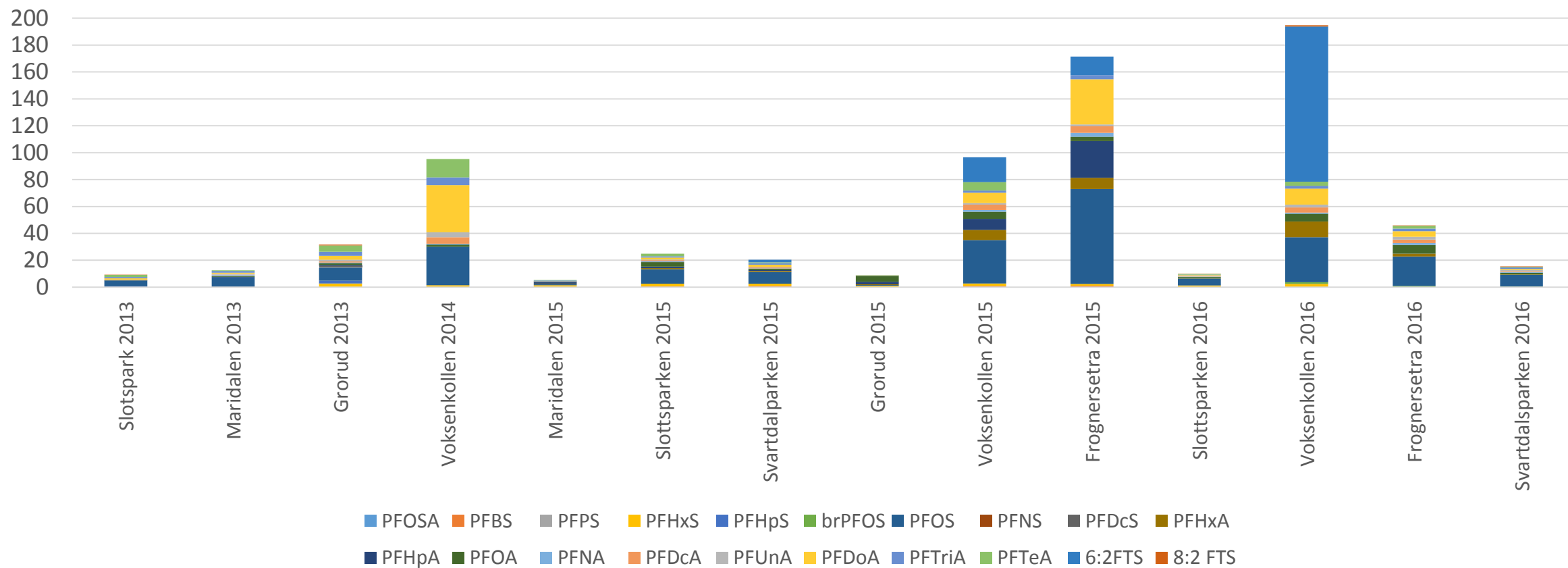


Soil in ng/g dw



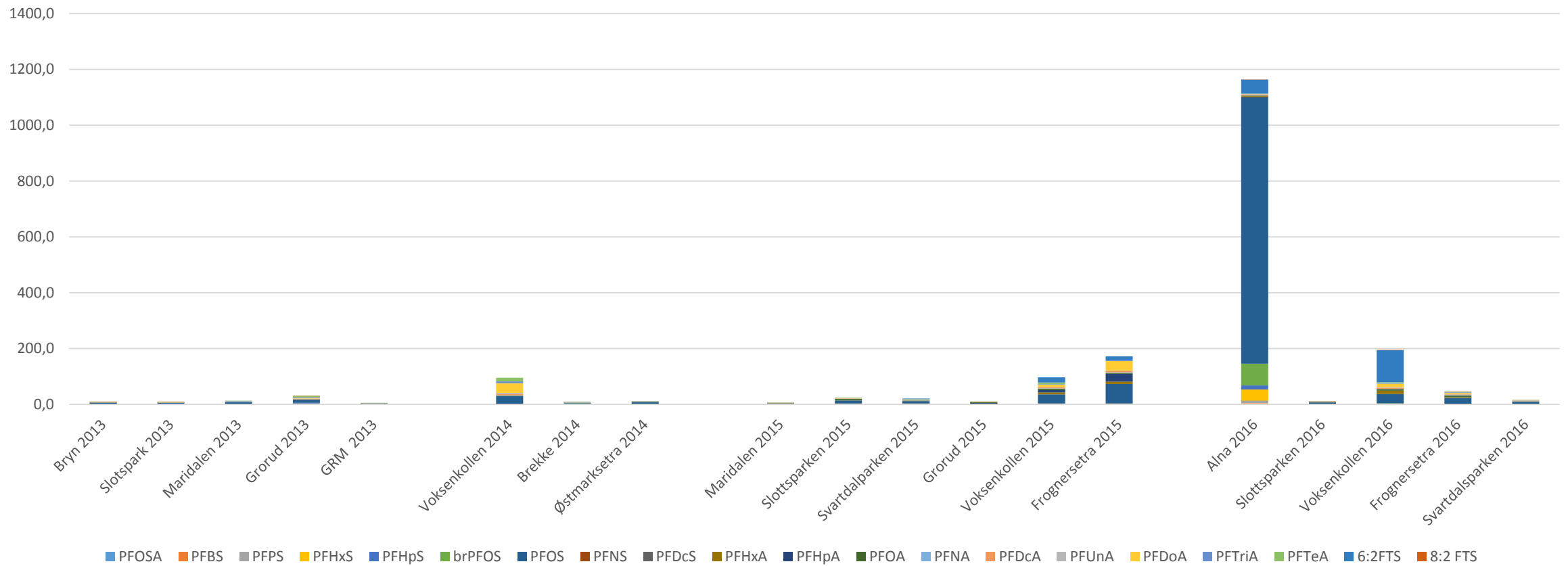
Earthworms in ng/g ww

Earthworms in Oslo



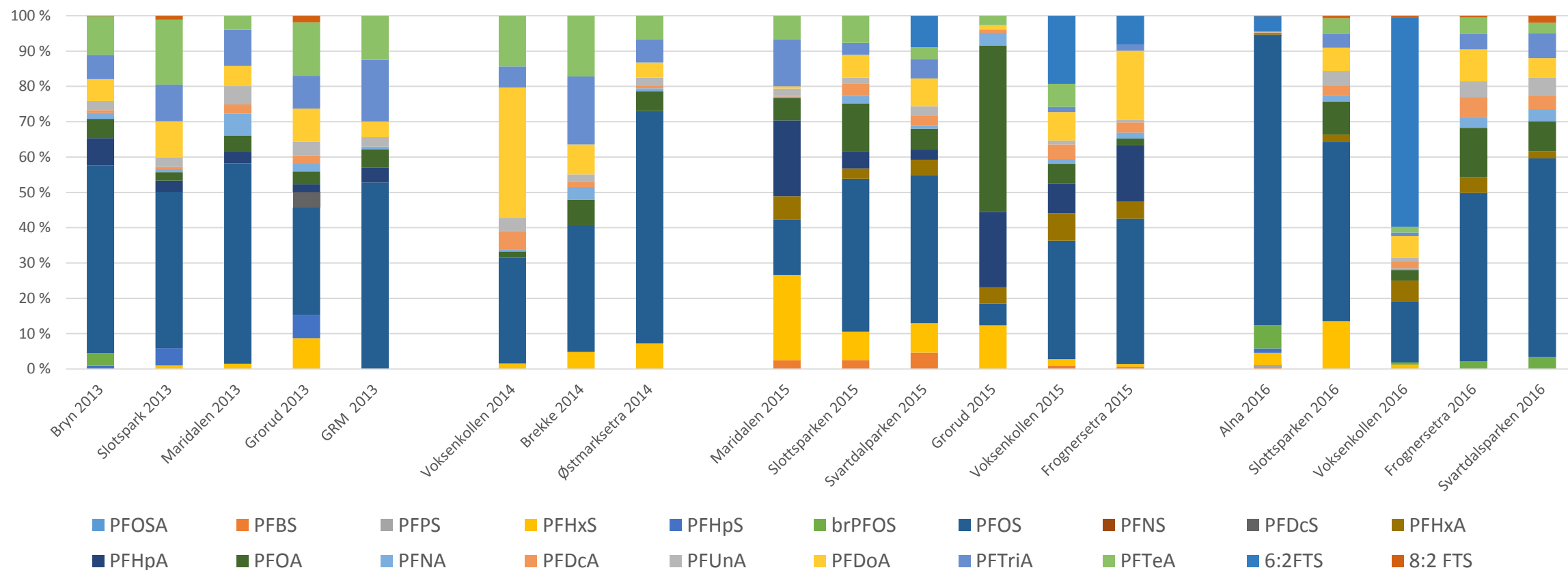
Earthworms in ng/g ww

Earthworms in Oslo

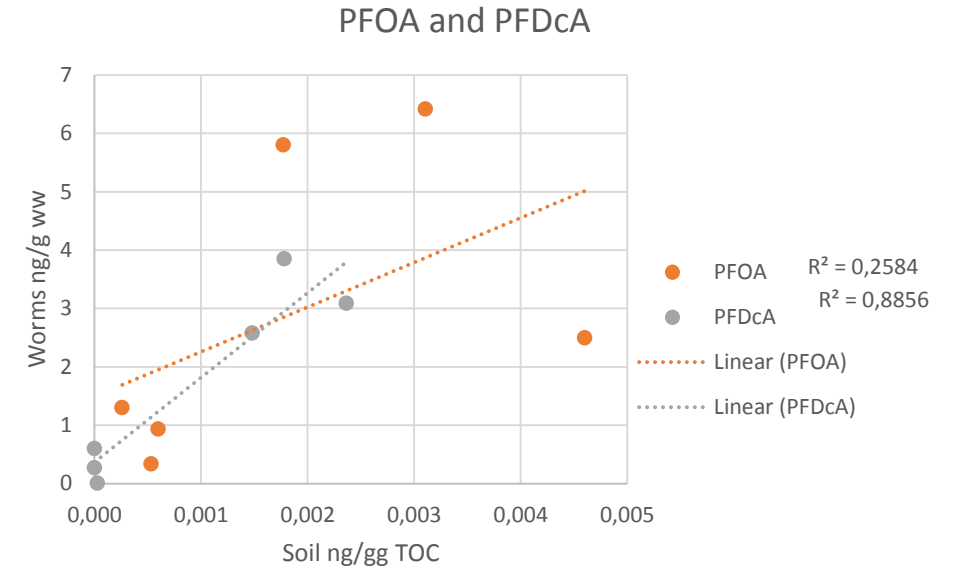
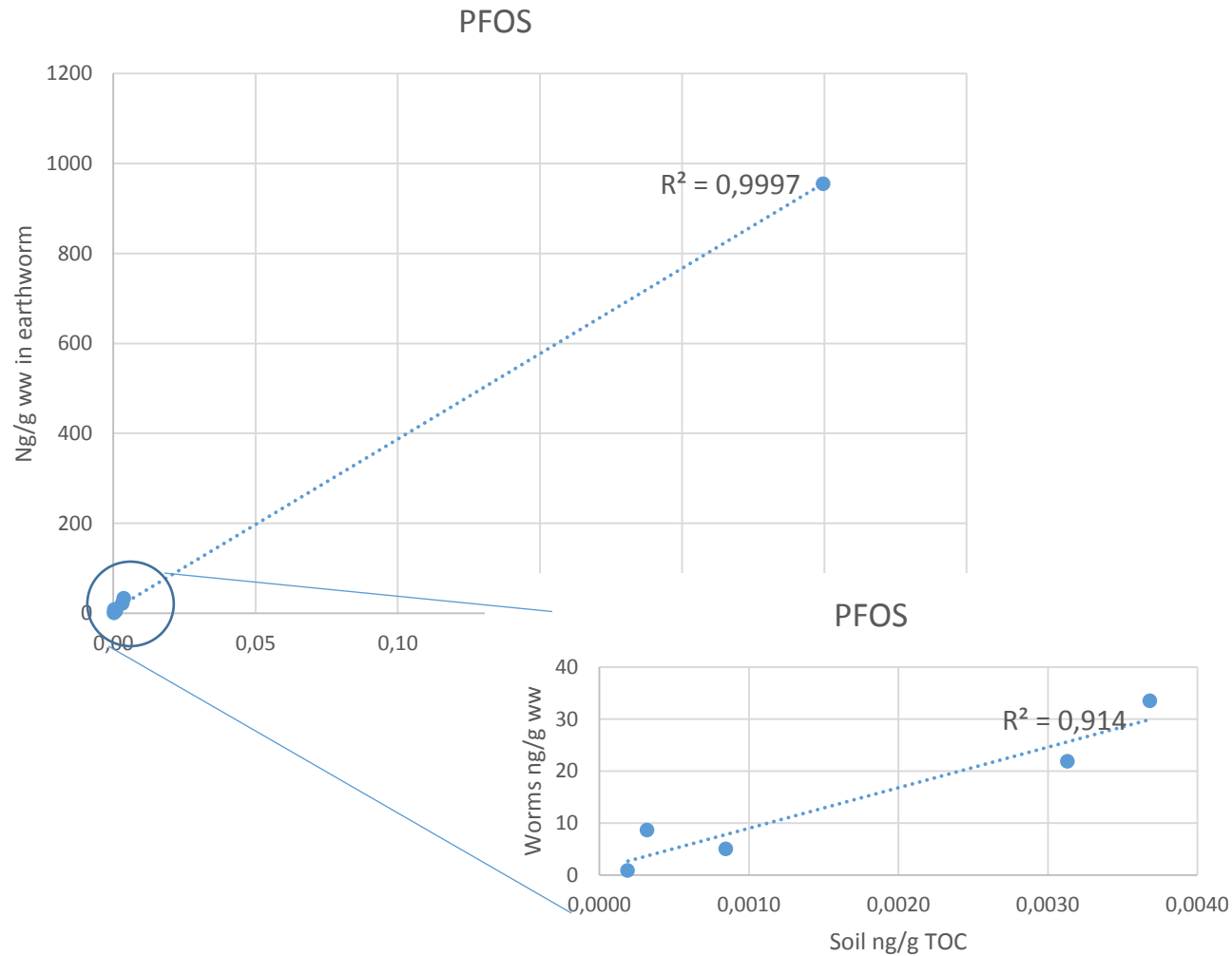


Earthworms in ng/g ww

Earthworms in Oslo

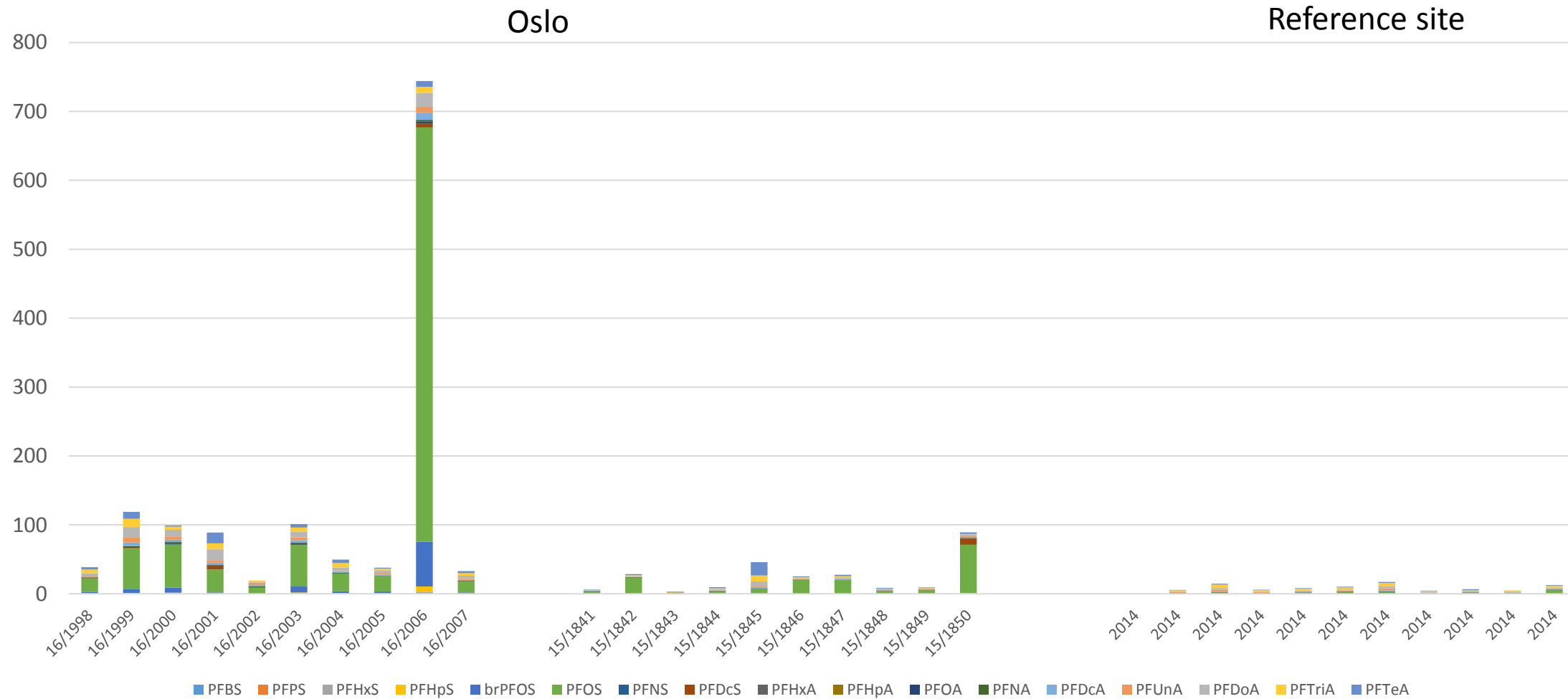


Soil to earthworm uptake



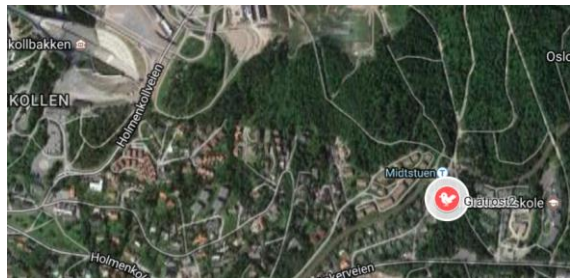
BSAFs: PFOS: 9500
PFOA: 2178
PFDcA: 1370

Fieldfare eggs ng/g ww

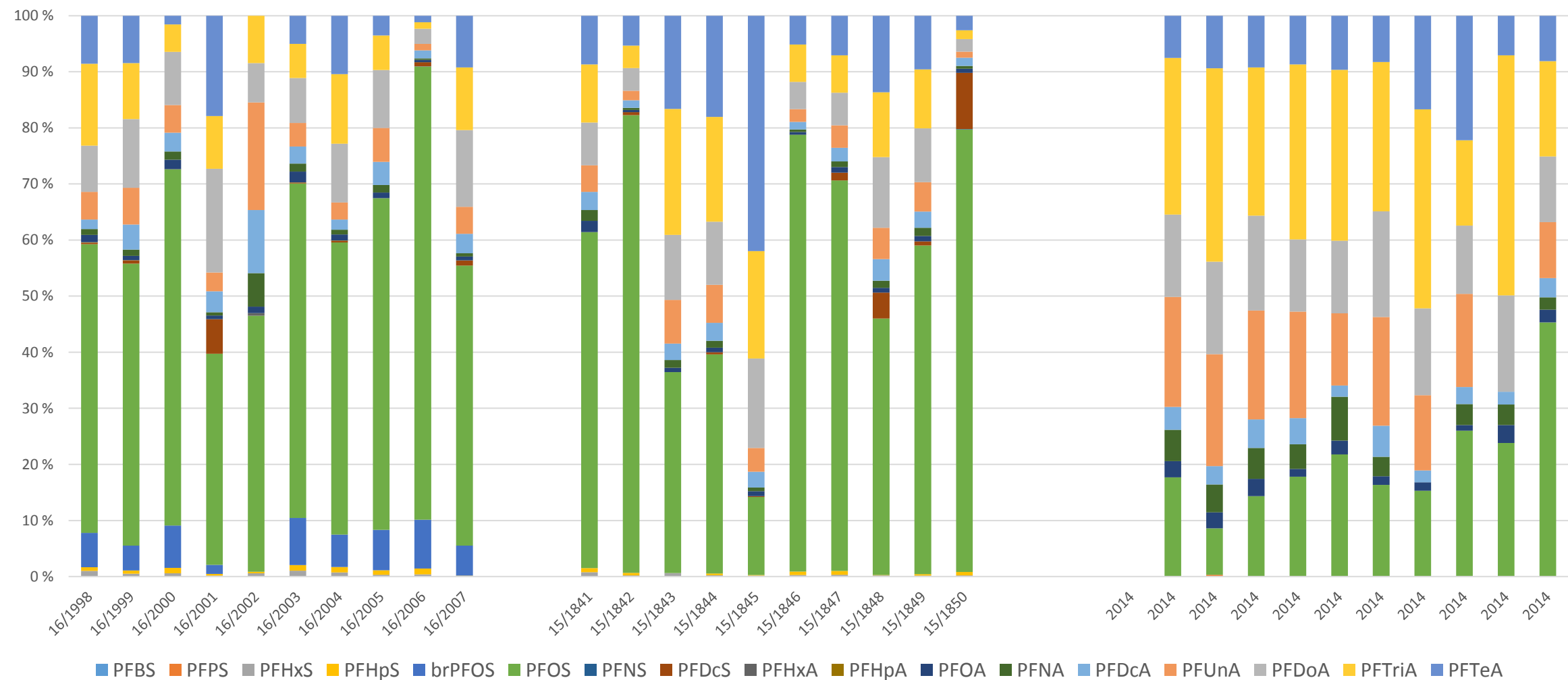


PNEC: 1000 ng/g ww in avian birds (Newsted JL, Coady KK, Beach SA, Butenhoff JL, Gallagher S, Giesy JP. Environ Sci Technol 2005;39: 9357–62.)

Fieldfare eggs ng/g ww

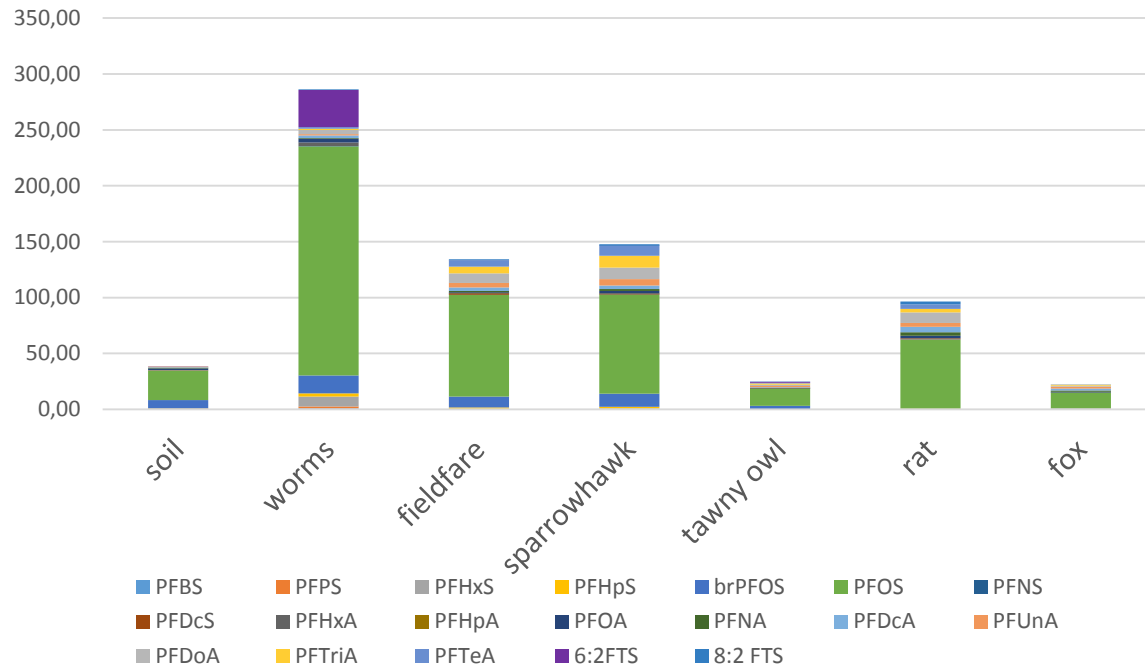


Fieldfare eggs



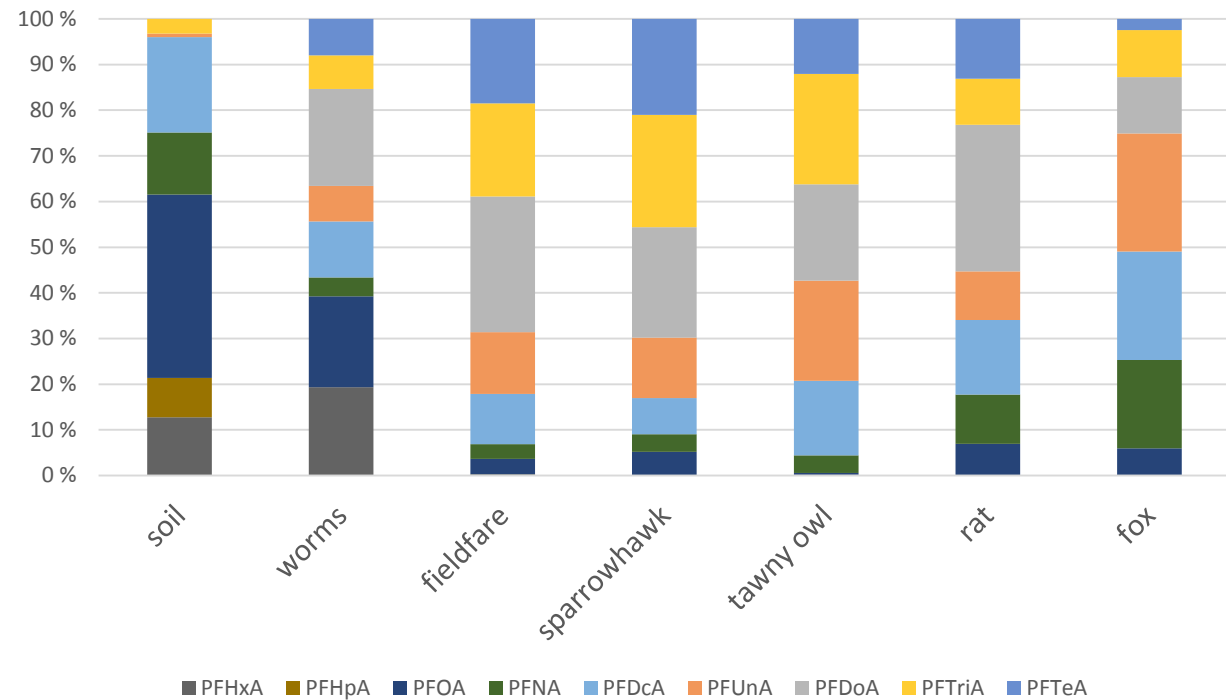
PFAS patterns and observations

allPFAS in ng/g ww



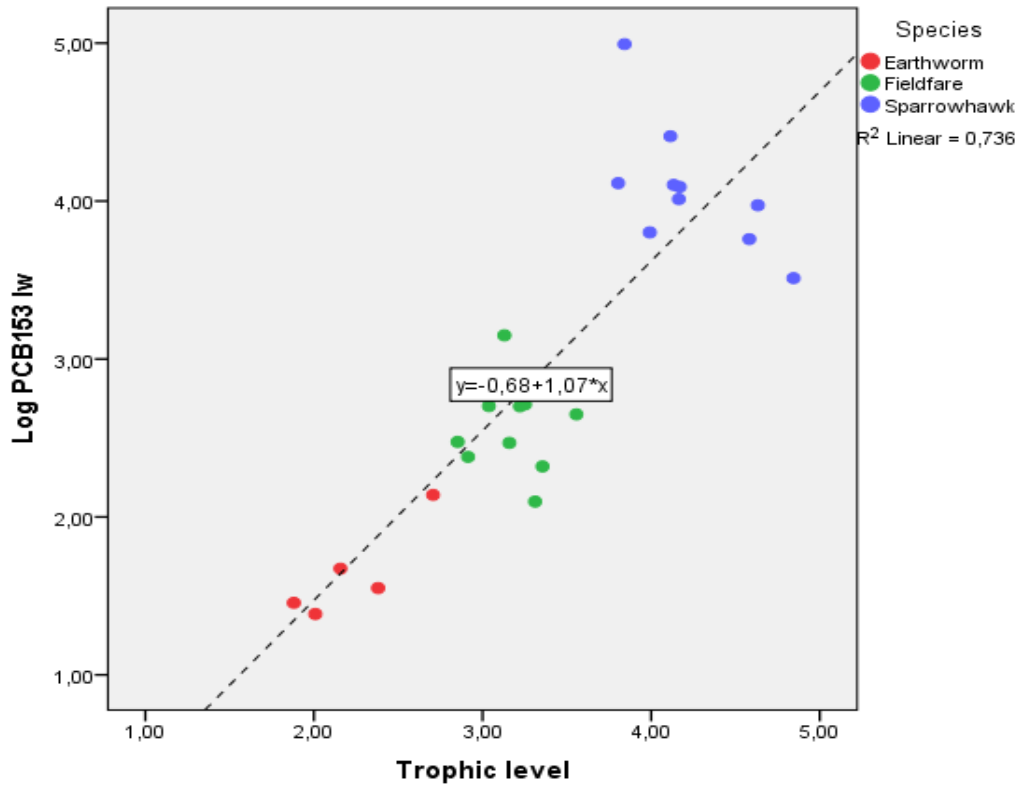
Largely dominated by PFOS, but....

PFCAs

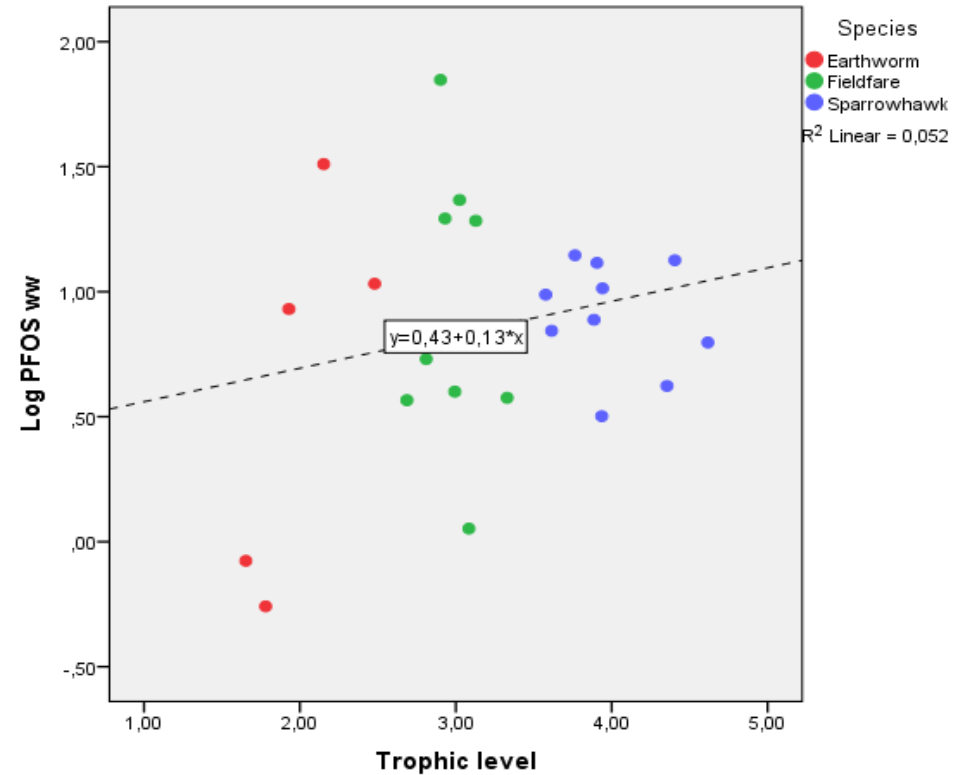


... the contribution of longer-chained PFCAs increases

Bioaccumulation/ TMF



PCB 153: 11.7
PFOS: 0.9
PFTrA: 1.5
PFTeA: 1.8



Conclusions

- Worms and fieldfare are useful bioindicators for point sources
- Extreme levels in vicinity of recycling facilities, industrial areas and skiing sites
- BASF for PFOS > 5000, not for other PFAS
- TMF close and larger than 1 for PFOS, PFTrA and PFTeA
- PFOS and PFOA constitute a major risk for predators/ dietary intake
- No PNECs available for other PFAS than PFOS and PFOA

Outlook & Acknowledgements

- 4 more years
 - Include new emerging PFAS as well
 - Added Fornebu, old airport, in 2017
-
- Thanks to:
 - Norwegian Environmental Agency for funding
 - People in the field and the lab