Monitoring of contaminants in Norwegian city animals

Urban terrestrial monitoring program 2013-2017

Funded by Environment Agency, Norway

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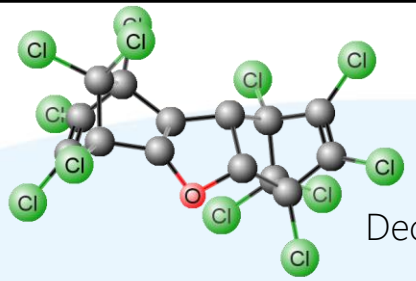
Background



Dec-602

- Many consumer products contain potential harmful chemicals for environment and health
- Normally highest concentration in densely populated areas as larger cities
- Location: the capital Oslo, Norway (~670 000 inhabitants)
- Chemicals in focus: Persistent, Bioaccumulative, Toxic – PBT chemicals
- → REACH, Stockholm convention, national regulation and potential cleanup
- Not sufficient knowledge about the levels, bioaccumulation, magnification and risk of contaminants in terrestrial ecosystem
- Do they behave very differently than in the marine/ freshwater ecosystems
- Local sources?

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Main objective

Assessment of **concentrations, 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
2015 soil was added
2016 air was added
2017 badger liver was added
Adapted design from year to year from results and recommendations
2013-2017: 4→ 12 compound classes i.e. 150 single compounds
TMF with food chain approach- EW-FF-SH
Risk from mixture: Sum(MEC/PNEC)

Compounds

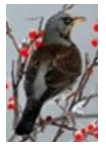
- Metals,
- PCBs, PBDEs, newBFR
- PFAS,
- Siloxanes,
- CPs,
- Dechloranes,
- OPFR,
- Phenols
- UV compounds,
- Biocides
- DDT gr

Samples

- Air (5)
- Soil (5)
- Earthworm (5)

Same location





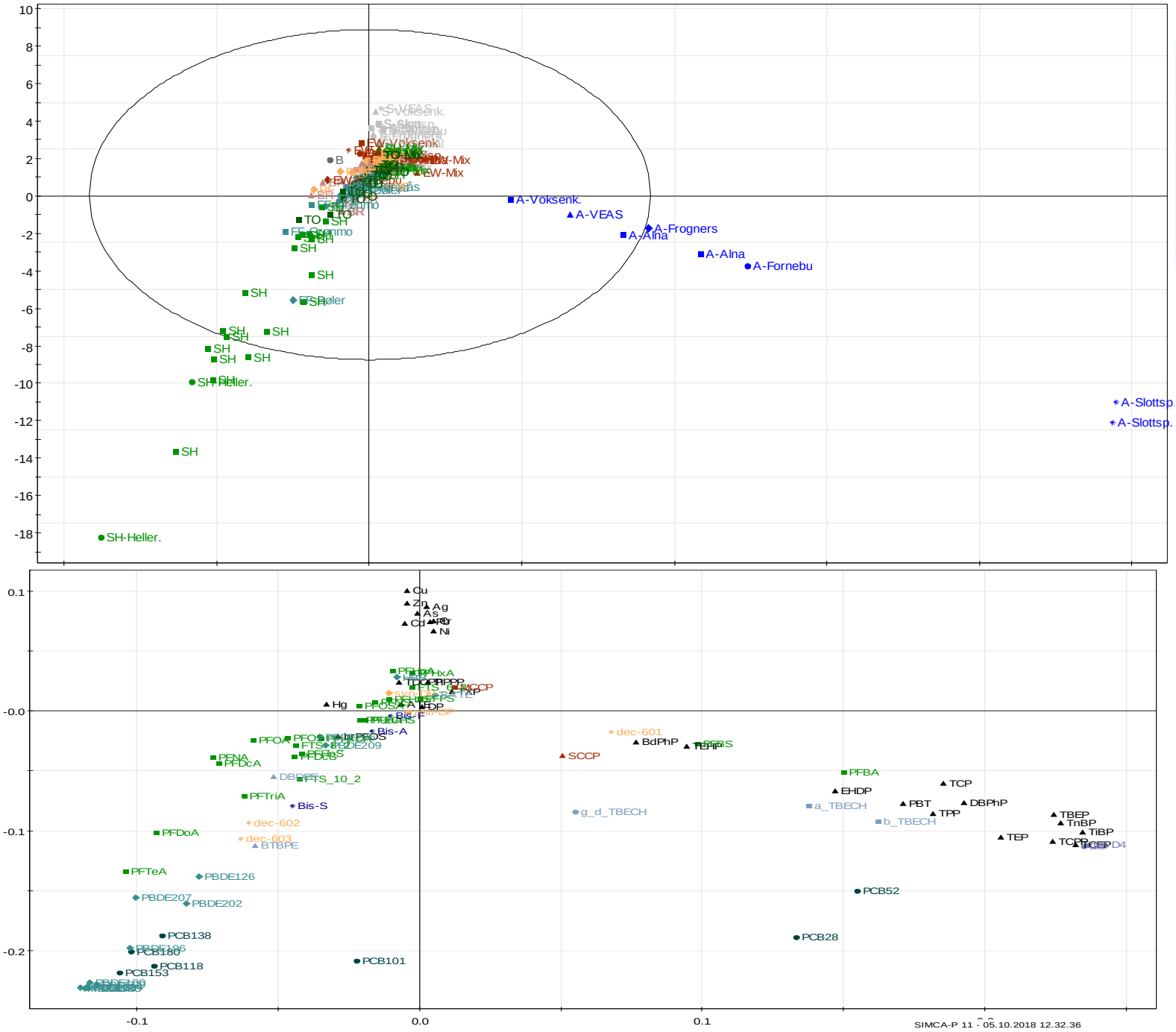



- Fieldfare egg (10)
- Sparrowhawk egg (10)
- Tawny owl egg (10)
- Red fox liver (10)
- Brown rat liver (10)
- Badger liver (10)

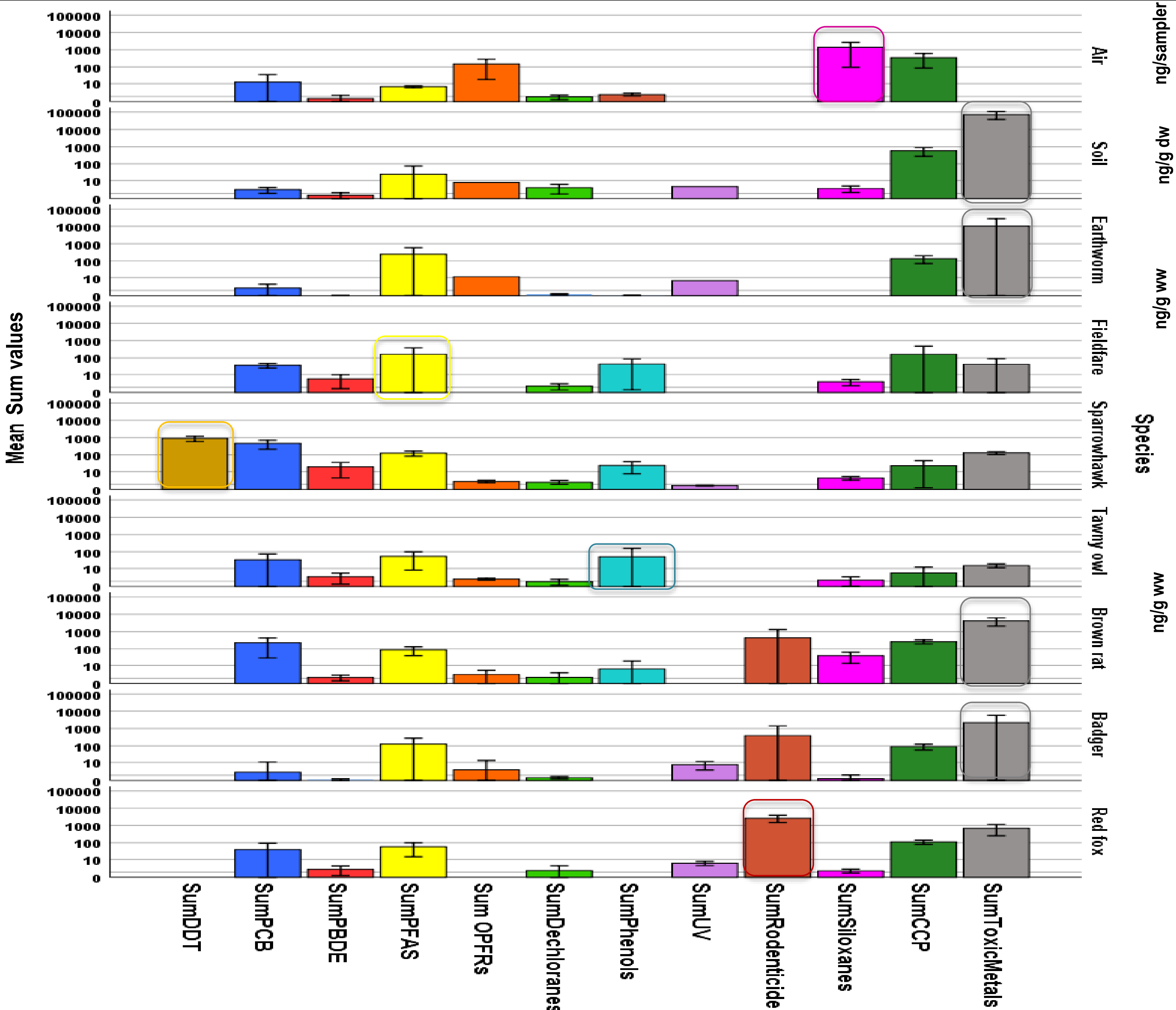
Same locations if possible

Sampling locations in Oslo, 2017

PCA analysis –2016-2017 common pollutants



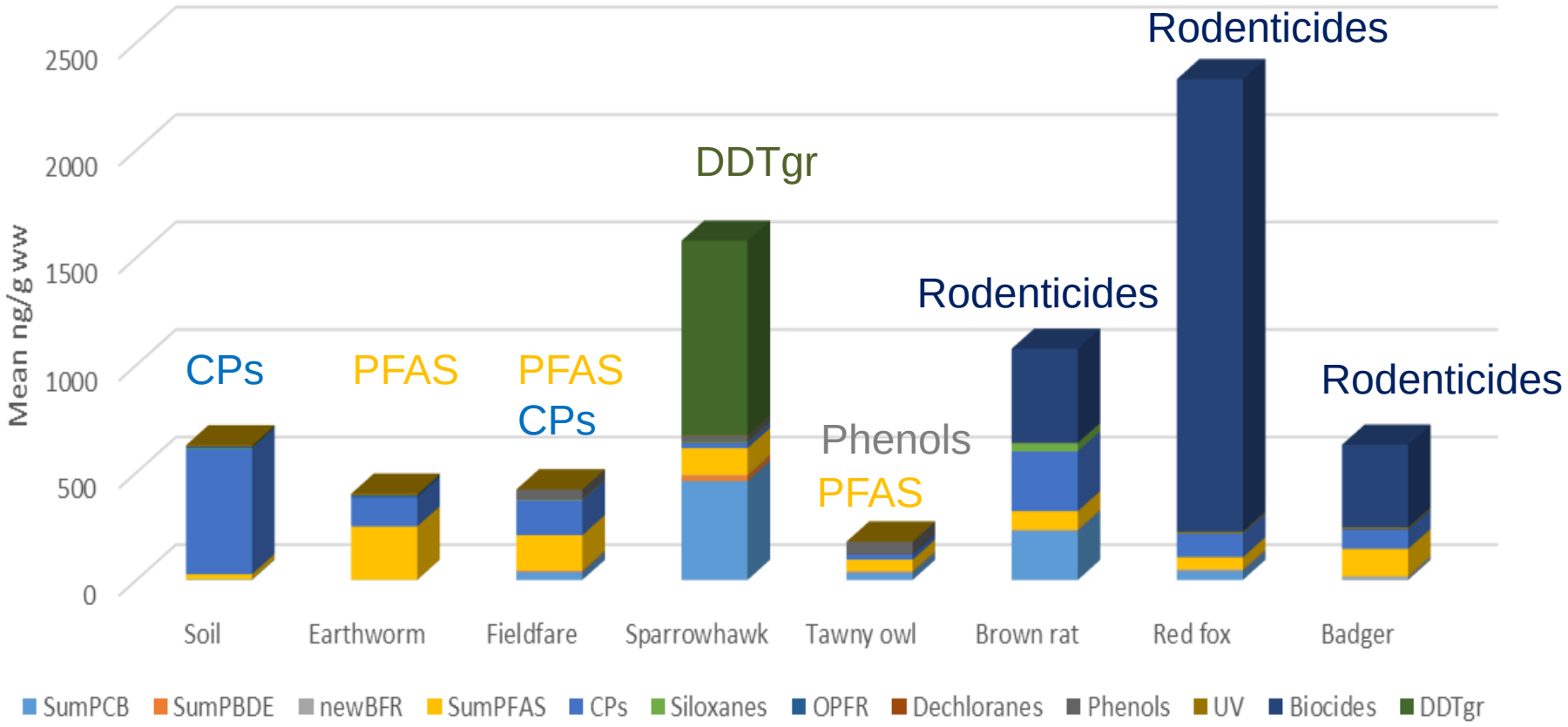
A: Air
S: Soil
EW:Earthworm
FF: Fieldfare
SH:Sparrowhawk
TO: Tawny owl
RF: Red fox
B: Badger
BR: Brown rat



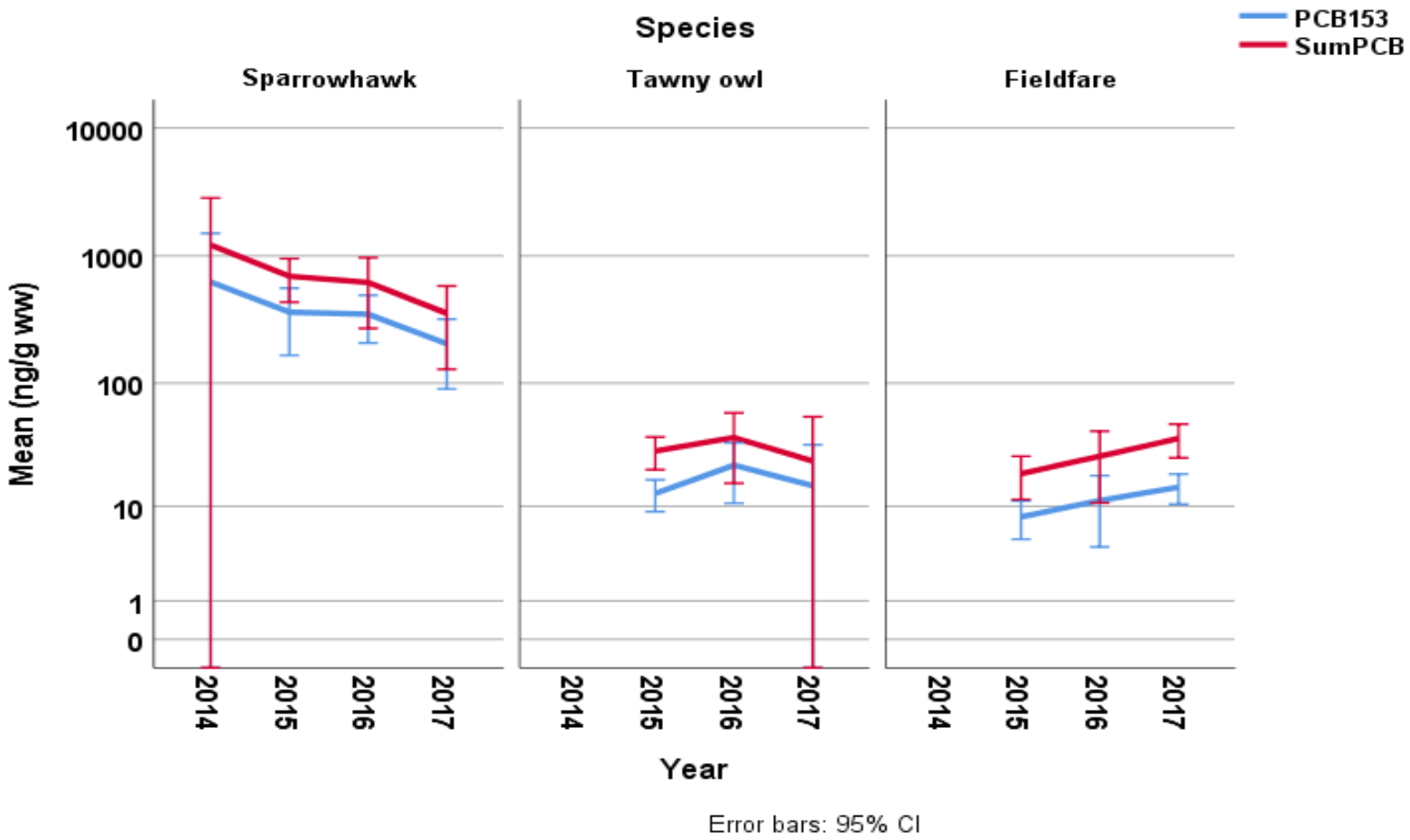
Mean Sum values
100000
10000
1000
100
10
0
Air
ng/sampler
Soil
ng/g dw
Earthworm
Fieldfare
Sparrowhawk
Tawny owl
Brown rat
Badger
Red fox
ng/g ww
Species
SumDDT
SumPCB
SumPBDE
SumPFAS
Sum OPFRs
SumDechloranes
SumPhenols
SumUV
SumRodenticides
SumSiloxanes
SumCCP
SumToxicMetals

3

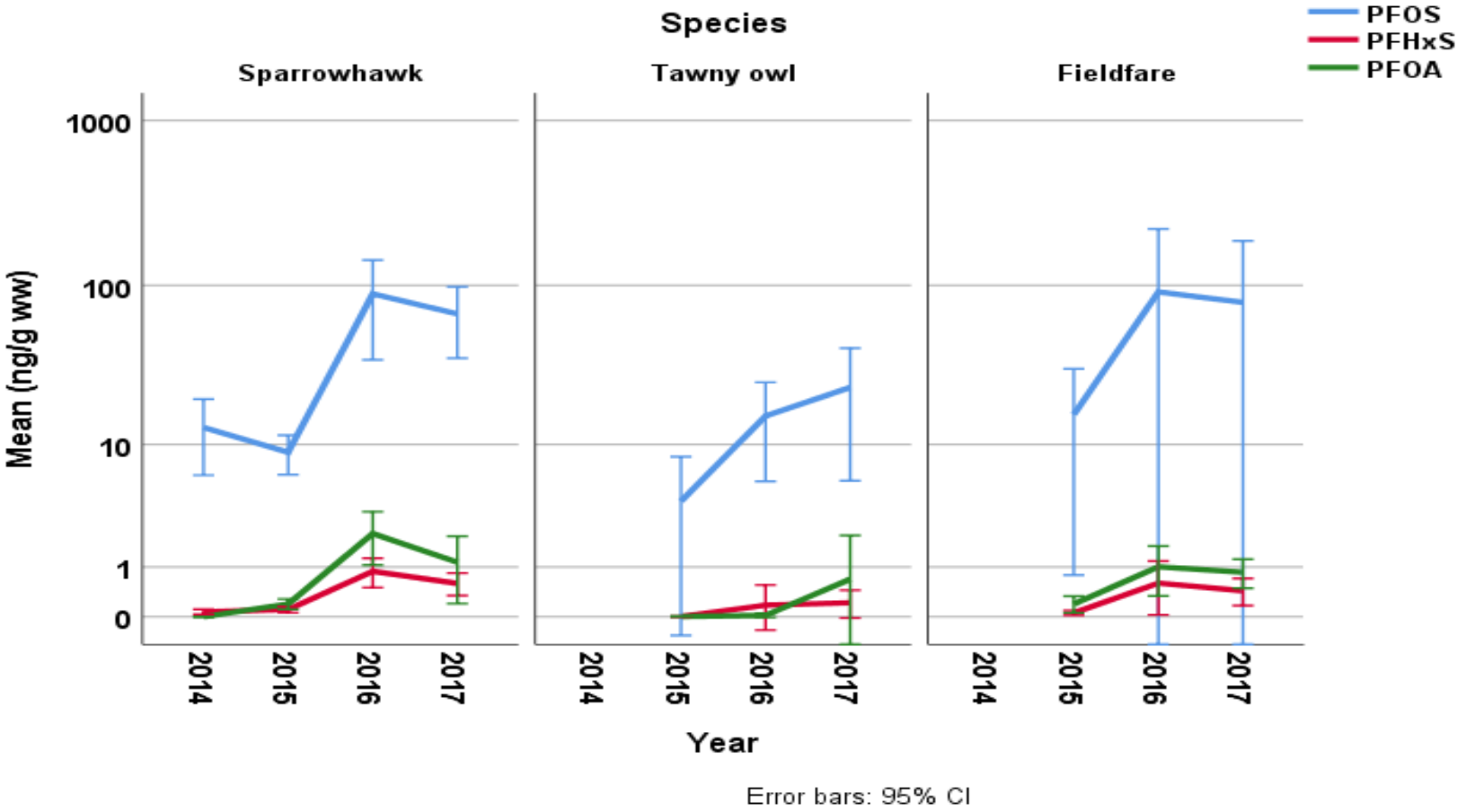
Organic pollutants 2017
Mean Sum values



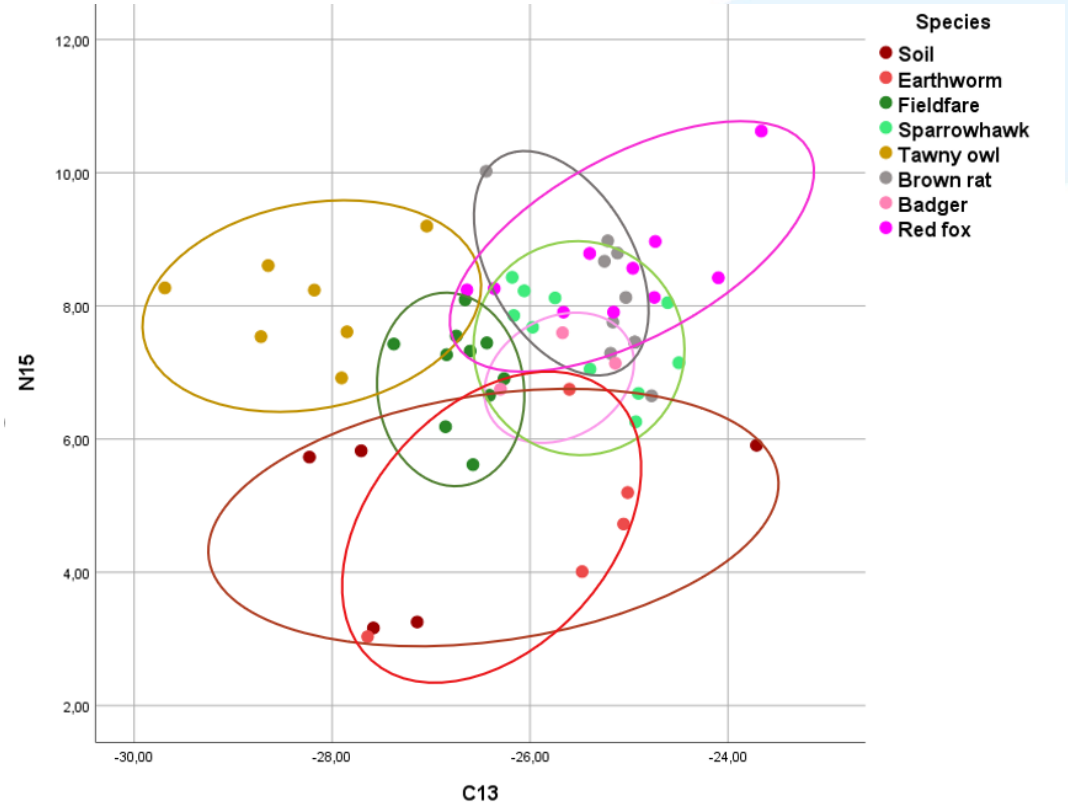
Change over time 2014-2017-sumPCB and PCB153



PFAS- Change over time 2014-2017



TMF-Trophic magnification factor



TMF calculations with a foodchain approach

Earthworm
Fieldfare
Sparrowhawk

$$TL_{fieldfare} = 3 + (\delta^{15}N_{fieldfare} - (\delta^{15}N_{earthworm} + 2.4))/3.8$$

$$TL_{sparrowhawk} = 4 + (\delta^{15}N_{sparrowhawk} - (\delta^{15}N_{earthworm} + 2.4))/3.8$$

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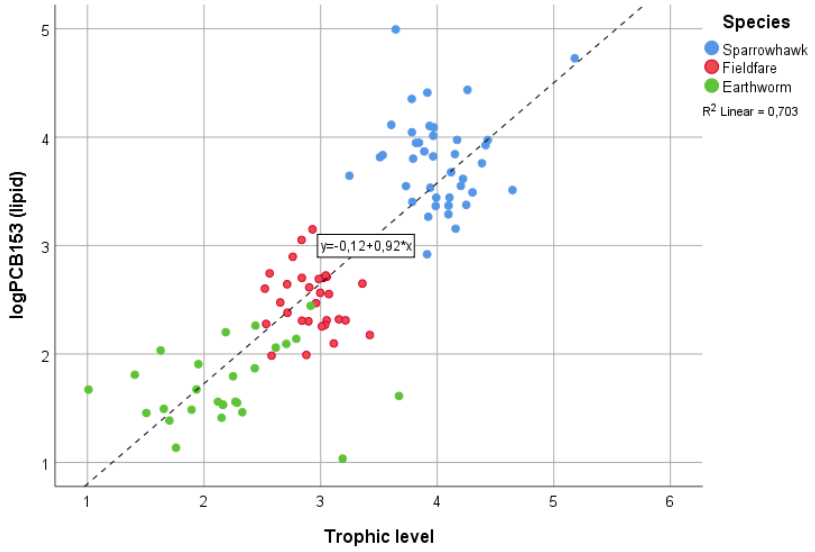
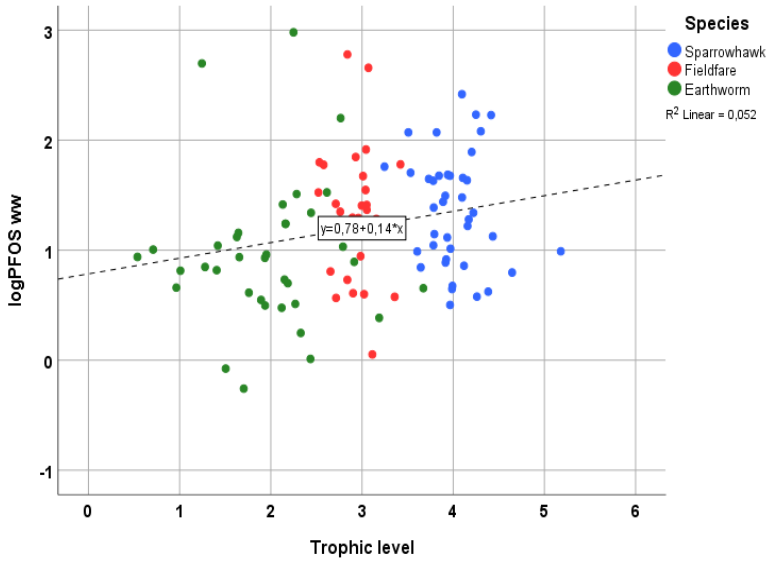
TMF- food chain approach 2014-2017 data





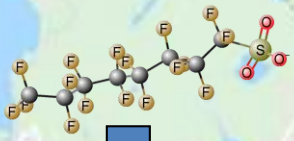
TMF's based on four years of data, 2014-2017

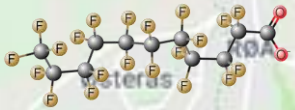
	PCB153	SumPBDEs	PFOS	PFUnA	PFHxS	D5	SCCP	MCCP
TMF	8.3	4.4	1.4	1.7	0.44	1.0	0.8	0.6

on ww basis for PFAS and on a lw basis for all other substances

Local sources/ Hot spots?

PFSA and PFCA in Earthworm



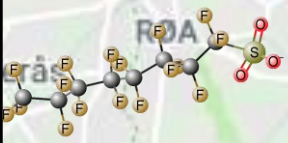


PFOS~500 ng/g ww

Sum(PFUnA> PFOS> PFTriA)~520 ng/g ww

Holmenkollen
HOLMENKOLLEN
Haslum
Bekkestua
Vøyenenga
Sandvika
Fornebu
Slottsparken
Oslo
GRUNERLØKKA
GAMLE OSLO
ALNABRU ALNA
GRORUD
STOVNER
Gjelleråsen
Slependen
Hvalstad
Nesoddtangen
Flaskebekk
Ursvik
Hellvik
Konglungen
Asker
Risenga
Fjordvangen
Alvæm
Vollen
VEAS
Slemmestad
Borgen
Heggedal
Fjellstrand
Bomannsvik
Svartskog
Kolbotn
HOLMLIA
LAMBERTSETER
NORDSTRAND
ØSTENSJØ
Sofiemyr
Siggerud
Google My Maps

PFOS in fieldfare



Sognsvann
Kjelsås
Holmen
Grorud
Blindern
Teisen
Svartdalsp.
Ekebergsl.
Bøler
Grønmo

900 ng/g ww

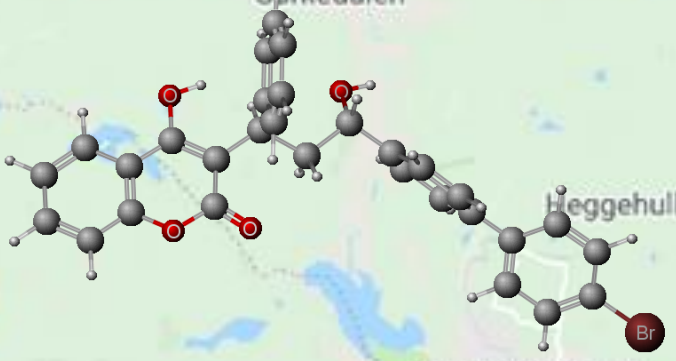
Former municipal landfill →2007
Highest [PFOS] 2017-2016-2015
Maximum conc all years

(Secondary) poisoning of non-target predators

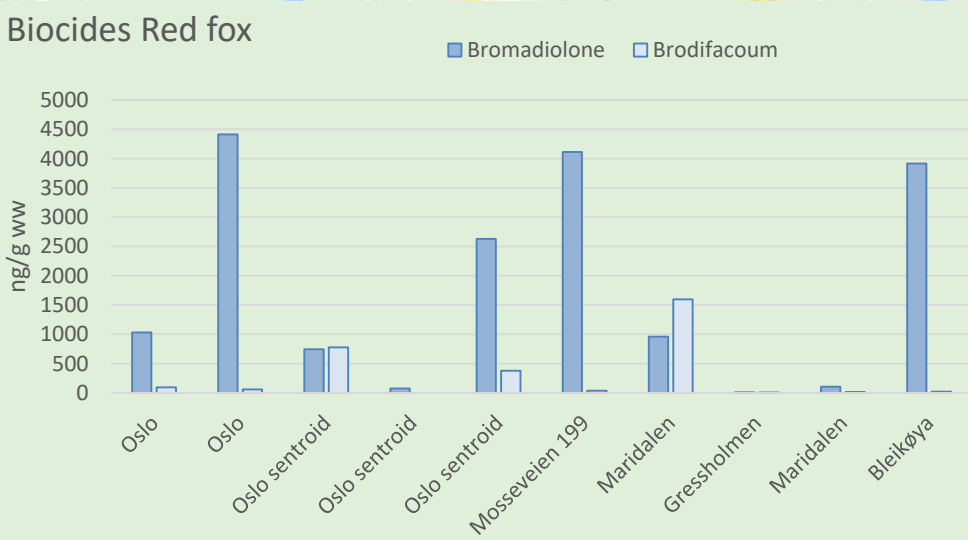
Rodenticides – anticoagulants controlling rodent populations

Very high concentrations in some red fox liver samples

Rodenticides in red fox



	Bromadiolone	Brodifacoum	Flocumafen	Difenacoum	Sum Biocides
N	10/10	9/10	0/10	2/10	
Mean	1800	299	<LOD	30.0	2105
Median	996	47.9	<LOD	<LOD	2040
Minimum	9.8	<LOD	<LOD	<LOD	17
Maximum	4412	1597	<LOD	30.5	4502



Bromadiolone: four samples > 2000 ng/g ww

Conclusions

- Data (soil, earthworm, fieldfare egg) indicate local pollution sources
- PFAS: Soil & earthworm at Alnabru, Fieldfare egg at Grønmo
- Pb in fieldfare egg from Kjelsås, SCCP in fieldfare egg from Bøler

- FF more exposed to local sources than expected for migrating birds?

- TMF for biomagnification- useful, but egg concentrations for birds and not whole animal in the calculations, and uncertainty in TL equation.

- Sum (MEC_{median}/PNEC)

  Soil ecosystem: As, Zn, PFOS and PCB most important for Sum> 1

  Earthworm as food: Cd, PFOS, PFOA most important for Sum >1

  Fieldfare egg as food: PFOS, PFOA, HCB most important for Sum>1 in 80 % of the locations. NB! Low conc. of metals in bird egg content, risk from metals can be underestimated if sparrowhawk eats juvenile bird which has earthworm as main food item

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Conclusion

- Risk for effects?
  - Max. PFOS in FF (900 ng/g ww) lower than effect threshold value of 1900 ng/g ww in bird egg
  - Rodenticides –risk for poissoning (> 2000 ng/g ww) from previous reported studes. Red foxes from Oslo area at risk?
- 2018 locations, fieldfare egg from Alnabru included
- Long term monitoring important in order to understand relationship between sources, expoure, bioaccumulation and risk for ecosystem and humans
- Thanks to Norwegian Environment Agency for initiative and funding!

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Thank you for your attention!

Big thank to all project participants

NINA
Nina Eide, Kristine Roaldsnes Ulvund and Aniko Hildebrand, Norwegian Institute for Nature Research (NINA), prepared the samples before analysis. Bjørnar Ytrehus, NINA, made the autopsies of foxes and rats. Bird eggs were collected by Gjøran Stenberg, Fredrik Gustavsen, Arnkjell Johansen og Neri Horntvedt Thorsen. The nests were located in nest boxes installed by Arnkjell Johansen, Vestby, who is a local contact for State Nature Inspectorate (SNO).

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